THE PLASTICS HERITAGE CONGRESS 2019

HISTORY, LIMITS AND POSSIBILITIES

29th – 31st MAY 2019

LISBON, PORTUGAL

Title

The Plastics Heritage Congress 2019: History, Limits and Possibilities

Editors

Inês Soares

Maria Elvira Callapez

Design

Inês Soares

Paulo Fuentez

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WELCOME TO THE PLASTICS HERITAGE CONGRESS 2019: HISTORY, LIMITS AND POSSIBILITIES

THE PLASTICS HERITAGE CONGRESS **2019**
HISTORY, LIMITS AND POSSIBILITIES

Dear Colleagues

On behalf of the Organizing Committee, it is our great pleasure to welcome you to the Plastics Heritage Congress: History, Limits and Possibilities, held in Lisbon, from 29th to 31st May 2019.

We are delighted to have so many international participants, more than 200, from 24 countries, whose presence will contribute to the success of this academic meeting.

The congress theme is of great importance, covering a rich, multidisciplinary and wide range of theoretical and methodological approaches to the study of polymeric materials.

It is our most truthful wish that this meeting may foster an excellent atmosphere for scientific exchange and provide a starting point for challenges ahead.

The Local organizing Committee is wholeheartedly dedicated to provide maximum hospitality to everybody. Lisbon is utterly charming and we encourage you to visit the town, its surroundings and even the country.

Hopefully you enjoy your stay in Portugal. Thank you.

Maria Elvira Callapez

The congress

Under the aegis of the Plastics Heritage European Association (PHEA), the Portuguese Center for the History of Science and Technology (CIUHCT) will host the Plastics Heritage Congress 2019.

Plastics Heritage: History, Limits and Possibilities, the congress' general theme, is an output of the Project "The Triumph of Bakelite – Contributions for a History of Plastics in Portugal" combined with the fifth of a series of international Plastics Heritage Conferences and will be held in Lisbon, the capital city of Portugal, at the National Coach Museum, from 29th to 31st May 2019

This congress aims to address plastics history and heritage by encouraging papers that contribute to a deeper understanding of the socioeconomic culture and material culture of historic polymeric materials (HIPOMS) in their various representations and functions in society.

The main theme embraces the concepts of history, limits and possibilities of plastics heritage as organizing principles, thus perceiving their impact on the consumer and their technical and scientific developments.

About CIUHCT

The Centro Interuniversitário de História das Ciências e da Tecnologia (CIUHCT) is the result of the merging of two previous units in the area of History of Science and Technology: Centro de História e Filosofia da Ciência e da Tecnologia (CHFCT) and Centro de História das Ciências da Universidade de Lisboa (CHCUL). From 2007 to 2014 it hosted two research lines associated with its two different host institutions (FCT/UNL and FC/UL). Following the 2014 evaluation period, in which CIUHCT scored the maximum grade – Exceptional, CIUHCT has undergone a thematic reorganization.

CIUHCT
Centro Interuniversitário de História das Ciências e da Tecnologia
FCUL | FCT - UNL

CIUHCT aims at asserting the relevance of History of STM in building citizenship and European identity, focusing specifically, but not exclusively, in STM historical case studies on Portugal in an international perspective. CIUHCT participates actively in international debates on the concepts of center(s) and periphery(ies), on the relevance of STM knowledge in the construction of modern and contemporary societies, using an innovative methodological framework centered on the trilogy circulation, appropriation and innovation.

About PHEA (Plastics Heritage European Association)

PHEA is a network of European organisations, which are involved in plastics heritage of all aspects and times.

PHEA's intention is:

- To engage in activities relating to and to engage with research on 'historic polymeric materials' ('Hipoms'). More details of what Hipoms includes can be found in the Appendix. Activities include: to create a network and to facilitate cooperation among the member organisations and institutions (legal or non-profit private institutions such as: universities, departments, collections, museums and societies), which are involved in the cultural, technical and scientific research, cataloguing, showcasing, popularising, preservation and conservation of our common cultural heritage of historic polymeric materials and objects (HIPOMs / HIPOMOs) in art, design, architecture, archives and libraries, in ethnology, science, technology, industry, companies and in past and present daily life.

PHEA

- to communicate, exchange and mutually popularise the manifold, special knowledge and abilities of the PHEA
- to initiate applications and come to agreements for the exchange of students, researchers and for research cooperations.
- to apply for funding European research programmes on Plastics Heritage.
- to organise the International Forum 'Plastics Heritage' on a biennial basis.
- to encourage publishing of results in e.g. the PHEA attributed International Journal of Plastics History e-plastory as well as other relevant journals.

THE CONGRESS VENUE: MUSEU NACIONAL DOS COCHES/ NATIONAL COACH MUSEUM

The new Coach Museum emerges, not only, as a cultural site but also as a public utility space. In the words of the architect Paulo Mendes da Rocha "the Museum has no doors and relates to all of its surroundings". The project is more than a museum; in the end it functions as an urban infrastructure providing a public utility space for the city.

Thus, two concerns coexist; on the one hand the primary need to expand the exhibition area of the museum and its technical support infrastructure, while on the other, the need to create additional attractions for the most visited museum in the country. Moreover, there was a need to bind one of Lisbon's most prominent fronts, the Belém monument area, where the construction of the new building has created a new dynamism in the museum's surrounding area, creating new public spaces and urban walkways in the city that are reminiscent of earlier times.

The new Coach Museum building comprises a main hall with a suspended nave and an annex, which is connected by an overpass, enabling circulation from one building to the other. This layout creates a gantry like structure directed towards an internal square, where the old Rua da Junqueira buildings also face.

The new museum encompasses premises for the permanent and temporary exhibitions, reception halls, and a workshop for conservation and restoration, a contribution towards the development of conservation and restoration activities of this unique legacy.

New spaces have been provided for the Library and the Archive, as well as an Auditorium, which will allow for the organization of a number of cultural activities that will greatly improve the scope of the public programs offered by the museum.

For the conference, 3 specific locations will be used:

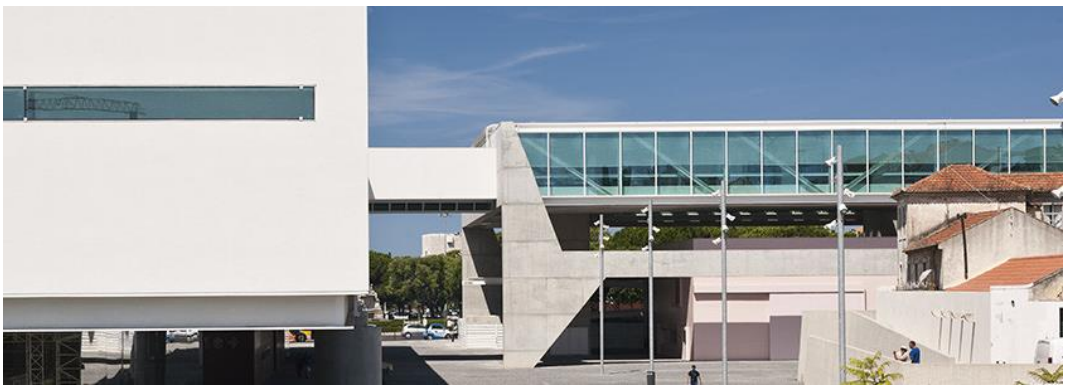
1. Registration and poster exhibition- glazed room located in the exhibition building on the ground floor

2. Auditorium (session A) - pink annexe building located on the ground floor

3. Library (session B) - annex building that hosts the museum services, located on the 2nd floor

Library

The Library aims to become an international reference centre for researchers and students in the thematic area of its collection, including conservation, restoration, as well as museology.



Auditorium

The museum is available to rent this venue for a range of activities including Symposia, Conferences, Product Launches, and other events, subject to review and approval of submitted proposals.

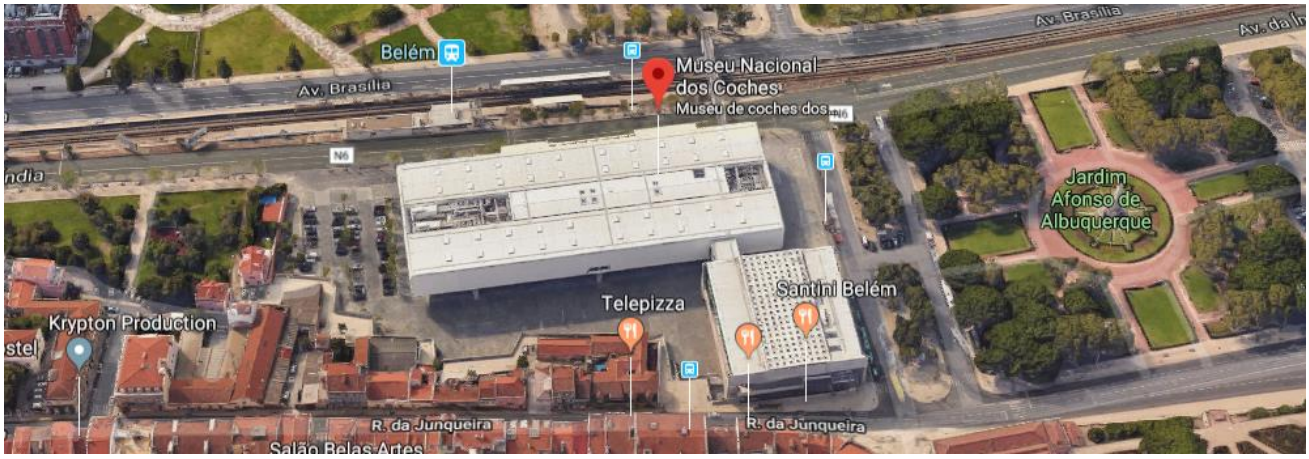
Exhibition building

The registration and poster exhibition will take place in this glazed room, as well as the coffee breaks and lunches.

Location

The National Coach Museum is located in downtown Lisbon by the river Tagus.

Av. da Índia 136, 1300-004 Lisboa, Portugal



How to get to the museum

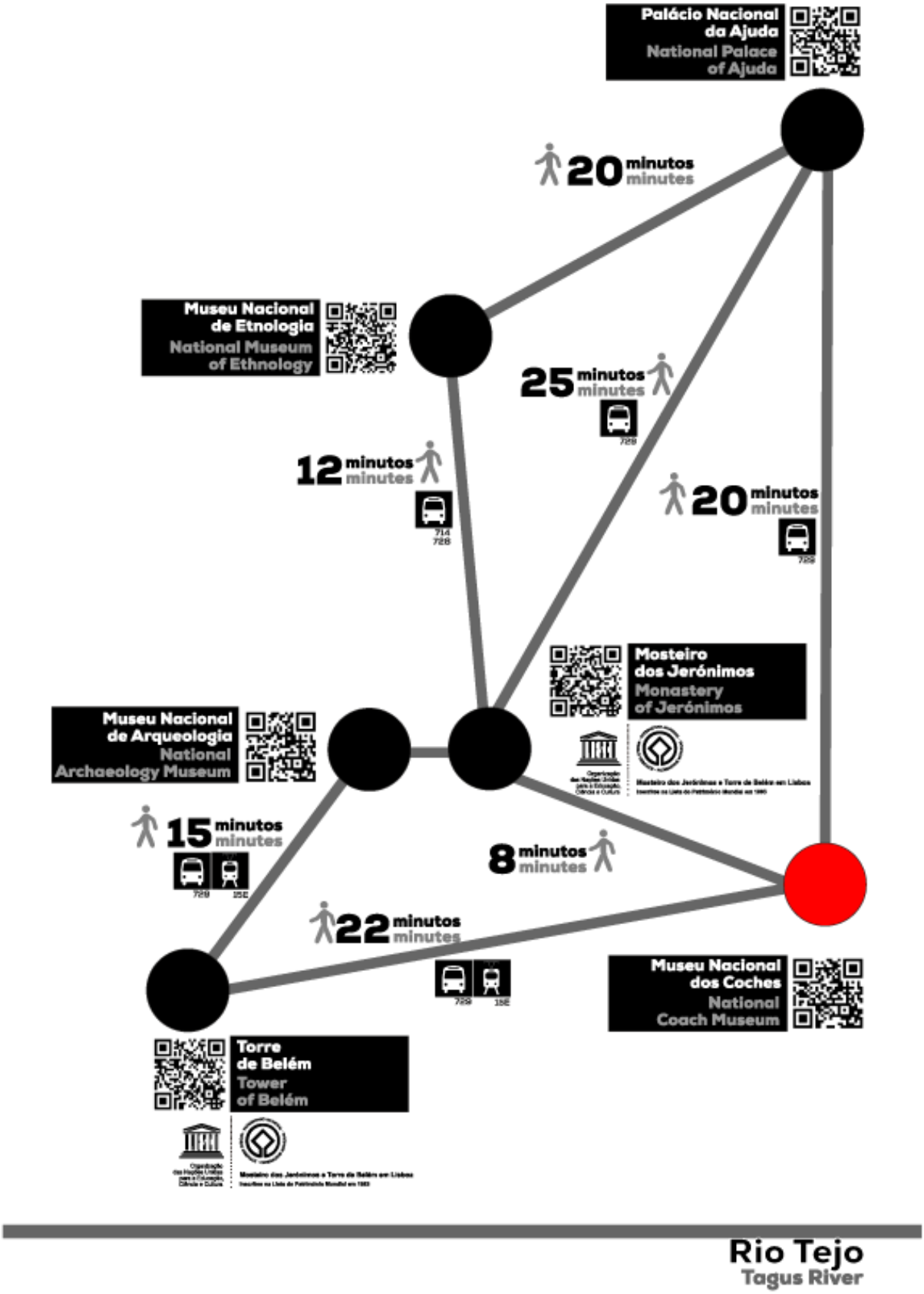
Bus: 28, 714, 727, 729, 751

Tram: 15

Train: Cascais Line (Belém Station)

Boat: Belem River Station

Visit nearby



VISIT LISBON

Belém

Situated on the western part of central Lisbon, Belém is one of the most historically relevant districts of the city. With a vast cultural heritage, given the great Portuguese marine discoveries of the 15th and 16th centuries, it is home to the city's most quintessential tourist attractions:

The Belém Tower (Torre de Belém) stands tall on the northern bank of the Tagus river. This 16th century architectural piece was initially built as a part of the river's defense system. Today, it is one of the most visited monuments in Lisbon.

The Jerónimos Monastery (Mosteiro dos Jerónimos) is possibly the most notorious example of the Portuguese Late Gothic Manueline architecture style, inspired by the maritime voyages of explorers such as Vasco da Gama.

The Navy Museum (Museu de Marinha), incorporated in the Monastery, is a maritime museum dedicated to the history of navigation in Portugal.

The Monument to the Discoveries (Padrão dos Descobrimentos), with a total height of 56m, immortalizes the Infante Henry the Navigator, one of the most important figures in the history of the overseas explorations.

The Gardens of Belém (Jardins de Belém) are the perfect place to enjoy a Pastel de Belém. The recipe for this famous wonder of Portuguese gastronomy has been around since the 19th century and has been kept a secret ever since. Selling around 20 thousand pastéis every day, they are a crucial part of any trip to Lisbon.

The Cultural Center of Belém (CCB- Centro Cultural de Belém) is the largest cultural infrastructure in Portugal. Aiming to promote culture in all its embodiments, the CCB has held the Berardo Collection Museum (Museu Colecção Berardo) since 2007.

The MAAT – Museum of Art, Architecture and Technology is the latest artistic center in town. This 3,000m²avant-garde building hosts exhibitions by contemporary artist from all over the world.

The Cordoaria Nacional. The factory-turned-museum stages exhibitions throughout the year, from furniture to paintings.

Praça do Comércio

At the center stands a statue of King José focusing his eyes on the river. Lisbon's vastest square was once a port, before being destroyed by the 1755 earthquake and tsunami. Today, a symbol of the the Pombaline architectural style.

Rua Augusta and the Rua Augusta Arch (Arco da Rua Augusta) - Lisbon's busiest pedestrian street. It connects Praça do Comércio to the Rossio square in a wonderland of classic cobblestone designs, street performances and cafés. A street famous for its time-honored stores, it is also known for its Rua Augusta Arch. Facing the Praça do Comércio Square, the arch is equipped with an elevator which grants tourist the opportunity to overlook the view from the top.

MUDE – Museu do Design e da Moda - A design and fashion museum located at Rua Augusta. It is considered to be one of the best design museums in Europe. The museum features several great names in design such as Charles &Ray Eames, Yves Saint Laurent, Christian Dior and Vivienne Westwood.

Rossio Square

Surrounded by shops, cafés and restaurants, Rossio hides its past quite well. This square was the stage for bullfighting, military parades and bonfires of the Inquisition. Rossio now hosts a monument dedicated to King Pedro IV standing between two baroque fountains.

D. Maria II National Theater (Teatro Nacional D. Maria II) - This neoclassical theater finds itself in the Rossio Square. It is one of the most acclaimed theaters in Lisbon and it aims to strengthen the relationship between the community and this fine art.

Chiado

The place where celebrated writers came to write is now a cultural neighborhood packed with old bookstores, theaters and churches. Very close to Bairro Alto, Chiado is the place to meet before a night out. Despite the buildings dating back to the 18th century, Chiado has stood the test of time by being one of the most active areas in Lisbon.

Café A Brasileira - If you have seen the statue of Fernando Pessoa, you know you have reached the A Brasileira. Opened in 1905, it is the city's oldest café. It was a popular spot for last-century intellectuals and academics and the Art Deco-style interior design continues to attract large crowds.

Santa Justa Lift (Elevador de Santa Justa) - Open to the public since 1902, the Santa Justa Lift stands tall at 45m. It connects Chiado to the Largo do Carmo.

Carmo Convent (Convento do Carmo) - Dating back to the 14th century, it was an example of the Gothic style of architecture in Lisbon. However, it was almost fully destroyed by the 1755 earthquake.

São Jorge Castle (Castelo de São Jorge) - A Moorish castle sitting on top of a hill, the São Jorge Castle offers a picture-perfect view of the river and the city. It was built in the mid-11th century as a part of the defense system for those who lived on the citadel.

Tram 28 (Elétrico 28) - The well-known yellow tram that connects Martim Moniz to Campo de Ourique. Passing by Graça, Alfama, Baixa and Estrela, this iconic tram ride stops by some of the most relevant neighborhood in Lisbon. Ever since its inauguration in 1914, it has been a common sight in the old streets of the city.

Miradouro das Portas do Sol - Another one of Lisbon's most beautiful lookout points. This time, the eyes meet with the streets of Alfama. The place for an evening drink, it is sometimes possible to hear the echoing sounds of the Fado coming from the neighborhood below.

Sé de Lisboa - It is one of the oldest monuments in Lisbon. Built in the 1100s, it is a Roman Catholic church.

Miradouro de Santa Luzia - Introducing its visitors to the neighborhood of Alfama, this lookout point allows a panoramic view of the city. By the Church of Santa Luzia, it is possible to find two tile panels. One is representative of the Comercio Square before the 1755 earthquake, while the other showcases the São Jorge Castle being taking over from the Moors in 1147.

Alfama

The oldest district in Lisbon is where the most traditional elements of the city can be found. Much like its soul, Alfama smells of grilled fish, echoes the sound of Fado and serves emblematic Portuguese cuisine.

Fado is a music genre highly associated with the city of Lisbon. Originating from the 1820s, it has a similar meaning from the Portuguese word saudade. The lyrics of Fado often express melancholic and nostalgic feelings, usually combined with a narrative of the life at sea. Together with the sound of a guitar, the voice of those who sing it resound through the casas de fado. Some of the most renowned are Café Luso, Faia and Senhor Vinho. Since 2011, Fado has been a part of UNESCO's World's Intangible Cultural Heritage.

Fado Museum (Museu do Fado). This museum is a celebration of the cultural heritage of Fado. It aims to value this art form as an identifying token of the city.

Bairro Alto

Might be an old neighborhood, but it is young in spirit. Known for its bar-hopping culture, it is a mecca for young adults who want the night to last until the morning. Peaceful at day and busy at night, Bairro Alto mixes bars and dated houses in an environment impossible to experience anywhere else in the city.

Museum of Pharmacy (Museu da Farmácia) - A museum dedicated to the evolution of the Portuguese pharmaceutical history and technology, this award-winning cultural space is of international recognition. Focusing on the development of the science of pharmacy from the 15th century until today, the museum recreates antique Portuguese pharmacies so that the visitor profoundly experiences their progress.

WELCOME RECEPTION: RESERVATÓRIO MÃE D'ÁGUA/ MÃE D'ÁGUA RESERVOIR

The entry into Lisbon of the Águas Livres Aqueduct, set by the arch on Rua das Amoreiras, which was built by Hungarian architect Carlos Mardel from 1746 to 1748, ends at the Mãe d'Água das Amoreiras Reservoir.

The cistern had three design plans. The initial project included three more arches, which would bring it to the northern side of the Largo do Rato square. In the final design project, the reservoir was simplified and the number of vats and outer decoration elements was decreased.

When Carlos Mardel died in 1763, the Aqueduct's final reservoir which had been started in 1746, was still pending completion. The works were resumed in 1771 by Reinaldo Manuel dos Santos, who introduced some changes to the initial plan.

The main changes to the project were seen in the building's cover, the cascade and the replacement of the four Tuscan columns that had been designed by Mardel, with four robust rectangular pillars.

Although the work on the reservoir was resumed several times, even after Reinaldo dos Santos's death in 1791, the final work done to the cover and a few other details was only completed in 1834 during Queen D. Maria II's reign.

The Mãe d'Água Reservoir is currently an ample space, filled with light and unified. Its inside suggests the design plan of a Hall church, thereby proposing a holy nature of the space.

The water from the springs spouts from the mouth of a dolphin onto a cascade, built using stones carried from the springs of the Águas Livres Aqueduct, and it flows into a vat that is 7.5m deep, with a capacity to store 5,500 m3. From this vat, four columns rise that support a vaulted cupola ceiling which in turns supports the magnificent terrace overlooking the city of Lisbon.

The western front of this reservoir holds the Register House, where the water flows that were discharged to the fountains, factories, convents and noble houses were controlled.

The Water Museum promotes and conducts free and guided tours of the Mãe d'Água das Amoreiras Reservoir.

Until April 2, 2016, can be visited the photo exhibition "«In broad daylight, even the sounds shine». Wim Wenders scouting in Portugal".

How to get to Reservatório Mãe D'água/ Mãe D'água Reservoir

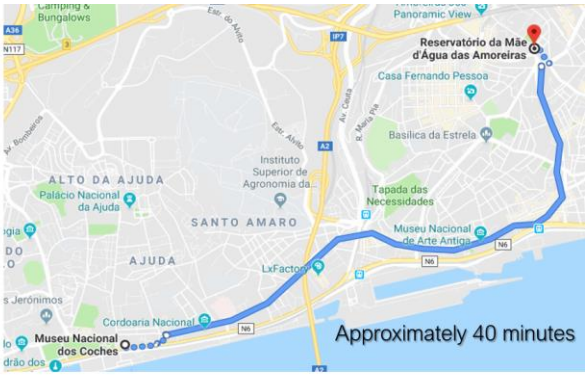
HOW TO GET TO THE WELCOME RECEPTION
RESERVATÓRIO MÃE D'ÁGUA/ MÃE D'ÁGUA RESERVOIR
FROM MUSEU NACIONAL DOS COCHES/ NATIONAL COACH MUSEUM

WEDNESDAY, 29 May 2019 (19h30)

Adress: Praça das Amoreiras 10. 1250-020 Lisboa

GPS: 38°43'15.64"N 9°9'20.12"W

Bus price: 2.00€ (please try to pay with exact change)



1st option

Museu Nacional dos Coches/ National Coach Museum
1 min
728 - Portela
From: Estação Fluvial de Belém **To: Av. Infante Santo** — 3 stations
4 min
720 – Picheleira
From: Av. Infante Santo **To: Rato** — 7 stations
5 min
RESERVATÓRIO MÃE D'ÁGUA/ MÃE D'ÁGUA RESERVOIR

2nd option

Museu Nacional dos Coches/ National Coach Museum
1 min
728 - Portela
From: Estação Fluvial de Belém **To: Santos** — 5 stations
2 min
727 – Est. Roma-Areeiro
From: Santos **To: Rato** — 7 stations
5 min
RESERVATÓRIO MÃE D'ÁGUA/ MÃE D'ÁGUA RESERVOIR

3rd option

Museu Nacional dos Coches/ National Coach Museum
1 min
728 - Portela
From: Estação Fluvial de Belém **To: Santos** — 5 stations
1 min
706 – Est. Santa Apolónia
From: Santos **To: Rato** — 7 stations
5 min
RESERVATÓRIO MÃE D'ÁGUA/ MÃE D'ÁGUA RESERVOIR

4th option

Museu Nacional dos Coches/ National Coach Museum
5 min
727 – Est. Roma-Areeiro
From: Belém **To: Rato** — 20 stations
5 min
RESERVATÓRIO MÃE D'ÁGUA/ MÃE D'ÁGUA RESERVOIR

Whatever the options you choose, you must get out in Rato's station

MUSEU DE LEIRIA: PLASTICIDADE – UMA HISTÓRIA DOS PLÁSTICOS EM PORTUGAL

Plastic has transformed our lives like few other inventions. Since its creation, just over 100 years ago, to the present day, it has replaced an enormous variety of materials and has been used in all sorts of objects. Plastics are in the composition of packaging, textiles, building materials, furniture, paints, automobiles, audio and video equipment, computers, medical equipment, and most personal objects. They even replace parts of the body.

If we were to name our time, based on the type of materials that shape the world we live in, it would be the Plastic Age. The exhibition Plasticity - A History of Plastics in Portugal results from the partnership between the Municipality of Leiria and the research project "The Triumph of Bakelite - Contributions for a History of Plastics in Portugal", developed at the Interuniversity Center for the History of Science and Technology - Faculty of Sciences of the University of Lisbon and funded by the Foundation for Science and Technology - FCT .

This exhibition would not exist if a collaborative process, involving the community of the Leiria region and extending itself to the country, had not been initiated. The gathered collection (photographs, objects, machines, documentation and oral records of workers' memories) was donated by private individuals, museums, research centers and plastic processing companies. Underpinned by scientific studies on plastic, it addresses from its historical importance to the social, artistic, economic and technological repercussions in contemporary society, without forgetting the worrying environmental issues with it associated.

The Leiria Museum could have found the project odd, but instead embraced it. There is no doubt about the pioneering role of Leiria in the history of the plastic manufacturing industry. This national history is that of the people of Leiria and, in its various expressions, local culture has to be the "place" where communities find their identity, where there is recognition that memories are respected, preserved and shared.

COMMITTEES

Scientific committee

Günter Lattermann (Chair)
University of Applied Scienece, Technology and Economy HTW Berlin, Germany

Maria Elvira Callapez (Vice-chair)
CIUCHT – Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa, Portugal

Alice Hansen
Fondazione Plart, Italy

Ana Ramos
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Arnaud Bozzini
ADAM MUSEUM, Brussels, Belgium

Carlos Bernardo
Department of Polymer Engineering, Minho University, Guimarães, Portugal

Elisa Storace
Curator of Kartell Museum, Noviglio - Milan, Italy

Geoffrey Mitchel
Centre for Rapid and Sustainable Product Development, Institute Polytechnic of Leiria, Marinha Grande, Portugal

Jake Kaner
Nottingham Trent University, United Kingdom

Joana Lia
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

João Paulo Martins
Faculdade de Arquitetura da Universidade de Lisboa. Centro de Investigação em Arquitetura, Urbanismo e Design

Katherine Curran
UCL Institute for Sustainable Heritage, London, United Kingdom

Maria João Melo
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Penny Sparke
Kingston University, London, United Kingdom

Peter Morris
Science Museum, London, United Kingdom

Ruth Keller
HTW Berlin, Germany

Susan Mossman
Science Museum, London, United Kingdom

Suzan de Groot
Cultural Heritage Agency of the Netherlands (RCE), Amsterdam, the Netherlands

Thea van Oosten
Senior conservation scientist, freelancer, Netherlands

Local committee

Maria Elvira Callapez (Chair)
CIUCHT – Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa, Portugal

Susana França de Sá (Co-chair)
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Artur Neves
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Eva Mariasole Angelin
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Inês Soares
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Maria João Melo
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Sara Marques da Cruz
CIUCHT – Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa, Portugal

Sofia Nunes
Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus da Caparica, Portugal

Sofia Rodrigues
Universidade Católica Portuguesa, Portugal

Secretary

Ana Martins
(FCiências^{ID}, ammartins@fciencias-id.pt)

Inês Soares
(i.soares@campus.fct.unl.pt)

Sara Marques da Cruz
(saramarquesdacruz1@gmail.com)

Susana França de Sá
(susana.sa@fct.unl.pt)

Volunteers

Artur Neves
(al.neves@campus.fct.unl.pt)

Eva Mariasole Angelin
(e.angelin@campus.fct.unl.pt)

Sofia Nunes
(sar.nunes@campus.fct.unl.pt)

Sofia Rodrigues
(sofia.pinto.rod@gmail.com)

Jury Poster

Günter Lattermann (Chair)

Geoffrey Robert Mitchel

Katherine Curran

Louise Dennis

Maria João Melo

Ruth Keller

Honour committee

Amaro Reis
(Presidente APIP; Sacos 88)

Ana Coelho
(Sumol/Compal)

Ana Isabel Borges
(Mãe d'Água Reservoir)

Ana Simões
(FCUL)

Armando Morais
(Poliversal, SA)

Carlos Silva
(Joluce Plásticos SA)

Elisa Storace
(Kartell Museo)

Francisco Toscano Rico
(Presidente CVR Lisboa, Vinhos de Portugal)

Gonçalo Lopes
(Vice-Presidente Câmara Municipal de Leiria)

Henrique Leitão
(FCUL)

Hugh Karraker
(Actor, Producer "All Things Bakelite")

Jaime Rezola Clemente
(Baquelite Liz, S.A)

João Cortez
(Celoplás, Plásticos para a Indústria SA)

João Janz
(JANZ – Contagem e Gestão de Fluídos, SA)

João Neto
(Museu da Farmácia)

Joaquim Menezes
(Iberomoldes)

Luis Montelobo
(ShinEtsu, CIRES, Lda)

Maria João Guerra
(JANZ – Contagem e Gestão de Fluídos, SA)

Nuno Frois
(Sociedade Internacional de Embalagens)

Nuno Guimarães
(AGI)

Paula Diogo
(FCT-NOVA)

Paulo Almeida
(PLASGAL)

Pedro Gonçalves
(ShinEtsu, CIRES, Lda)

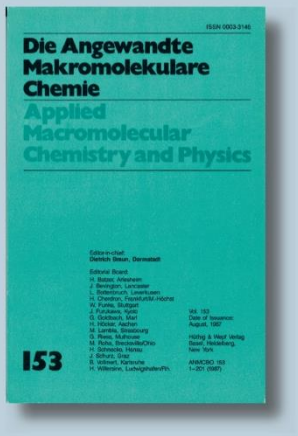
Raúl Castro
(Presidente Câmara Municipal de Leiria)

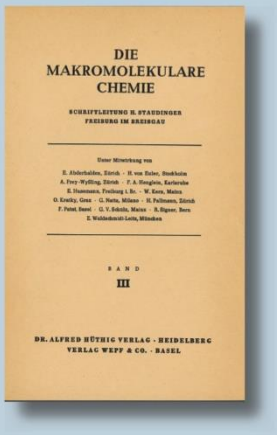
Richard Thommeret
(SOLVAY)

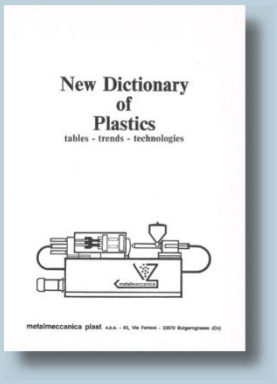
Silvana Bessone
(Directora do Museu Nacional dos Coches)

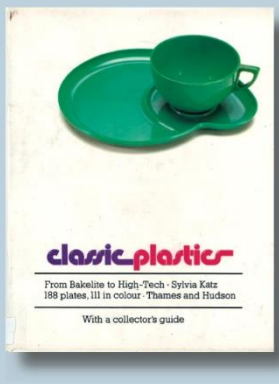
Vânia Carvalho
(Directora Museu de Leiria)

EISENBIBLIOTHEK









We're looking for literature on plastics!

Are you moving?
Clearing out the house?
Going digital?

Maybe you have books or periodicals on the subject of plastics that you have to get rid of because of lack of space or that are no longer important for you:

- Reference and textbooks, Overview works
- Prehistory and early history of plastics
- Chemistry and physics of plastics, Materials science
- Plastic objects in art and design
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- Areas of application
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KEYNOTE LECTURE BY JEFFREY MEIKLE

Date and Venue

This lecture will take place on July 29, from 9:50 to 10:50, at Museu Nacional dos Coches (National Coach Museum).

The Speaker

Jeffrey L. Meikle is the Stiles Professor in American Studies at the University of Texas at Austin. His book American Plastic: A Cultural History (1995) was awarded the Dexter Prize by the Society for the History of Technology. Since then, he has published Design in the USA (2005) and Postcard America: Curt Teich and the Imaging of a Nation, 1931-1950 (2015); he also co-edited Public Space and the Ideology of Place in American Culture (2009). Most of his research and writing examines the larger cultural significance of insignificant material and visual artifacts that have often gone unexamined. His current research project marks a departure: an investigation of so-called "neo-Beats": writers, artists, photographers, filmmakers, and musicians whose works have been inspired by or have appropriated themes and methods from the original Beat writers of the 1950s and 1960s.

The Lecture

Rethinking Early Plastics: The Rhetoric of New Materials

Promoters of new plastic materials in the early twentieth century had to confront an identity crisis. What were these new materials? In addition to establishing suitable applications for a range of materials with quite different properties, promoters had to invest them with meaning. How should the new plastics be presented to manufacturers and consumers? What shapes, colors, and textures were appropriate for objects made from them? Such questions had never come up with regard to traditional materials such as wood, stone, and metals, with which humanity had been familiar for centuries. At first, manufacturers who adopted such new materials as celluloid and Bakelite used them as substitutes for traditional materials and flaunted the ease with which their surfaces could be made to imitate the materials for which they substituted. Gradually, plastics began to take on unprecedented new forms and textures, and an array of artificial colors, as designers and manufacturers realized that they enabled nearly unlimited material expression. What does it mean when a culture must come to terms with new materials that have never existed before, for which there is no vocabulary, no design rhetoric? The history of cultural accommodation to synthetic materials forms a case study of cultural adaptation to other infinitely malleable forms of expression, such as the digital media of the past three decades.

Keywords: artificiality; Bakelite; celluloid; imitation; technological utopianism; terminology

PROGRAMME AT A GLANCE

WEDNESDAY, 29 May 2019

Venue: Museu Nacional dos Coches/ National Coach Museum

8:00	Registration opens	
9:15 – 9:50	Opening Session: Silvana Bessone, Maria Paula Diogo, Henrique Leitão, Amaro Reis, Raúl Castro, Maria Elvira Callapez (Auditorium)	
9:50 – 10:50	Keynote Lecture: Rethinking Early Plastics: The Rhetoric of New Materials, Jeffrey Meikle Laudatio by Ernst Homburg (Auditorium):	
10:50 – 11:10	Coffee break	
11:10 – 12:50	SESSION A (Auditorium) Hipoms' heritage	SESSION B (Library) Museums, collections, archives
12:50 – 14:20	Lunch	
14:20 – 16:00	SESSION A (Auditorium) Hipoms' heritage	SESSION B (Library) Preservation, conservation, characterization
16:00 – 16:30	SESSION A (Auditorium) Poster flash presentation: P1 – P13	SESSION B (Library) Poster flash presentation: P14 - P26
16:30 – 18:00	Posters/ Coffee break (coffee break ends at 17:00)	
19:30 – 21:30	Welcome Reception: Reservatório Mãe d'Água/ Mãe d'Água Reservoir	

THURSDAY, 30 May 2019

Museu Nacional dos Coches/ National Coach Museum

8:30 – 9:45	SESSION A (Auditorium) Preservation, conservation, characterisation Poster flash presentation: P27 – P37	SESSION B (Library) Preservation, conservation, characterisation
9:45 – 10:35	SESSION A (Auditorium) Preservation, conservation, characterisation	SESSION B (Library) Preservation, conservation, characterization
10:40	Meeting point to excursion to Leiria	
13:00 – 14:30	Lunch (*Grelha* Restaurant), Leiria	
15:00 – 16:00	Film viewing "All Things Bakelite" by Hugh Karraker (great grandson of Leo Baekeland) followed by debate Round table: Hugh Karraker, Jeffrey Meikle, Robert Friedel, Susan Mossman, Penny Sparke, Miguel Ritto, Paulo Almeida, Tiago Coelho, Pedro Gonçalves. Moderator: Maria Elvira Callapez	

16:00 – 18:30	Visit to Plastics Exhibition at Museu Leiria (Vânia Carvalho, Sara Marques da Cruz)
	Welcome reception, Canapés and drinks will be served by the Mayor of Leiria
19:00	Departure to Lisbon

FRIDAY, 31 May 2019

Museu Nacional dos Coches/ National Coach Museum

8:00 – 9:40	SESSION A (Auditorium) Hipoms' history	SESSION B (Library) Museums, collections, archives
9:40 – 10:55	SESSION A (Auditorium) Hipoms' history	SESSION B (Library) Scientific Analysis for the Conservation of Cellulose Acetate Session
10:55 – 11:30	Coffee break	
11:30 – 12:45	SESSION A (Auditorium) Hipoms' history	SESSION B (Library) Preservation, conservation, characterization
12:45 – 14:15	Lunch	
14:15 – 15:25	SESSION A (Auditorium) Hipoms in art, design Poster flash presentation: P38 – P47	SESSION B (Library) Plastics and environment
15:25 – 17:00	Posters/ Coffee break (coffee break starts at 16:30)	
17:00 – 17:50	SESSION A (Auditorium) Hipoms in art, design	
17:50 – 18:15	Closing Session, PHEA Poster Award, by Günter Lattermann (Auditorium)	
18:30 – 20:00	PHEA Meeting (on special invitation) - Auditorium	

WEDNESDAY

WEDNESDAY PROGRAMME

29 MAY 2019

Museu Nacional dos Coches/ National Coach Museum

8:00 Registration opens

9:15 – 9:50 Opening Session (Auditorium):
Silvana Bessone, Maria Paula Diogo, Henrique Leitão, Amaro Reis, Raúl Castro, Maria Elvira Callapez

9:50 – 10:50 Keynote Lecture (Auditorium): Rethinking Early Plastics: The Rhetoric of New Materials, Jeffrey Meikle
Laudatio by Ernst Homburg

10:50 – 11:10 Coffee break

11:10 – 12:50 SESSION A – Hipoms' heritage

- Casein formaldehyde as a design component for CR Mackintosh, Jake Kaner
- Plasticity, and a (Hi)story of Milk Plastics, Tom Fisher, Damla Tonuk
- Forgotten histories & possible futures: Learning from 20th century fibres and films made from regenerated protein sources, Mary M Brooks, Richard S. Blackburn, Anita Quye
- Plastics, Sports and Emotions, Stefan Poser

Collective discussion

SESSION B – Museums, collections, archives

- Impact of plastics on archives, Cancy Chu, Petronella Nel
- Plastic Space: Shellac as Informed Material in the History of Imitation Lacquerware, Gabriele Oropallo
- Identification and degradation of cinematographic films with magnetic audio track, Vítězslav Knotek, Petra Korandová, Radka Kalousková, Michal Ďurovič
- Material analysis of animation cels produced in early 1990s before the digital era, Marina Higashimori, Masahiko Tsukada

Collective discussion

12:50 – 14:20 Lunch

14:20 – 16:00 SESSION A – Hipoms' heritage

- Gutta Percha, natural rubber or balata? History and material characterization, Hanna M. Szczepanowska

- From celluloid to a quick arrival at Poudre B: Paul Vieille's unveiled path to his famous formulation, Yoel Bergman

- The use of plastics in the Soviet household appliances. Plastics rarities from the Moscow Polytechnic Museum's collections, Alla Nudel

- All nicely wrapped up in plastic". Packaging, marketing and consuming goods wrapped in plastic in the 1960s Norway, Liv Ramskjaer

Collective discussion

SESSION B – Preservation, conservation, characterization

- *Plastics at an exhibition*: a critical assessment of mid-infrared reflection techniques in cultural heritage, Susana França de Sá, Eva Mariasole Angelin, Inês Soares, Joana Lia Ferreira, Costanza Cucci, Giovanni Bartolozzi, Marcello Picollo, Maria João Melo, Maria Elvira Callapez

- MOLAB access at the Italian Triennial Design Museum: non-invasive portable spectroscopies unveiling the composition of iconic objects of the Italian design, Francesca Rosi, Annalisa Chieli, Barbara Ferriani, Costanza Miliani

- Identification of Unstable Museum Plastic Objects Based on Spectroscopy Techniques and Microfading Analysis, Anna Klisińska-Kopacz, Julio M. del Hoyo-Meléndez, Agata Mendys, Anna Kłosowska-Klechowska

- The study of cellulose acetate- based animation cels through portable spectroscopic techniques, Francesca Caterina Izzo, Giovanni Bartolozzi, Costanza Cucci, Francesco Grazzi, Marcello Picollo, Alessandra Carrieri

Collective discussion

16:00 – 16:30 SESSION A – Poster flash presentation: P1 – P13

- P1: How to approach mass objects? About the development of a standardized glossary and a digital database, Aleksandra Papis, Margrit Bormann

- P2: Film photography and the creation of a visual world, Nevena Ilic

- P3: Use of Plastic in Conservation and Restoration of Cultural Heritage, Julia Wagner, Caitlin Southwick, Mariana Escamilla, Ariana McSweeney, Francesca Cardinali, Estelle De Bruyn, Bianca Gonçalves, Lucile Pourret

- P4: Jet; the 'magic' polymer, Sarah Caldwell Steele

- P5: Contemporary Polynesian Art in Aotearoa People, Material and Preservation, Heike Winkelbauer, Valentina Pintus

- P6: Polymeric materials in the historical scientific collections: various solutions to different needs, Anna Giatti

- P7: Fashioning polyamide. Plastics in everyday life of the 1950s and 1960s, Viola Hofmann

- P8: The material legacy of oil: Moplen and domestic interiors during the Italian economic boom, Emilia Garda, Marika Mangosio, Valentina Villa
- P9: A brief history of polymeric materials in paints, Jorge Moniz, Susana Carvalho

- P10: Plastor Company – A history of more than one hundred years, Ion Seres, Elena Helerea

- P11: Plastics Companies in Romania – History and Heritage, Laura Leluţiu, Elena Helerea

- P12: Poliversal | Plasteme moments from 50 years of commercial and industrial success: trust, quality and innovation, Inês Matoso

- P13: Investigation into Reasons for Disintegration of Amber with Inorganic Inclusions and Conservation Method, Jurga Bagdzevičienė, Jūratė Senvaitienė, Bronė Kunkulienė, Janina Lukšėnienė

SESSION B – Poster flash presentation: P14 - P26

- P14: Optimising an ATR and Reflectance FTIR Analysis Methodology for Identifying Three Dimensional Polymeric Objects in Cultural Heritage Collections, Julianne Bell, Petronella Nel

- P15: A System Dynamics Approach to Modelling Degradation in Cellulose Acetate Film, Ida Ahmad, Katherine Curran, Simoni da Ros, Isabella del Gaudio, Argyro Gili, Deborah Cane, Joyce Townsend, Luca Mazzei

- P16: Collecting plastic emotions, Pina di Pasqua, Alice Hansen

- P17: Conservation of natural rubber, which solutions for which degradations, François Duboisset

- P18: Degradation of plastic art: What to do?, Erich Jelen

- P19: Study on Thermoplastic Synthetic Polymers Used as Supports in Contemporary Art Works, Maria Leite

- P20: Selected ion flow tube-mass spectrometry (SIFT-MS) in heritage science: non-invasive VOCs profiling of natural and synthetic resins, Francesca Modugno, Jacopo La Nasa, Ilaria Degano, Fabiana Cordella, Adele Ferretti, Maria Perla Colombini

- P21: Pratone: planning the preservation of an icon, Alice Hansen, Giovanna Cassese, Gabriella Russo, Maria Antonietta Di Marco

- P22: Conservation and active "post-stabilization" of plastics in cultural heritage, Yvonne Hed, Asbjørn Iveland, Erik Nygaard, Harry Øysæd, Jorunn Nilsen

- P23: Optimization of Microbiological Sampling Methods for Light Sensitive Layer of Historical Photographic and Film Materials, Kateřina Hricková, B. Benetková, M. Nováková, M. Ďurovič, V. Knotek, H. Sýkorová, J. Kadavá, D. Savická, K. Demnerová

- P24: High-risk neighborhoods … Spectacles made of cellulose nitrate and cellulose acetate, Judith Huber

- P25: Influence of relative humidity and acetic acid concentration in the air to the loss of plasticizers from cellulose acetate material of the Transparent Figures of the Deutsches Hygiene-Museum Dresden, Benjamin Kemper

- P26: Synthetic materials in the modern library collections – PVC bookbindings, Vítězslav Knotek, Petra Vávrová, Radka Kalousková, Jitka Neoralová, Nikola Šipošová, Dana Hřebecká

16:30 – 18:00 Posters/ Coffee break (coffee break ends at 17:00)

19:30 – 21:30 Welcome Reception: Reservatório Mãe d'Água/ Mãe d'Água Reservoir

29 MAY 2019

Session A - Hipoms' Heritage (11:10 – 12:50)

Casein formaldehyde as a design component for CR Mackintosh (11:10 – 11:30)

Jake Kaner (Nottingham Trent University)

The chemically modified biopolymer casein formaldehyde is found in a number of objects designed by Charles Rennie Mackintosh, the Scottish architect and designer.

What properties of the material attracted Mackintosh to use casein plastic in his design schemes which are found in the various architectural environments in the UK?

Was it employed as a substitute for coloured glass or was it used as a 'plastic' material in its own right with an intention to celebrate this polymer?

What are the visual and surface properties that attracted Mackintosh to employ the material and is there evidence to demonstrate this held in extant collections and archival resources?

Casein plastic has been located in both Scotland and England in architectural schemes designed by Mackintosh in the early twentieth century and little is known about this choice of this innovative material.

Recent discussions at the Glasgow conference *intangible matters* raised interest in this research and new discoveries of Mackintosh's further use of casein plastic in his designs, such as the Tea Rooms in Glasgow.

The paper aims to establish casein formaldehyde as a significant material used by this world-renowned architect and reveal new insights into this lesser known material as an important component of Mackintosh design to inform plastics heritage and design history through expanded knowledge that locates the material in surviving objects, supported by archival evidence.

Keywords: Architecture, casein formaldehyde, CR Mackintosh, design history, furniture, plastics heritage.

Plasticity, and a (Hi)story of Milk Plastics (11:30 – 11:50)

Tom Fisher, Damla Tonuk (Nottingham Trent University)

In this paper, through a social history of plastics we elaborate on the material and social 'plasticity' of plastics. Materially, i.e. as physical substances, plastics define a wide range of material compositions with different qualities, from bio-based origins in Casein and Cellulose to petroleum-based versions, with an apparently infinite range of material qualities - soft and hard, shiny and matte, opaque and transparent. Socially (and culturally) they stand for distinct values, from environmental hazards to environmentally friendly materials, from authentic to synthetic, from hygienic to tacky (Fisher, 2004). Plastics have aesthetic and unstable relationships to both their consumers and producers, and as the materials change so do the ways they are valued.

In this paper, we build on historical work on the origins of casein plastics made of milk (Lattermann, 2017) and their use (Kaner, 2017), and on milk itself, a vital bodily fluid and raw material, to elaborate on the social and material agency of plastics. By relating the story of the development of modern casein plastic to the parallel story of its source material, milk, we explore its culture - how different ideas about hygiene, bacteria, naturalness, and technology simultaneously transformed both milk, and milk plastics. As such, rather than a perspective dominant in design literature that sees materials as passive actors who play the roles assigned to them by designers

(Karana et al., 2015), we borrow the term 'agency' from science and technology studies (STS) to implicate at the activeness of materials in creating effects (Bennett, 2010). We elaborate on the capacities of matter in reproducing these meanings to propose the term 'plastic agency'. This originates from the specificity of plastics as unstable and dynamic materials that opens up the interaction between materials and their social environments – a perspective that can be applied to all materials. With this historical analysis of plastics, we open up a new perspective for design scholars in conceptualising their relationships to materiality.

Keywords: plastics, casein, milk plastics, milk, plastic agency, nature, bacteria.

Forgotten histories & possible futures: learning from 20th century fibres and films made from regenerated protein sources (11:50 – 12:10)

Mary M Brooks (Durham University), Richard S. Blackburn (University of Leeds), Anita Quye (University of Glasgow)

This paper explores the forgotten history of fibres and films made from regenerated protein sources such as milk, soyabeans, maize, peanuts, egg-white, feathers and slaughter-house products from historical, technological and ecological perspectives. It argues that learning from these experimental 20th century fibres can provide new approaches for creating sustainable fibres for the 21st century.

As war loomed, politicians and planners became anxious about the availability of wool for military requirements. Transforming surplus or waste proteins into fibres and films was actively encouraged. Major companies registered patents using regenerated proteins. Du Pont argued such 'new and valuable composition of matter comprising intimate mixtures of proteins and synthetic linear polyamides' resulted in strong, flexible films. Analysing the rhetoric of national duty and ideology associated with these materials illuminates their trajectory from futuristic and utopian to association with deprivation and substitution. Thomson's rubbish theory is used to analyse their disappearance from cultural memory. Evidence from these failed and forgotten fibre is reframed as the basis for new experimentation into sustainable fibres.

Material studies of these regenerated proteins draws on textual and visual archival sources, including patents, fibre samples, and rare surviving textiles and dress from international museum collections.

Contemporaneous technical literature describing historical methods of industrial production and use gains particular importance, bringing insight into chemical and physical expectations of the fibres with which to develop appropriate scientific methods for identification, and to investigate their material significance and preservation.

Issues of sustainability in relation to materials used for manufacturing textiles and the impact of such textiles during use (e.g. generation of microfibres) and at the end of their life will be discussed. These present opportunities for using waste materials for a sustainable fibre. Textile fibres produced from food waste that do not require any extra land use, whose microfibres have minimal impact in the environment, and that are fit for purpose could truly provide a next generation of material.

Deeper understanding of previous experimental work in the use of surplus/waste proteins to produce fibres and films, and cultural reactions to these materials, is valuable in developing innovative fibres to meet current ecological concerns.

Keywords: regenerated proteins fibres; films; sustainable fibres; cultural memory

Plastics, Sports and Emotions (12:10 – 12:30)

Stefan Poser (Helmut Schmidt University)

The history of plastics in sports can be narrated as an impressive success story, beginning already in the 1960s. The material was key to light weight constructions in many different sports. Plastic-based constructions enabled sportsmen to perform better, to jump higher, to be faster …. This process continued during the last 50 years powered by many different kinds of highly specialized plastic items. The negative aspect of these developments was an increasing risk of tremendous injuries.

Sports became a field of testing new materials before they were introduced to larger markets. The new technical devices were combined with plastics equipment such as special clothes or high-tech shoes. Professionals took profit from these developments as well as persons who enjoyed leisure sports. Well known is shark skin sports ware from synthetics for professional swimming as well as the neoprene suit for activities as diving or surfing. Even balls for soccer games from leather were exchanged to plastics in order to improve the speed of the game. Especially new out-door sports ware which came up in the 1990s might have had a considerable influence on public opinion: they were much more comfortable than the synthetic clothes of the 1970s which contributed to a negative image of this material.

The paper intends to introduce research on emotions in the history of materials following an ICOHTEC session on plastics and emotions, organized by E.M. Callapez, G. Lattermann and St. Poser in 2018. In fact plastics contributed to the societal role of sports: it made competitions as leisure sports more interesting, and thus generated positive emotions. Contributed the introduction of plastic devices in sports to the image of plastics as well?

Keywords: sports, emotions, light weight constructions, high-tech synthetic materials

Impact of plastics on archives (11:10 – 11:30)

Cancy Chu, Petronella Nel (University of Melbourne)

Archives are repositories of information and records, offering windows into social and cultural history. With the introduction of cellulose nitrate film in 1889, plastics became integrated into practices of art and documentation. Over time, plastics developed into significant components of records stored in magnetic, optical and digital formats (Calmes 1993). Furthermore, the development of plastic as a synthetic alternative to paper, wood, metal and textiles have had a notable impact on archival storage techniques. Plastic bindings, covers, coatings and containers are currently widely used in museums, libraries and archives alike (Keneghan 2002). Coated and synthetic papers have been rising in popularity since the 1940s for use in printed books and documents, and pose a challenge to conservators and collection managers due to their proprietary formulations and lack of available treatment and storage conventions.

This paper argues for the need for greater attention to the conservation of plastics in archives. A review of the wide range of plastics known to be present in archives is used to demonstrate their value and presence in human history. A comparison of current preventive conservation techniques, particularly regarding photographic and magnetic records, shows the need for greater examination of sustainable, low-budget solutions. Limitations of instrumental analytical techniques when examining thin, laminate polymers are described. Finally, the paper will conclude with an outline of current plans for collection surveys, industry questionnaires, and experimental analysis in the context of PolyMuse, a coordinated plastics research project in Australian institutions. This paper builds on previous museum-based research on malignant plastics – unstable plastics that increase the degradation of surrounding materials (Williams 2002; Shashoua 2008; Lavédrine et al. 2012) – and expands the conversation to record-based institutions. Knowledge gaps in materials analysis, collection management and professional expertise on archival plastics are described to show the need for future research.

Keywords: archives, malignant plastics, heritage conservation, surveys, Australia

Plastic Space: Shellac as Informed Material in the History of Imitation Lacquerware (11:30 – 11:50)

Gabriele Oropallo (London Metropolitan University)

This paper examines the biopolitical and technical implications of the increase in intercontinental shellac trade that was prompted by the rise in imitation lacquerware on European markets. The paper examines the inception and progressive acculturation of the new material through a primary source close reading of period treatises such as *Trattato sopra la vernice*, published in 1720 by the Italian Jesuit Filippo Bonanni, and Jean-Felix Watin's *L'art de faire et d'employer le vernis* in 1772.

By the 18th century, increased purchasing power and the opening of new transcontinental trade routes intensified the exposure to East Asian artefacts among wealthy Europeans. European craftsmen's access to the lacquer was prevented not only by East Asian resistance to giving away of industrial secrets, but also by the near technical irreproducibility of the original technique. The Italian and French techniques, in its stead, called for the use of shellac imported from India. Imitation lacquer techniques became collectively known as japanning. Shellac is a resin secreted by the female individuals of a bug, the Kerria Lacca, to form tunnels on the branches of several trees.

Lacquer goods went from being initially appreciated simply as novelty, luxury items to being recognized for their material qualities. The latter included resistance to water, wear and tear, stains, and most importantly the visual allure of both their glossiness and deep blackness—material qualities that had before been relatively rare in European material culture. In parallel, japanned artefacts also became a medium to imagine and play a perception of the exotic. The prints or reliefs embedded within the multiple layers of varnish that cover japanned artefacts mostly represented life scenes and landscapes perceived as oriental by the craftsmen and their public.

Shellac allowed Italian and French craftsmen to postpone the transformation of the sap into lacquer across edited distances of time and space. Import of the material to Europe reached a critical mass, and this had a bio-economical impact on the local ecosystems. This was due to a boosted farming of the bug in the Indian subcontinent, which at previous times in its natural history had been considered a pest. At the verge of the age of mechanical reproduction of artefacts, japanning presages a new dominance of surface over structure. The material implications are wide-ranging because the new availability of shellac in Europe brought by the japanning fashion arguably allowed for increased material confidence, and ultimately contributed to the process leading to demand for oil-based polymers. Surface would progressively and literally evolve into structure.

Keywords: shellac, environmental history, cultural history, geopolitics, orientalism, japanning

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Identification and degradation of cinematographic films with magnetic audio track (11:50 – 12:10)

Vítězslav Knotek, Petra Korandová, Radka Kalousková, Michal Ďurovič (University of Chemistry and Technology in Prague)

A magnetic audio track was used to record sound in the cinematographic industry from the 1950s to the 1980s. In these years, the film bases were made from cellulose triacetate (CTA) or polyester. The magnetic audio track is basically formed by magnetic particles in a polymeric binder. It is known that the CTA films can relatively fast succumb to degradation such as shrinkage and embrittlement if stored under wet and warm storage condition. The change in dimensions of film reels can block the digitalization of audio track in some parts. Moreover, the magnetic particles and the type of binder could accelerate the degradation of CTA film base. Therefore, the main goal of this work is the degradation of the magnetic sound track and its influence on CTA film base.

Several archival films with magnetic audio track and one type of modern film were analyzed by infrared spectroscopy, in order to identify the chemical composition of the film bases and the binder of the magnetic audio track. The type of magnetic particles was investigated by Raman spectroscopy and scanning electron microscopy. The samples of films were aged at elevated temperature and humidity in closed boxes. The rate and degree of degradation of the film and magnetic track were evaluated by infrared spectroscopy and quantified by a degradation index, which expresses the ratio of the bandwidths of the characteristic groups. The results showed that the investigated film bases were made from CTA and the binder of the magnetic tracks was cellulose nitrate. The degree of films degradation can be easily determined by infrared spectroscopy using a suitable degradation index. The macroscopic observation of the influence of the audio track on CTA base was difficult considering high base to audio track volume rate. Some changes in chemical composition were detected in the immediate vicinity of the audio track by microscopic methods.

Keywords: cellulose triacetate; magnetic audio track; degradation; infrared spectroscopy

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Material analysis of animation cels produced in early 1990s before the digital era (12:10 – 12:30)

Marina Higashimori, Masahiko Tsukada (Tokyo University of the Arts)

Until the mid-1990s when the digital technology was introduced to the commercial animation production, a large number of cel animations were produced in Japan, and enormous amount of animation cels were created. For many years animation cels were considered as intermediate products of animation production, and not much attention was paid for their preservation, or in some cases they were just abandoned. It is only in recent years that the archival value of the materials and documents used for the animation production, including cels, is recognized, and the importance of their preservation started to be discussed. For planning sustainable preservation strategies of those materials, understanding of their chemical compositions and current condition is essential.

In this context, we had an opportunity to study the materials of five animation cels, which were created for the production of three different animations in early 1990s. To understand the chemical composition of transparent substrates and paints, we mainly adopted non-invasive analytical techniques, such as XRF, ATR-FTIR and Raman spectroscopy.

ATR-FTIR revealed transparent substrates of all five cels were made of cellulose acetate. Three of them are emitting an acidic smell and their IR spectra showed large peaks attributable to the hydroxyl group. These facts suggest that the hydrolysis of acetate is advancing in those cels, and better preservation condition should be planned. From the IR spectra of paints we found polyvinyl acetate as a binding medium, and most of the paints contained barium sulfate as an extender. By XRF and Raman spectroscopy some pigments were detected, such as titanium dioxide and phthalocyanine blue and green. Black contour lines of figures didn't show peaks of amorphous carbon in Raman spectra, and they were not observable in IR reflectography; both suggest the presence of black pigment or dye rather than carbon black. Some of these findings did not agree with the information we could find in the literatures about the materials used in cel production, or the information obtained from animation creators who worked for cel paintings. We need further studies to better understand the range of materials used in animation cels.

Keywords: Animation cel, non-invasive analysis, cellulose acetate, polyvinyl acetate

Gutta Percha, natural rubber or balata? History and material characterization (14:20 – 14:40)

Hanna M. Szczepanowska (West Virginia University, School of Art and Design, Morgantown WV, USA)

Gutta percha (GP), natural rubber (NR) and balata (B), natural latexes from Southeast Asian trees are polyisoprenes of great industrial and historic importance as seen in cultural heritage collections. Because of their identical chemical formulas, they were referred to interchangeably and mixed together in the early experiments at the turn of the 19th century. The focus of this study is on GP, a natural plastic, in a context of material history and comparative analysis with NR and B. The aim of this work is to establish microanalytical markers in GP, NR and B that can guide their identification in cultural heritage collections and lay the foundation for the preservation strategies of objects made of these polymers. Most information on GP is based on historical records and only limited current data is available to confirm these. This research covered three areas: a. fieldwork to identify plants and gather fresh traceable samples of GP, NR and B latexes; b. study of the evidence of surviving processing facilities of GP and their products in two locations, Lingga Island, Riau Archipelago and Cipetir on Java, Indonesia; c. laboratory analysis of fresh latexes, 10-years old commercial stock of GP and over 100-years old archival collection of GP, NR and B specimens from the Archives of the Botanic Gardens in Singapore.

The latex extraction from the tree trunks (for NR and B), and leaves (for GP) and subsequent processing produced materials of variable composition and use making their characterization challenging. The comparative investigation of these three materials aimed to establish the chemical markers enabling to differentiate between them in cultural heritage objects. The properties of solid GP were compared with NR and B relying on vibrational spectroscopy (Raman 785nm and FTIR-ATR); the nuclear magnetic resonance (^{1}H NMR) was used to determine their *trans*- and *cis*-polyisoprene classification.

The results revealed that multiple factors govern alterations of these materials: time of latex coagulation differs between species within one genus, morphology of latex extracted from tree trunk differs from latex extracted from leaves, morphology of fresh latexes cannot be traced in coagulated solids. The spectroscopic analysis of aged material compared to fresh latexes is more complex because of the presence of the degradation products; multi-variant analytical approach provided complementary information about these studied materials.

Keywords: polyisoprene latexes, Raman spectroscopy, nuclear magnetic resonance

From celluloid to a quick arrival at Poudre B: Paul Vieille's unveiled path to his famous formulation (14:40 – 15:00)

Yoel Bergman (Tel-Aviv University)

In the last 15 years I have been analyzing Paul Vieille 1880s' gunpowder research through open literature. Vieille, a French state scientist arrived at a novel, polymeric based, smokeless gunpowder formulation, Poudre B, on November 1884. It contained some 96% cellulose nitrate (CN) and processed with organic solvents to obtain a "dough", rolled into carpets, dried, and cut into thin plate-like gunpowder grains. Soon, other shapes and slight formulation variants were formed to fit different calibres and the Poudre B became the first dependable military smokeless gunpowder family. Other smokeless powders appeared towards the end of the 1880's, gradually replacing together with Poudre B, the centuries old granular black powder that produced much smoke when fired and delivered lower ballistic performance. In 2016, I had a first opportunity to review Vieille's 1880s laboratory notebooks, enabling as will be described, to answer open questions, i.e., major historiography has been unable hitherto to determine when did Vieille turn to CN? why did he begin with CN at all? and what path did he pursue and the duration of development? A careful reading of the notebooks and crosschecking with additional documents point to a surprisingly quick progression within a few weeks in late 1884, from white celluloid of 82% CN and 18% camphor to the almost completely CN based Poudre B (the CN in Poudre B was most probably more insoluble than in Celluloid). The role of celluloid in 1884 can be interestingly compared with Alfred Nobel's claim in his new

smokeless Ballistite patents beginning late 1887. There he wrote that Ballistite is a modification of celluloid, where part or all of the camphor is replaced with the energetic, oily and plasticizing nitro-glycerine. The notebooks also draw new possibilities for his motives.

Keywords: Vieille, Poudre B, Smokeless Powders, Cellulose Nitrate, Celluloid

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The use of plastics in the Soviet household appliances. Plastics rarities from the Moscow Polytechnic Museum's collections (15:00 – 15:20)

Alla Nudel (Polytechnic Museum)

In the first half of the 20th century in the USSR in industrial volumes produced two main types of plastics – celluloid and phenolic plastics, including carbolite. At first, these materials were used to make products that did not require high strength: inkstands, haberdashery, some electrical products. Many of them are represented in the collection of the Polytechnic Museum as a reflection of the first stage in the use of synthetic and artificial plastics.

In the middle of the XX century the range of household appliances produced in the USSR has expanded. The first household electric vacuum cleaners, washing machines and refrigerators appeared. Engineers who were looking for options to reduce the mass and size of home appliances offered to try phenoplast as a replacement for the metal in these products. The choice of this plastic was also explained by its excellent mechanical and dielectric properties.

In the late 1940s in the USSR, the first models of home appliances with cases made entirely of carbolite appeared. One of them was the manual electric vacuum cleaner «Ural-PR-1». It was produced until 1956. To date, only a few copies have been preserved. Therefore, the vacuum cleaner «Ural-PR-1», which is in the collection of our museum, is a real rarity.

Another innovative apparatus of that time – the household washing vibration device. It consisted of a generator of low-frequency sound vibrations and elastic membranes installed in the carbolite case having the shape of a mushroom.

These devices also were producing for a short time and their rare preserved specimens today are for us a unique monument of engineering thought and an object of study and preservation.

The Polytechnic Museum has one of the largest collections of polymer materials and products from them in Russia. The museum collection includes all the main types of plastics produced from the end of the nineteenth to the beginning of the twenty-first century and unique products from them.

Keywords: carbolite, phenoplast, vacuum cleaner

All nicely wrapped up in plastic". Packaging, marketing and consuming goods wrapped in plastic in the 1960s Norway (15:20 – 15:40)

Liv Ramskjaer (Norwegian Museums Association)

The new plastic materials made possible a new way of packaging the different sorts of consumer goods: from cellophane wrappings of cigars etc. in the 1930s to the wide use of polyethylene in different sorts of plastic bags in the 1960s powered by the increasing trends of self-service shops. The new packaging material made the products visible for the customers and served as a teaser for the delicate goods inside trying to persuade the customer to buy.

The paper examines the development in the Norwegian plastic packaging industry and the connected changes in the retail business as well as the transfer of cultural changes in the marketing, advertising and consumption in the 1960s. Central questions: Who were the agents of transformation? What were the driving forces, and push and pull factors, behind the new packaging system? How did the existing packaging industries react to this? Are there any similarities or differences between the USA and Norway in the utilization of plastics in packaging?

In Norway the transformation from paper to plastic in packaging in the 1960s were substantial. Changes in retail business, consumption patterns and increased mass consumption of ready-made products for the households altered the way of presenting the goods to the customers. The decreasing prices for polyethylene in the early 1960s made this development possible.

Several archives of the Norwegian plastics industries, as well as plastic and consumer magazines show that they grabbed the possibility of developing new businesses in different segments of the packaging industry and diversified into the packaging sectors by buying up paper-packaging companies or establishing new plastic departments. Others started up developing suitable new packing methods for example for milk or frozen goods. This made possible wider distribution of fresh fish to areas earlier out of reach for fresh fish, and a new industry in frozen fish was established. The 1960s was the breakthrough decade for the home-freezers in Norway making distribution of ready-made frozen goods possible as well as the increasing home-freezing activity.

Keywords: Plastic, packaging, retail, self-service shops, consumption, ready-made goods, advertising

Plastics at an exhibition: a critical assessment of mid-infrared reflection techniques in cultural heritage (14:20 – 14:40)

Susana França de Sá, Eva Mariasole Angelin, Inês Soares, Joana Lia Ferreira (Departamento de Conservação e Restauro e LAQV-Requimte – Faculdade de Ciências e Tecnologia, Universidade NOVA de Lisboa), Costanza Cucci, Giovanni Bartolozzi, Marcello Picollo (Nello Carrara" Institute of Applied Physics, National Research Council), Maria João Melo (Departamento de Conservação e Restauro e LAQV-Requimte – Faculdade de Ciências e Tecnologia, Universidade NOVA de Lisboa), Maria Elvira Callapez (CIUHCT-Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa)

Within the project The Triunph of Baquelite – Contributions to a History of Plastics in Portugal (coordinated by Maria Elvira Callapez), several hundred Portuguese plastic objects from private collections and industries have been selected to be displayed in the exhibition '*Plastic* idade – uma História do Plástico em Portugal' (Leiria, Portugal, in 2019). The collections include objects covering all ages of the Portuguese plastics' industry (since 1930s to 2000s) and several plastic formulations – formaldehyde resins and thermoplastics such as PE, PP, PS and plasticized PVC. The selected plastic items had not been prepared to be exhibited (not identified nor cleaned). Thus, molecular characterisation was crucial to select the best conservation procedures.

This presentation focuses on the use of mid-IR spectroscopy in reflection modes for that purpose. Attenuated total reflection is a well-established method, but it requires physical contact with the material. For fragile objects this is not always possible. For this reason, reflection methods without sample contact have been tested for the identification of these plastics. In reflectance spectra both specular (the angles of incidence and reflection agree) and diffuse (the angles of incidence and reflection are different) components can be measured. The interpretation of these infrared signals is more complex as overtones and combination bands may appear as well as spectral artifacts such as derivative-like spectral features and inverted bands (reststrahlen). These distortions result from several factors such as sample roughness, absorption and refractive indexes, and the presence of both diffuse and specular components. Spectral differences have been critically assessed by comparing two portable FTIR spectrometers; Alpha Bruker Optics with external reflectance interface and Agilent 4300 Handheld with diffuse reflectance interface. The first acquires both specular and diffuse components, the latter excludes the specular one.

With this work, we expect to contribute for a better preservation of plastics heritage in museum collections and exhibitions. On the other hand, the results obtained allow the building of a database assembling selected mid-IR reflection modes that will enable a more efficient extraction of the rich information still hidden in a plastic's molecular spectrum.

Keywords: Portuguese plastics industry; material characterisation; infrared spectroscopy; reflection modes; external and diffuse reflectance.

MOLAB access at the Italian Triennial Design Museum: non-invasive portable spectroscopies unveiling the composition of iconic objects of the Italian design (14:40 – 15:00)

Francesca Rosi, Annalisa Chieli (CNR-ISTM and SMAArt), Barbara Ferriani (Ferriani srl & Ca' Foscari University of Venice), Costanza Miliani (CNR-ISTM and SMAArt)

The Italian Triennial Design Museum, inaugurated in 2007, is the first Italian design museum. The museum houses a large collection representing the heterogeneity of the history of Italian design together with its innovation and experimentation. In 2016, the Museum asked the mobile laboratory MOLAB of the E-RHIS infrastructure (www.e-rihs.it) to conduct a non-invasive investigation of some of the plastic objects in their collection. With the final aim of safeguarding and preserving the numerous items made using different types of plastics, the museum asked for the study of objects with unknown or uncertain composition. Among the available portable non-invasive analytical techniques of MOLAB, vibrational spectroscopy FT-IR in the wide spectral range 10000-400 cm-1 was selected as the most appropriate for unveiling the nature of the polymer constituting the plastic object. Previous

papers in fact demonstrated the usefulness of FT-IR spectroscopy in reflection mode for determining the class of polymer exploring the 4000-400 cm-1 range. Infrared reflection spectra recorded from the design objects were compared with spectra recorded from a reference ResinKit TM collection both in transmission and reflection modes. No spectral correction (namely Kramers Kronig) could be applied to the reflection spectra of both the polymer references and museum objects since the presence of inorganic fillers generated a reflected light composed of the surface and the volume components. However, the combined exploration of mid and near FT-IR integrated with X-ray fluorescence (XRF) spectrometry, allowed to identify the nature of the polymer- including variations within the same class of materials- the inorganic fillers, as well as the inorganic and organic pigments for colored objects.

Keywords: Plastic, reflection mode, FT-IR, extended IR.

Identification of Unstable Museum Plastic Objects Based on Spectroscopy Techniques and Microfading Analysis (15:00 – 15:20)

Anna Klisińska-Kopacz, Julio M. del Hoyo-Meléndez, Agata Mendys, Anna Kłosowska-Klechowska (The National Museum in Krakow)

Museum collections are constantly enriched with polymeric materials. Considering the dynamic development of polymer chemistry, it can be assumed that the amount of cultural objects made of plastic and found in museum collections will continue to increase over the upcoming years.

Unfortunately, objects made of plastic, contrary to popular opinion, are very unstable and vulnerable to museum environments. Although there might be different rates and degradation paths, it is common that these processes begin at the very moment when the object is created.

What is worse, there is a group of materials that are particularly dangerous and not only destroy themselves, but their degradation products may become harmful to other objects stored next to them.

The main aim of this work is to develop a non-invasive method for the easy determination of the state of preservation of polymeric objects using as example the collection of the National Museum in Krakow. The polymers and additives composing the objects were identified and characterised with portable Raman and portable NIR spectroscopy equipment. Additionally appropriate complementary investigations using micro-Raman spectrometer, hyperspectral camera in SWIR spectral range (1000-2500 nm) and FTIR spectrometer were performed. Additionally, color alterations associated with exposure to light were evaluated using microfade testing.

Understanding the materials used in objects and conservation treatments on the stability of objects will permit to devise ways to reduce and minimize their physico-chemical degradation. This will allow to provide advise on the care and display of these objects in order to ensure safe exhibition and storage.

Keywords: portable Raman, microfadometry, NIR spectroscopy, museum plastic objects

The study of cellulose acetate- based animation cels through portable spectroscopic techniques (15:20 – 15:40)

Francesca Caterina Izzo (Ca' Foscari University of Venice, Department of Environmental Sciences, Informatics and Statistics), Giovanni Bartolozzi, Costanza Cucci, Francesco Grazzi, Marcello Picollo (Istituto di Fisica Applicata "Nello Carrara"), Alessandra Carrieri (Private conservator, Academy of Fine Arts of Verona)

A multi-analytical in situ spectroscopic approach was adopted for the investigation of a corpus of animation cels, created for the Italian television and dating from 1950's to 1970's. Presently, this corpus of cels is stored and conserved in the collection of the Museum of Industry and Labour "Musil" in Brescia (Italy). Nevertheless, several

of these animation cels exhibit diverse degradation phenomena such as shrinkage of the plastic sheets, loss of plasticizers, lacunae on the painted layers, yellowing, presence of exudates, and efflorescences.

The study of the original and degradation materials of a selected group of these objects was performed with non-invasive portable spectroscopic techniques such as fiber optic reflectance spectroscopy (FORS), total reflectance Fourier transform infrared (TR-FTIR) and Raman spectroscopy. Most of the materials constituting these cels, like the plastic substrates, the binding media, the pigments and dyes used for painting the animation characters, were identified by means of the above reported analytical techniques. In addition, the obtained data were validated by using other analytical laboratory techniques, such as pyrolysis gas chromatography-mass spectrometry (py-GC-MS) and thermally-assisted hydrolysis and methylation pyrolysis gas chromatography-mass spectrometry (THM-py-GCMS).

The results underline the composition of the plastic substrate as cellulose acetate, while the painted layers contained a variety of pigments bound mainly in an alkyd-based resin.

This study also provides information on the state of preservation and the degradation phenomena, in particular those occurring on the plastic substrate due de-acetilation of plastic sheets and the loss of phalate-based plasticizers.

Keywords: Animation cels; rodovetri; cellulose acetate; FORS; TR-FTIR; PY-GC-MS

Session A - Poster flash presentation: P1 – P13 (16:00 – 16:30)

P1 - How to approach mass objects? About the development of a standardized glossary and a digital database

Aleksandra Papis, Margrit Bormann (State Museum Auschwitz-Birkenau)

The State Museum Auschwitz-Birkenau in Oświęcim holds among other items a collection of about 5000 toothbrushes made of plastics, mostly of cellulose nitrate. They are testimonies of the Holocaust and valuable documents of its history - often the only proof of the existence of their owners. As objects of everyday use and with origins in various manufactories they represent a cross section of European toothbrushes production in the 1940's.

For most toothbrushes the irreversible and unstoppable degradation processes are already far advanced, the items have cracks and losses, are brittle, and some of them are totally destructed just existing in the form of small pieces. Thus the biggest problem is the loss of their readability and function as historical documents, which in consequence leads to the loss of the object's significance.

This collection of toothbrushes is an interesting issue for research. Its main advantage is the mass scale of both objects and damages that can be recorded. The recording method of damages in the field of mass objects requires the development of an appropriate strategy, as well as the invention of suitable methods and tools. Usually this "mass object" is only treated as a whole, a mass collection of similar items. They are being generalized by giving them common traits for description and common criteria in documentation and in conservation treatment. This generalization is further extended to the control of the conservation state of the whole collection, which makes a precise approach to each single object impossible. The effects of such a generalized methodology are only approximately estimated results, and consequently an inaccurate approach to the object.

At present the Museum develops a digital database especially for objects made of plastics to enable efficient control of their preservation state. With the help of a standardized glossary the program allows a normalized description of form and condition of the objects. This is not a conservation documentation, but only its supplementation, a helpful tool for defining the conservation conditions of the collection over time.

Keywords: cellulose nitrate, toothbrushes, mass object, approach, glossary, standard, database

P2 - Film photography and the creation of a visual world

Nevena Ilic (CIDEHUS and HERCULES Laboratory, University of Évora)

The invention of photography was one of the greatest patents in the 19th century. With its industrialization, at the begging of the 20th century, it created an entire new spectrum of a visual world where we continue living.

More than one hundred years ago, George Eastman, as the result of his invention to capture light on photo sensitive material (celluloid film), created the photographic industry, based on chemical processes and plastic transparent film – which is called, from today's perspective, analog or film photography. The industry of photographic film allowed us to reach unsuspected level for the use of it, and the possibility that all men could become photographers. It has allowed us to watch, document, educate and depict ourselves in the field of art, journalism and science. It became our cultural and historical memory.

In terms of the conference theme, this paper aim is to explain how the invention of film photography media with the help of new technology in the early 20th century, created a pattern of a visual world in which we live in present moment. The study examines the history of the film photography in the case study of Kodak company and its achievements in the fields of science, technology, technique, advertisement, design, art and journalism.

Keywords: film photography, cellulose nitrate, cellulose acetate, heritage, Kodak

P3 - Use of Plastic in Conservation and Restoration of Cultural Heritage

Julia Wagner, Caitlin Southwick, Mariana Escamilla, Ariana McSweeney, Francesca Cardinali, Estelle De Bruyn, Bianca Gonçalves, Lucile Pourret (University of Amsterdam, Sustainability in Conservation, Cologne University of Applied Sciences, Mount Auburn Cemetery, Royal Institute for Cultural Heritage (KIK-IRPA), Museu de Arte de São Paulo)

Plastic in conservation is problematic: it is not sustainable. As art, it deteriorates too quickly; and for the planet, not quickly enough. Sustainability in Conservation (SiC) is an international organization working towards changing habits and raising awareness regarding sustainable practice in conservation and restoration of cultural heritage. Reducing use of plastic is one of our goals, so a survey was conducted to better understand plastic types in use and recycling/reuse patterns. Data collected provides a scope of habits and information to help identify focus areas. SiC aims to use this for providing desired information on improving plastic usage, recycling habits and to design programs that induce change towards a greener profession.

The survey, composed of nine questions in both open and closed formats, was completed by 220 respondents from all over the world, including conservators from museums, private studios and educational institutions across a variety of specializations.

Results indicate that amongst respondents, the most commonly used plastic items are (nitrile) gloves, polyester (PET) films (e.g. Mylar, Melinex), adhesive tape, polyethylene (PE) cloth (e.g. Tyvek) and PE foam (e.g. Ethafoam). Estimates of average daily use include approximately three gloves and three sealable plastic bags per respondent. Gloves, PET film, PE foam (particularly off-cuts) as well as packaging materials are among the items respondents considered most wasteful.

While only 26.8% of respondents reportedly upcycle and less than half recycle, the survey confirmed that reuse is more commonly practiced. Concerns on the topic were voiced, primarily regarding disposal of contaminated plastics, soft plastics, off-cuts, the cost of recycling programs and regulations prohibiting recycling of some materials.

More than half of respondents stated they would increase their efforts to reduce/reuse/recycle plastic materials if they were provided with information on how to do so. This demonstrates the need for reliable resources regarding best practice and more accessible information for conservators. SiC aims to provide this type of information and the means to become more sustainable. Tailored programs, such as a plastic tracker or calculator, could be a solution to aid this transition to minimise plastic waste in conservation.

Keywords: plastic, waste, recycling, reuse, reduce, sustainability, conservation equipment and materials

P4 - Jet; the 'magic' polymer

Sarah Caldwell Steele (University of Yale)

In mainland Europe we first witness the utilisation of the natural polymeric material known as jet for amulets in the Upper Palaeolithic, the period during which our hominid ancestors first developed complex language, culture and art, laying down the foundation for our modern human civilizations. In the Americas such artefacts are seen as early as 13,000 years ago and in the British Isles, Whitby Jet, arguably the best quality gem hydrocarbon in the world, first appears in the Early Neolithic. Almost certainly utilised for shamanic ritual, the unique 'plastic' properties exhibited by members of the jet group make it quite literally a 'magic' material. These artefacts belong to the world of magical-religious beliefs of difficult definition and are related to superstition. The ancient philosophers debated the nature of these black materials which behave oddly in relation to combustion, and they have inspired poem and verse by some of history's most brilliant minds. During the Medieval Era, these same attributes brought jet to the attention of the alchemists as a potential candidate for the 'Philosophers Stone'.

Despite its illustrious history, very little research has been carried out on this culturally important material, and myth and folk law tend to prevail, rather than hard scientific facts.

As a material, jet has experienced many boom times, the most notable being its meteoric rise to fame, followed by catastrophic collapse as a jewellery product in C19th Britain. Partly responsible for its downfall was the Victorian demand for a jet simulant. Natural reserves were running low and we witness the fledging plastics industry rising to the challenge, initially using pressed horn but then vulcanised rubber, shellac, galalith, Bois Durci, cellulose nitrate and later cast phenolics, all of which making convincing jet simulants.

Against the odds the jet industry has survived and today there are five groups of indigenous people who still work this polymer as a way of life. Somewhere deep in the human psyche it seems, we are still drawn to jet, and perhaps as humans we have always been destined to worship plastic, whether natural, semi-synthetic or of our own making.

Keywords; jet, gem hydrocarbons

P5 - Contemporary Polynesian Art in Aotearoa People, Material and Preservation

Heike Winkelbauer, Valentina Pintus (Institute for Conservation/Restoration, Academy of Fine Arts, Vienna)

Today the conservation of plastics in art is a wide field of research undertaken by conservators and conservation scientist. Nevertheless when it comes to indigenous artefacts the research has been manly focused on the identification of plastics used to imitate ivory, tortes shell, amber or other materials.

Most of us in the western world are familiar with pacific artefacts displayed in Ethnographic collection dating from last centuries. Those historic collections mainly include objects made from materials like plant fibres, wood, shells and feather so called traditional materials. With the colonisation of the pacific new art and craft material like cotton, pre made fabrics, textile dyes, yarns and many other materials became available. Not only organic materials but also manmade synthetic materials as well as metals became welcome additions to what could be gathered in the direct surroundings or had been previously traded with other pacific groups. Those materials included, oil drums, plastic buckets, bottles, synthetic beads, buttons, nylon fibres and strings to only mention a few. Consequently many artefacts made post European contact have new materials incorporated. With the large migration of Polynesian people to New Zealand many materials previously used became unavailable or could not be grown in the different climate. While the early arrivals often had traditional materials harvested by relatives and then send to New Zealand, over the years this process became too time consuming or too expensive. Instead new manmade materials produced or available in New Zealand have replaced the use of plant matter supplied from Polynesia. Nowadays many of the created works of art are made from plastics only.

To widen the focus and contribute to a deeper understanding of the contemporary Polynesian material culture in New Zealand this work presents an introduction to a wide variety of materials and designs. Furthermore results of the material identification by means of FTIR-ATR using reference samples from artists, cultural groups and as well as original materials from museum's collections in New Zealand are presented.

Keywords: plastics, research, contemporary, New Zealand, Polynesian material culture, reference samples, artists, cultural groups, museum's collections, material identification, FTIR-ATR

P6 - Polymeric materials in the historical scientific collections: various solutions to different needs

Anna Giatti (Fondazione Scienza e Tecnica, Florence)

In the field of scientific research and education practice, the experimental and didactic activity covers a considerable area, so the scientific heritage represents the testimony of ideas, processes, successes and fails,

and is worthy to be preserved and studied. Experimental activity is challenging and, when looking for solutions, materials with different features are crucial and often closely related to the function of the objects.

Shellac was the solution to a series of needs for experimenting with electricity or the main component of a varnish for the best preservation of metal and wood. Shellac had been available since the ancient time, but in the second half of the Nineteenth Century, objects made of natural, artificial, and then synthetic polymeric materials appeared, and it was a revolution. They were able to satisfy the necessity of electrical insulation and could be molded into the most effective shapes. Ebonite and gutta percha are some of them. Furthermore, rubber was perfect in scientific and technical apparatus thanks to its elasticity, but unfortunately it is particularly prone to degradation. Divulging the didactical activity, the need to reproduce natural science specimens in artificial models becomes more pressing. This need was satisfied thanks to transparent, moldable new materials. Moreover, models made of such materials are strong and can resist in the teachers' hands (or rather in the students' hands!).

The preservation of polymeric materials could be central to ensure the preservation of the cultural value of the historical scientific apparatuses and models, but it could turn out as challenging. From this point of view, the awareness of the presence of such materials and the preventive conservation measures are crucial.

Keywords: scientific and technical heritage, historical educational models, historic polymeric materials, preventive conservation.

P7 - Fashioning polyamide. Plastics in everyday life of the 1950s and 1960s

Viola Hofmann (Department of Arts and Material Culture, Technical University Dortmund)

In the 1950s and 1960s, the West German chemical fiber industry tried to establish polyamides 6 and 6.6 on the consumer market sustainably. The aim was, to position the new synthetic fibers in the textile and clothing culture, in addition to the already well-known cellulose fibers, as well as to compete with natural fibers. However, the hoped-for groundbreaking demand remained, as historical statistics show. Consumers reacted cautiously. The new textile fiber was in the everyday life of the 1950s and 1960s neither known nor proven. So manufacturers founded interest groups, which launched collective advertising for the polyamide fiber. In order to convince the customers, that's one of my theses, an entirely new poetics of materiality was created. The invention of the brand Perlon© was one step in many ways to equip the new synthetic fiber with its own narratology. Based on various historical sources, advertisements, promotional materials and catalogs for dealers and sellers, I will analyze with which semantic strategies interest groups tried to load the new material with positive meanings. By crossing literature, fairy tales, comic books and material samples, a new genre for the popularization of scientific knowledge emerged. Read against the grain, these sources reveal themselves not only as advocates of the new material, but are indicative of the resentment in everyday life. These resistances to the new material have so far received little attention in research. On the contrary, many publications speak of the positive response to synthetic fiber, although there are some sources of oral history that show deep uncertainties over the material. In my lecture I will also ask about the changes for the human senses and experiences that arose from the confrontation with the new material as well as for the role of fashion, which finally succeeded in gradually infiltrating synthetic fibers into everyday human life.

Keywords: Plastics, polyamide, new materiality, new semantics, industry, everyday life, fashion

P8 - The material legacy of oil: Moplen and domestic interiors during the Italian economic boom

Emilia Garda, Marika Mangosio, Valentina Villa (Politecnico di Torino, Department of Structural, Geotechnical and Building Engineering - DISEG)

In 1954 the chemical engineer Giulio Natta developed isotactic polypropylene, a new plastic material characterized by high chemical-physical and mechanical performances. It was patented in 1957 under the name of Moplen and produced on a large scale by the Italian chemical company Montecatini, owner of the patent.

The great application potential of this new plastic product quickly declares its commercial success: Moplen becomes a symbol of progress and development and, like other synthetic materials, a manifesto of the so-called economic boom that from the Sixties of the Twentieth century deeply innovated lifestyles and housing models. Lightweight, non-deformable, unbreakable and coloured, Moplen is initially used as a 'replacement material', re-proposing the shapes and functions of objects already in daily use, but improving their performance, and soon establishes itself as "the ideal material for the modern home".

The paper aims to illustrate how the introduction of Moplen has contributed to the transformation of traditional domestic interiors, leading them definitively into modernity.

In those years, Italy has witnessed a massive shift in population from the countryside to the city in search of new employment and from regions with an agricultural vocation to regions with predominant industrial development. Modern city life is characterized by a greater dynamism, of physical movements and in social roles, and a scan of working times increasingly obsessive. Time control is also increasingly reflected in the housing model and in particular in the management of spaces and paths in service areas within the home, such as kitchen, bathroom and closet, where all operations must be easy and contained in time and space. The spread of Moplen responds to this need for compression of time and space. The new objects for everyday domestic life, which spread like wildfire in Italian homes - such as small appliances and containers - are beautiful, efficient, compact and save time.

The reconstruction of the dynamics of everyday life of the time, which are reflected in the design of new concept living spaces, also makes use of the extensive advertising on Moplen, in particular mediated by a new mean of communication, television.

Keywords: Moplen, industrial heritage, housing models, economic boom, Italy

P9 - A brief history of polymeric materials in paints

Jorge Moniz, Susana Carvalho (OMNOVA Solutions)

One of the main ingredients of a paint is the binder, usually an organic polymer. Upon drying of the paint, the polymer will bind the pigment particles between themselves and to the substrate. Above a certain amount, a continuous plastic film is obtained, useful as a barrier between air and the substrate. However, paints have been produced for ages, long before synthetic polymers were established in the 20th century. Natural organic materials were used such as waxes, gums, resins, casein, animal glue, egg tempera or drying oils. The development of polymer chemistry based on oil-derived monomers introduced new possibilities for the formulation of paints. Alkyd resins, epoxy resins, polyurethanes, acrylic and vinyl polymers were created in a variety of compositions and properties, introducing a powerful toolbox to the paint manufacturer. Nowadays, safety, health and environmental concerns are driving innovation, removing dangerous ingredients from the formulations and searching for more natural, renewable options for the polymeric binder. The challenge is now to recover ancient knowledge and combine it with synthetic polymers technology in order to obtain novel materials that can keep or improve the paint properties, while being safe and sustainable for man and the environment.

Keywords: paints, polymers, binders

P10 - Plastor Company – A history of more than one hundred years

Ion Seres (PLASTOR SA, Oradea, Romania), Elena Helerea (Transilvania University of Brasov)

The paper deals with the history of a Romanian company involved in the production of plastics, namely Plastor, analyzing the conditions in which the evolution and diversification of the plastics manufacturing was possible in a period of over a hundred years of existence.

The paper examines the conditions in which in the year 1914 in Oradea, a private investor set up a Factory of Hair-pins and Combs. The company had 22 employees and was registered at the same address as today (175, Calea Clujului , Oradea). The production of the factory has continuously increased and diversified after the Romanian Great Unification (1918), and specially, between the two World Wars. The turning point was nationalization in 1948, when, the ownership of company is taken over by the communist state. During the transition to the centralized production, between 1949 and 1952, the factory changed its name several times and merged with other small companies, manufacturers of plastic products, sweepers, table tennis balls. In the years 1952-1959, two new production units (manufacturing molds and bakelite products) merge with the factory. In 1963, the company is getting a new name: Fabrica de Mase Plastice Viitorul (The Plastics Manufacturing Factory "The Future"), and, new capacities are developed for production of brushes and plastic houseware. Important investments are made for mold-injection and molds design and manufacturing. During the years of extensive industrialization - the 1970s - at Fabrica de Mase Plastice Viitorul, the portfolio of products is enriched by investing in new technologies: packing tapes, films, and blow molded products. The company became the largest toy manufacturer in Romania. Competencies for mold-injection and blow molding molds are increased.

The paper analyzes the conditions in which the plant was privatized after 1989, when PLASTOR Group became a joint stock company. In years 1999-2000, with the set goal to be more reactive to the market requests, the firm reorganizes as a group of companies: PERGO (brushes and self-adhesive labels), MONITA (toys and games); RECOLO (plastics recycling, production of films, bristles, packing tapes); TRANSIOR (transportation); PROMOTIC (whole-sale and retail).

In 2001, the company is restructured in 3 production divisions: Division 1: houseware and industrial products, Division 2: technical products and molds, Division 3: winter sport equipment.

New developments are done, and in 2005, it is registered the first Plastor propriety outside Bihor county (in Brasov county). In 2008, a new set-up branch, PLASTOR TRADING take over the sales and distribution of consumer goods made by Plastor Group companies. In 2013, the tolling shop of the company is re-located in a new building, on Gutenberg street, in Oradea, and in 2014 the anniversary of 100 years of the company is organised.

In this paper, new elements about company history and some measures for heritage company preservation are also presented.

Keywords: plastics, industrial heritage preservation, Plastor company history

P11 - Plastics Companies in Romania – History and Heritage

Laura Leluţiu, Elena Helerea (Transilvania University of Brasov)

Our work will focus on the history of the Romanian plastics industry, in a period of one hundred years, starting with 1918 - the yeart of unification of Romania, continuing with the interwar period and the period of the communist regime and then, the period after 1989, when a strong deindustrialisation occurred, followed by a slower recovery and the current assertion of plastics production.

In Romania, after Great Unification, the plastics industry started to develope because Romania had rich resources - natural gas and petrochemical products.

After World War II, the nationalisaton took place, and almost all companied became state-owned companies. As a result, with a centralized policy, starting with the first five-year development plan, the state funds were allocated for the creation of many enterprises producing plastics with the aim of replacing deficient materials.

Romanian rubber and plastics industry was represented by 19 large companies, 9 medium companies and 8 plastics sections in others light industry and electric/electronic companies. The total production capacities were about 500 thousand tones but only 60% were used. All the classic technologies, injection, extrusion, blow film, blow molding, thermoforming were applied in these companies. The main products were film, pipes, technical and domestic articles, PU foam unsaturated polyester etc.

Over the past years, Romania's Plastics & Rubber industry has recorded a significant increase. After 2000, the production manufactured by the Plastics & Rubber sector has followed upwards trends, outpacing the annual growth of the processing industry. Now there are currently over 600 production facilities operating in the plastics processing industry, some 300 of which contribute significantly to the total volume of processed products. Out of the latter, some 30 are large companies, most of them formerly state owned before 1990.

In the paper we do a comparative analysis on the present profiles of some of the companies in the Plastic & Rubber sector and how they understand to promote their industrial and technical heritage.

Keywords: industrial heritage, history, plastic and rubber industry, Romanian companies

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P12 - Poliversal | Plasteme moments from 50 years of commercial and industrial success: trust, quality and innovati

Inês Matoso (Poliversal invited historian/researcher)

Experience and success in trading, distribution and production of plastic products make Poliversal | Plasteme an interesting case study among companies dedicated to the immense universe of plastic and its derivatives. A look at the archives and intangible heritage allowed us to identify moments that were remarkable for the growth of the company and relevant turning points given the rapid scientific evolution of plastic materials.

Established in 1966 in Luanda by the Portuguese businessman Armando Augusto Morais, firstly Ultramar Comercial, this company had already marked its market position when being an exclusive agent of Montedison in the overseas provinces. The establishment of Plasteme in Brazil, given the political situation resulting from April Revolution, in 1974, in Portugal and Overseas, did not prevent this businessman from establishing it in Lisbon in 1977, starting a new cycle that would lead to founding Poliversal, in 1980, as a distributor of polyurethane in Portugal. In the nineties began the manufacture of masterbatches. Currently have exclusive relationships as a distribution company of prestigious petrochemical polymers in addition to produce and trade compounds and masterbaches.

We propose to share some stories that over these five decades somehow contributed to make it a reference, operating beyond the Iberian market, largely in the European and which in the last decade has opened up to the vastness of sales in China, always under the prerogative of the relationship of proximity to the customer, trust and satisfaction with the product in a permanent improvement of quality and at the forefront of innovation - Poliversal | Plasteme success in a world where the plastic industry / market becomes more competitive and innovative every day.

Keywords: Experience. Trust. Quality, Innovation. Masterbaches. Trading. Distribution. Production of plastic products

P13 - Investigation into Reasons for Disintegration of Amber with Inorganic Inclusions and Conservation Method

Jurga Bagdzevičienė, Jūratė Senvaitienė, Bronė Kunkulienė, Janina Lukšėnienė (Lithuanian Art Museum, Pranas Gudynas Restoration Center.)

The Palanga Amber Museum is a subdivision of the Lithuanian Art Museum with rich and valuable amber collections comprising unique raw Baltic amber pieces, archaeological amber finds, ancient and contemporary decorative art objects and jewelry, as well as superb collection of amber pieces containing interesting plants and insects inclusions.

A few years ago a problem associated with the condition of some amber exhibits arose. It was observed that some amber pieces and artifacts tend to disintegrate – crack or split. All these exhibits have dark grey, light grey and whitish substances either on their surfaces or inside the body.

The aim of this research was to determine the reasons for amber disintegration and to either stabilize or slow down an object's rate of deterioration by conservation measures. The substance on amber surface and inside was identified by combining the analytical methods (microchemical, optical microscopy, ATR-FTIR and XRD). The pH measurements of aqueous solution of grey masses (over-and interlayers substances) and the test of microbiological contamination of amber pieces was also performed.

Having summarized results of analyses we conclude that grey substance consists of three components: pyrite, iron (II) sulfate hydrate and silica dioxide. pH value of aqueous solution of grey substance is highly acidic and fluctuates between 2.69 and 3.15

Pyrite is found in sedimentary rock, fossils and amber with organic inclusions. Organic materials (plant, insect and other remains) are pyritized when they are in marine sediments. One of the most important chemical processes in organic-rich marine sediments is decomposition of organic material in bacterial sulphate reduction, the final product of which is pyrite.

During long-term oxidation in humid environment pyrite transforms into hydrate iron (II) sulfates, the crystals grow and expand 4-fold. A result of this process is spontaneous disintegration of amber pieces. The formation of the hydrate iron (II) sulphate creates highly acidic environment and it further tends to accelerate the oxidation of the pyrite.

Conservation of amber objects is carried out in three stages: neutralization of pyrite oxidation products by solution of ethanolamine thioglycolate; consolidation of inclusion regions with low molecular weight hydrocarbon resin Regalrez® 1094 and if the amber artefacts are fragile they are saturated with dammar resin solution; split fragments of amber are glued together with acrylate copolymer and surface of artefacts are protected with microcrystalline wax. The optimum storage and exhibition conditions for amber are provided.

Keywords: Baltic amber, pyrite, ATR-FTIR, XRD, Conservation

P14 - Optimising an ATR and Reflectance FTIR Analysis Methodology for Identifying Three Dimensional Polymeric Objects in Cultural Heritage Collections

Julianne Bell, Petronella Nel (Grimwade Centre, University of Melbourne)

The Australian collaborative project, PolyMuse, is bringing together data and resources from eight organisations to develop a framework for managing plastics in museum collections. A key aim is to collate object-oriented descriptive and analytical data from each partner organisation via the development of a relational database. However, accurate comparisons of scientific data require consistent data collection and analysis procedures.

Fourier Transform Infrared (FTIR) spectroscopy is a useful analytical tool for identifying polymers, vital for determining preservation pathways. A diamond attenuated total reflection (ATR) accessory allows high-quality infrared (IR) spectra to be recorded non-destructively on a wide range of materials over a short period of time (Picollo et al 2014). Due to items ranging in shape, size, hardness and fragility, it may not be possible for them to be clamped onto the diamond window. Instead, an IR spectrum can be obtained by pressing the object onto the window using handheld pressure. Another alternative is the use of an external reflection (ER) module, which removes the need for contact with the object, and may be preferential for use with particular polymers (Cucci et al 2014; Saviello et al 2016).

For this paper an investigation was conducted into the development of a project reference collection, spectral library and FTIR measurement process for identifying three dimensional polymeric objects in the museum context. Various elements of the measurement process were investigated for 12 polymer types and case study objects from the cultural heritage perspective. These include:

- A comparison of ATR and ER modules;
- The difference between clamping and manually holding objects in contact with the ATR window;
- Use of three different size windows with the ER module;
- Number of co-added scans from 8 to 128, resultant time taken to collect each measurement and associated OHS and time management issues;
- The impact of these elements on signal to noise ratios (S/N); and
- Use and availability of reference spectra and material samples.

Keywords: Fourier transform infrared spectroscopy; polymer identification; non-invasive analysis; reference spectra; reference materials; methodology development

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P15 - A System Dynamics Approach to Modelling Degradation in Cellulose Acetate Film

Ida Ahmad, Katherine Curran, Simoni da Ros, Isabella del Gaudio, Argyro Gili (UCL Institute for Sustainable Heritage), Deborah Cane, Joyce Townsend (Tate, Tate Britain), Luca Mazzei (UCL Chemical Engineering)

Historic Polymeric Materials (HIPOMS) present significant conservation challenges in museum and archival collections. Over the last twenty-five years many chemical and physical degradation processes in these materials have been identified. However, there are still open questions about the best approaches to the storage and display of HIPOMS in museums and archives. A key problem is that although there is awareness of specific degradation mechanisms, the ways in which these interconnect to produce observed damage phenomena is not well understood.

An example is cellulose acetate (CA), which is important historically as one of the first semi-synthetic polymers. It was used for film reel and photographs, and also as a hard plastic in artworks and social history objects. Unfortunately, this material is unstable in the long-term, putting these cultural artefacts at risk.

As it degrades, CA produces acetic acid. The presence of acid causes further harm to the material. The choice of enclosure for CA objects is important from a conservation perspective as it determines the acid levels to which the object is exposed. In this poster, we investigate the impact of using tightly sealed or open storage containers for storing CA film, using a system dynamics model.

It was found that under recommended conditions for temperature and relative humidity, the expected lifetimes were substantially shorter than those predicted by guidelines developed for film stock. The lifetimes were significantly affected by choice of enclosure. The findings imply that we are potentially underestimating the risk to film collections. Practical outcomes from this research could be development of new guidelines, based on our more holistic approach to understanding degradation processes. These will enable conservators to make better-informed decisions about how to store CA film.

Keywords: Cellulose acetate, mathematical modelling, system dynamics

P16 - Collecting plastic emotions

Pina di Pasqua, Alice Hansen (Fondazione Plart)

About forty ago Maria Pia Incutti, an Italian collector, started gathering plastic objects coming from all over the world. After many years, in 2008, this collection became the heritage of the Plart Museum, Naples, Italy.

These objects were selected not basing on historical or scientific criteria but on emotional ones, both individual and collective. The Plart Collection is full of examples of "emotional" objects: indeed mostly feelings and a sensorial approach led the collector in the research of the plastic lamps, boxes, jewels, lamps, chairs that are now part of the permanent collection of the Museum. Since the very first use of plastics in the world of design we can find an emotional use of these materials. In fact, in commercial objects, made in materials such as Bakelite, Formica or Bandalasta, we can find emotional aspects: Brokes and Adams, for instance, promoted its products persuading customers with a variety of beautiful marbled and translucent pastel shades of Beatl, it being such stuff dreams are made on – dreams that last! In the period following the two world conflicts, materials such as acrylic, fiberglass, polyethylene and soft and rigid polyurethane foam revolutionized the production technologies, the aesthetics of our daily life and our relationship with objects. From that moment on, design, in addition to dealing with the shape of industrial goods, has been also involved in analysing the possible constructional and expressive applications of the new materials. Design, therefore, becomes a ground for comparison between research and social application; emotions often have a role in the designing of artefacts and they can sometimes be more important than the actual functional characteristics. The choice of materials frequently contributes to the perception we have of the objects. How has Plart decided to convey its extraordinary collection? Naturally, exhibitive choices too were based on an emotional impact.

Keywords: plastics, collecting, design, emotions, plastic objects companies

P17 - Conservation of natural rubber, which solutions for which degradations

François Duboisset (The CRAAC (Conservation restauration d'art ancien et contemporain))

A masterpiece of design and American modernism: a MAA chair (1958) of George Nelson, kept in the Modern art Museum of Saint-Etienne in France was restored. We will first see the scientific approach to remedy the degradation of natural rubbers on the chair. And after ten years of experience, what are the new possibilities of consolidation, more in line with the ethics and ecology.

The main alteration on the chair was the degradation of rubber pieces between the backrest and the seat. They were heavily cracked with a significant loss of flexibility, due to photo-oxidation associated with mechanical forces. These alterations were considered to be unstable and progressing.

The specification for the restoration was to consolidating resin which is flexible, adhesive on rubber, UV resistant, stable in time and reversible. Due to a lack in bibliography, we had to perform numerous tests with resins used in conservation and in the industry. Three resins were retained: ethylene vinyl acetate (EVA), thermoplastic elastomer, present in the BEVA; ethylene butyl acrylate, close to the EVA; a polyurethane-ether emulsion, ImpranilDLV/1. A protective agent, Tinuvin B75, is added to each resin to increase its stability to photo-oxidation.

Some samples of natural rubber were artificially aged in a light enclosure. The adhesives were deposited diluted in cyclohexane on the samples and then artificially aged a second time. Comparative peeling and stretching tests combined with chemical characterization by FTIR of the damage were performed to determine the optimal parameters for adherence and protection. The cyclohexane solution with 5% ethylene vinyl acetate and 0.25% Tinuvin B75 fulfilled the specifications of the consolidation and protection of the rubbers with a flexibility similar to the MAA chair rubbers

Keywords: …

P18 - Degradation of plastic art: What to do?

Erich Jelen (Fraunhofer UMSICHT)

Art can be timeless, but no piece of art can resist all the time: Stone crumbles, paint cracks, and plastics break down, chemical bond by chemical bond. Polymer degradation can be invisible, so conservators do not always know how much an object has degraded.

Almost all plastics lose their functionality over the time they are used, they may darken with time, as harsh light conditions transform their polymeric ingredients into yellow, orange, or brown molecules. Additionally, light and temperature fluctuations combine with oxygen and humidity in the air to break apart the polymers that make up the plastic. The degradation products tend to leach, joining an exodus of plastic additives included in recipes to make the material malleable or to protect it from ultraviolet light or heat. As essential components exit the plastic pieces, artwork begins to crack and crumble.

The characterization of the material and the status of degradation are the first steps to work out a strategy for conservation.

In the presentation there will be shown an idea of the different types of degradation of plastics, how to characterize the material (different analytical methods) and first development of new bio-based polymers for conservation.

Keywords: degradation, conservation, characterization, material

P19 - Study on Thermoplastic Synthetic Polymers Used as Supports in Contemporary Art Works

Maria Leite (Agrupamento de Escolas Raul Proença; Centro de Investigação e de Estudos em Belas-Artes, FBAUL, Departamento de Ciências da Arte e do Património), Ana Bailão (Centro de Investigação e de Estudos em Belas-Artes, FBAUL, Departamento de Ciências da Arte e do Património), Maria Araújo (FCUL. Departamento de Química e Bioquímica)

Synthetic thermoplastic polymers are present not only in daily life but also in works of art. The experimental impetus of contemporary artists takes them to use in their works diverse and unconventional materials, often construction materials, such as plastic wall paints, plastic covering membranes, electrical components, furniture, among others (Ubieta, 2011). It is therefore necessary to identify these polymers, to study their characteristics and their behaviour towards some external agents, such as visible and ultraviolet radiation, temperature, the ambient humidity or even in some cases, water in the liquid state and oxygen (Shashoua, 2008).

The research presented here aims to identify the plastic used by the Portuguese painter Daniel Vasconcelos Melim as a support for his paintings made in acrylic paint; to study its physical and chemical properties and to identify the most frequent change phenomena (Scicolone, 2009).

For the identification and comparative study of the plastic used, the following tests were performed: Visible and Ultraviolet Spectroscopy; Infrared Spectroscopy with Fourier transform - FTIR; density measurements and solubility tests in different solvents; pyrolysis and flame tests. All these tests were made on samples of RENOLIT – SE , a PVC thermoplastic membrane brand from different years, namely 2011 and 2018, material used by the artist in his paintings.

Aging tests were also carried out on membrane samples for 67 days, at room temperature of 21 °C and at 70 °C (Shashoua, 2008) in order to identify some alteration phenomena such as: colour change and loss of mass.

Keywords: Thermoplastic Synthetic polymers; PVC Membranes; Contemporary Art; Daniel V. Melim

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P20 - Selected ion flow tube-mass spectrometry (SIFT-MS) in heritage science: non-invasive VOCs profiling of natural and synthetic resins

Francesca Modugno, Jacopo La Nasa, Ilaria Degano, Fabiana Cordella, Adele Ferretti, Maria Perla Colombini (Department of Chemistry and Industrial Chemistry, University of Pisa)

The identification of artistic materials and the study of their degradation pathways is crucial to define the best conservation strategies. At present, the identification at a molecular level of organic materials in heritage objects requires in most cases the collection of micro-samples followed by micro-destructive analysis, after specific sample pretreatments.

In the last years the analysis of volatile organic compounds (VOCs) released by organic materials in heritage objects has been investigated as a quantitative and/or qualitative approach to non-destructively achieve information on: composition of materials, degradation processes, and air quality in confined enviroments. In

particular, solid phase micro extraction-gas chromatography mass spectrometry (SPME-GC/MS) has been used for the analysis of VOCs emitted from plastic materials, such as nitrocellulose and polyurethane, and for the study of the degradation of paper. The same approach has also been applied in the analysis of organic residues in archaeological residues. However, VOCs analysis by SPME strategy can't be performed in real time in-situ, and the results are influenced by the sampling step. For this reason we explored the potential of a mass spectrometry instrumentation that allows to perform VOCs analysis in real-time: selected ion flow tube-mass spectrometers (SIFT-MS). SIFT-MS is a direct mass spectrometric technique, recently introduced as a portable device, which achieves quantitative analysis of VOCs at trace levels, by applying precisely controlled ultra-soft chemical ionization. This approach avoids sample collection and preparation, and at the same time bypasses the pre-concentration and chromatographic steps required by SPME-GC/MS analysis. Eight different chemical ionization agents are generated in situ to react with VOCs in controlled ion-molecule reactions, providing enhanced selectivity. In this preliminary study, we explored the possibility to identify natural and synthetic resins used as paint varnishes by SIFT-MS on the basis of the VOCs released by the materials. We will present the results obtained on the analysis of the natural resins dammar, mastic and colophony, and of the synthetic resins Paraloid B67, Regalrez 1094, PVAc, and MS2A.

Keywords: volatile organic compounds, non-invasive analysis, natural resins, synthetic resins.

P21 - Pratone: planning the preservation of an icon

Alice Hansen (Fondazione Plart), Giovanna Cassese (Istituto superiore per le industrie artistiche), Gabriella Russo (Accademia di Belle Arti di Napoli), Maria Antonietta Di Marco (student)

Pratone is an informal armchair designed by Giorgio Ceretti, Pietro Derossi and Riccardo Rosso and produced by the Italian furniture brand Gufram. The seat is made of polyetherurethane expanded foam and finished with the patented formulation *Guflac*. It features huge, flexible artificial stalks people can jump on to and sink in: a radical project, an icon of the anti-design cultural revolution of the 70ies that subverts the domestic landscape. *Pratone* is part of the series *Multipli Fun-Foam*, sculptural art objects showing the influences of the artistic tendencies of the period such as Pop Art. They are industrially reproduced in limited editions, with a uniqueness and handicraft component. The object was designed 1966 and it was first produced in 1971 (a limited edition of about 200 pieces), so it probably dates 1966-1970. In 1972 the MOMA of New York dedicated an exhibition to Italian design, consecrating such objects to the history of design. A second production was re-activated for a limited edition about 20 years later. The *Pratone* pertaining the Plart collection is an original prototype, acquired by a precedent private Italian collector in 1984, in an auction that took place in Germany. During the years to follow it underwent a conservation treatment and it travelled in occasion of two temporary exhibitions. Since 2008 it's part of the Plart collection and even though it has laid in good conditions for almost ten years, it currently shows a bad state of preservation. Plart has activated a collaboration with the Conservation of Synthetic Materials Course of the Academy of Fine Arts of Naples in order to launch a conservation project for the *Pratone*, allowing the students to work on an original and iconic art object, under the supervision of the teachers and Plart's conservators. The project will take place during the whole academic year 2018/2019 and it will allow for the general and specific historical study, the mapping of degradation and a conservation treatment. Most important, it will aim at finding a permanent exhibitive solution in the museum's spaces.

Keywords: expanded polyurethane, conservation, design, plastic objects companies

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P22 - Conservation and active "post-stabilization" of plastics in cultural heritage

Yvonne Hed, Asbjørn Iveland, Erik Nygaard, Harry Øysæd, Jorunn Nilsen (Norner Research AS)

Plastic degrades with time and are often designed for a certain service lifetime. The cultural heritage made by plastics stored in museums and collections for future generations is often not aimed for long time storage and will degrade. To actively increase the service-lifetime of ready-made plastics is very complicated and complex. Active methods for increased service lifetime of ready-made plastics are seldom available. Usually, the conservation approach is mainly directed towards controlled storage condition and/or cleaning of the plastic surfaces. In the industry the stabilization of plastic is made by mixing in stabilization molecules to the plastic melt during the processing.

This project approaches the meeting between researchers that design plastics for certain service lifetimes defined by the market needs, and museum conservators, with the aim to extend this inherent service lifetime of pre-made plastics to infiniteness. In the project, research is performed to actively increase the service lifetime of ready-made plastics by "post-stabilization". Degradation of the plastics is studied by use of accelerated ageing to predict service lifetime after treatment.

In this talk, the progress in the project and the initial project results and strategies to decrease the degradation rate of plastics will be presented.

Keywords: Post-stabilization, plastics, service lifetime, accelerated ageing, degradation

P23 - Optimization of Microbiological Sampling Methods for Light Sensitive Layer of Historical Photographic and Film Materials

K. Hricková, B. Benetková, M. Nováková, M. Ďurovič, V. Knotek (UCT Prague, Department of Chemical Technology of Monument Conservation), H. Sýkorová, J. Kadavá, D. Savická, K. Demnerová (UCT Prague, Deprtment of Biochemistry and Microbiology)

Light sensitive layer of various photographic materials if often their least resistant part; its susceptibility to mechanical damage or risk of swelling in an aqueous environment may be a limiting factor in the choice of microorganism sampling method for detailed microbiological research of biodiversity of molds and bacteria causing biodeterioration. The aim of this study was to investigate the gentleness of several microbiological sampling methods (dry wipe with cotton stick, dry wipe with brush, imprint of wet filter paper with culture

medium, imprint of dry sponge, imprint of dry velvet, imprint of Hygicult medium) to chosen historical black and white photographic and film materials (nitrate, triacetate and PET films with gelatin layer, albumin papers, glossy and matt collodion papers, silver gelatin papers on baryta or RC paper, dry gelatin plates). For this purpose, the appearance of the surface of the light-sensitive layer was evaluated by means of scanning electron and optical microscopy (both light microscopy in polarizing microscope and digital microscope in reflected light with different observation angels) as well as by profilometry. Residues of culture media were determined by surface mapping by infrared spectroscopy. Our results are necessary basis for the optimization of microbiological sampling method: it shows that the most resistant to any changes are albumen and collodion papers, which is due to its adjustment to cardboard. The only method which does not cause any changes (scratches, residues of fibers or culture medium) on all tested samples is the imprint of dry polyurethane sponge. Thus, this is a promising method, which can be used in practice.

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Keywords: historical photographic and film materials; microbiological sampling methods; biodeterioration; scanning electron microscopy; optical microscopy

P24 - High-risk neighborhoods ... Spectacles made of cellulose nitrate and cellulose acetate

Judith Huber (State Academy of Art and Design Stuttgart, Objects' Conservation Master programme)

Vision aids such as spectacles are systematically collected since more than 100 years. They are not only part of private but also public and museum collections where they are considered to be culturally and design historically very interesting and informative since they have extremely varied historical and geographical provenance. As composite objects of different organic and inorganic materials, spectacles show a range of degradation mechanisms. They show traces of usage, care and repair of their owners and the opticians which influence their ageing. Their preservation is consequently as interesting as challenging. Apart from what professionals noted down since the end of the 19th century, hardly any specific conservation literature on the subject exists.

Since the late 19th century ground glasses were regularly framed in cellulose nitrate and later often acetate. As part of the author's Master thesis specific degradation phenomena of cellulose nitrate and acetate frames were observed, based on a survey of the remarkable spectacle collection of the Institute for the History of Medicine, University of Berne, completed by further examples with particularly typical damage patterns of a private spectacle collection with additional information about the objects history and handmade manufacturing techniques by the owner, a optician. All of the worn cellulose nitrate spectacles e.g. show typical crack and fracture patterns on bridges of the nose as well as at the temple ends.

Very obvious are the varied and typical degradation phenomena of cellulose nitrate and acetate frames with strongly corroding metal parts, as e.g. regularly the basic copper nitrate $Cu_2(NO)_3(OH)_3$, investigated using EDX/SEM, µ-Raman and FTIR spectroscopy. Acidic fumes from degradation also damage other nearby stored objects such as iron frames, generating a rust film which catalyses the degradation of polymeric and other materials.

A well-planned storage concept with preventive measures is therefore essential in the preservation of spectacle collections. The main focus lays on reducing the catalysts effect of various degradation products of material combinations.

Keywords: spectacles, composite objects, cellulose nitrate, cellulose acetate, degradation, basic copper nitrate, acidic fumes, catalyst effect

P25 - Influence of relative humidity and acetic acid concentration in the air to the loss of plasticizers from cellulose acetate material of the Transparent Figures of the Deutsches Hygiene-Museum Dresden

Benjamin Kemper (Academy of Fine Arts Dresden (HfBK))

In the early 20th century the new synthetic material cellulose acetate (CA) made it possible for the first time to produce a fully transparent frame of the human body.

These Transparent Figures are among the best-known objects produced by the Deutsches Hygiene-Museum. Since 1930 they have been shown to millions of visitors as part of permanent, special and touring exhibitions and became iconic exhibits. Even today they are key objects in the permanent exhibition of the Deutsches Hygiene-Museum.

Nowadays these various Transparent Figures show signs of significant damage. Especially the rapid chemical degradation of the CA causes a various number of damages.

One degradation phenomenon is the loss of plasticizers. The relative humidity and the concentration of acetic acid in the air seem to be two main influencing factors.

The aim of this study is to investigate how the relative humidity and the concentration of acetic acid in the air influence the loss of plasticizers.

For the investigation original cellulose acetate from the production of the Transparent Figures was artificial aged under various relative humidity conditions (30, 50, 70 %) with increased temperature as well as in atmospheres with different concentrations of acetic acid (up to 70 ppm) at room temperature. After that a novel extraction procedure [1] was used to quantify the remaining content of plasticizers in the CA by gas chromatography and mass spectrometry.

The results show that dimethyl phthalate (DMP) and diethyl phthalate (DEP) are more affected by the relative humidity than the other plasticizers in the CA. The content of the plasticizer with the highest concentration triphenyl phosphate (TPP) is in contrast very heterogeneously.

Furthermore, a higher concentration of acetic acid in the air causes the formation of a liquid on the material. This phenomenon is currently under investigation.

[1] submitted

Keywords: Degradation, cellulose acetate, plasticizer, acetic acid, relative humidity, GC/MS, artificial aging

P26 - Synthetic materials in the modern library collections – PVC bookbindings

Vítězslav Knotek, Petra Vávrová (The National Library of the Czech Republic in Prague, Collections Preservation, Development and Research Laboratories), Radka Kalousková (University of Chemistry and Technology in Prague, Department of Polymers), Jitka Neoralová, Nikola Šipošová, Dana Hřebecká (The National Library of the Czech Republic, Collections Preservation, Development and Research Laboratories)

Each book is primarily composed of paper block and a bookbinding. In modern library collections (after the year 1800), a bookbinding in many cases contains parts composed of synthetic materials. Different types of plastic materials have a different mechanism of degradation. Therefore, the main goal of this work is the non-destructive identification of synthetic materials in bookbinding, their degradation processes and methods of conservation, storage and preventive care as well. Based on the preliminary results of the survey of the collection in the National Library of the Czech Republic, the most usual types of synthetic materials in bookbinding are cellulose nitrate, cellulose acetate, polyethylene, polymethylmethacrylate, and polyvinyl chloride, both solid or plasticized. Plasticized polyvinyl chloride (PVC-P) represent very problematic case due to the releasing of plasticizers into surroundings. A further problem can be caused by the possible releasing of highly corrosive hydrochloride due to the exhausted stabilizers.

This work is focused on the research of several PVC-P bookbindings produced in the 1950s, 1960s and 1970s. The condition of bookbindings was studied by IR spectroscopy, dynamic mechanical analysis, nuclear magnetic resonance and extraction by diethyl ether. The content of stabilizers was analyzed by the velocity of hydrochloride release during heating of PVC-P samples. The results show that glass transition temperature corresponds to ambient temperature for some samples, which results in the raising of brittleness and decreasing of flexibility. The lowest content of stabilizers is present in the samples manufactured in the 1950s. However, none of the tested samples release hydrochloride at ambient temperature.

The authors would like to acknowledge the Ministry of Culture of Czech Republic for financial support within the framework of the Program of Applied Research and Development called NAKI (project no. DG18P02OVV001).

Keywords: non-destructive survey; bookbinding; degradation; plasticized polyvinyl chloride

THURSDAY

8:30 – 9:45 SESSION A – Preservation, conservation, characterisation

- Investigating conservation materials for painted PMMA: Comparing light-aged BMA resins with nano thermal analysis, Donald Sale, Angelica Bartoletti, Laurent Bozec, Marianne Odlyha

- Strategies for teaching polymer chemistry in the cultural heritage field, Rebecca Ploeger, Jocelyn Alcantara-Garcia

Collective discussion

Poster flash presentation: P27 – P37

- P27: Preservation Methodology for Acidic Plastic Objects in Estonian National Museum, Karoliine Korol

- P28: PlasCO_2 - Green CO_2 Technologies for the Cleaning of Plastics in Museums and Heritage Collections, Joana Lia Ferreira, Ana Aguiar-Ricardo, Sara Babo, Teresa Casimiro, Maria Natália Dias Soeiro Cordeiro, Susana França de Sá, André Melo, Maria João Melo, Anita Quye, Ana Maria Ramos, Yvonne Shashoua, Filipe Teixeira, Joana Tomás Ferreira

- P29: Cesar's expansions: the challenge of polyurethane foam consolidation and the colorimetry contribution to reinstatement, Marjorie Nastro, François Duboisset

- P30: On the trail of Celluloid in Portugal, Artur Neves, Maria João Melo, Maria Elvira Callapez

- P30A: NEMOSINE: Innovative packaging solutions for storage and conservation of 20th century cultural heritage of artefacts based on cellulose derivatives, Ana Maria Ramos, Artur Neves, Élia Roldão, Joana Silva, Eva Marisole Angelin and Maria João Melo

- P31: Cellulose acetate in works of art: exploring the causes of its degradation, Sofia Nunes, Eva Mariasole Angelin, Sara Babo, Artur Neves, Maria João Melo

- P32: Modern Paint Composition and Limits: Material characterization and degradation processes, Valentina Pintus, Manfred Schreiner

- P33: Development of a framework for assessing the light stability of plastic objects in heritage collections, Anna Pokorska, Lindsay MacDonald, Elise Talgorn, Boris Pretzel, Stuart Robson, Katherine Curran

- P34: The challenge of time – Restoration of a 1960s PVC sculpture, Sara Russo, Simone Caglio, Tommaso Poli, Bruna Mariani, Isabella Villafranca-Soissons

- P35: Towards conserving PMMA in art and design: investigating solvent impact and aging with nano thermal analysis, Donald Sale, Angelica Bartoletti, Laurent Bozec, Marianne Odlyha

- P36: Use of PLA and ABS in 3D printing for Fine Art. Analysis of filament and print composition and long term behaviour, Margarita San Andrés, Ruth Chércoles, Eduardo Navarro, José Manuel de la Roja, Javier Gorostiza, Elena Blanch

- P37: Synthetic materials in the modern library collections – national project, Petra Vávrová, Jiří Brožek, Jitka Neoralová, Dana Hřebecká, Nikola Šipošová, Michaela Čermáková, Lucie Koukalová, Vítězslav Knotek, Radka Kalousková, Lenka Malinová

SESSION B – Preservation, conservation, characterisation

- From microfibres to nanogels-conservation cleaning of plastics heritage, Yvonne Shashoua, Margherita Alterini, Gianluca Pastorelli, Louise Cone

- Identification of methodological protocols for the conservation of design plastic objects, Alice Hansen, Antonella Russo, Leonardo Borgioli

- Characterization of synthetic polymers in heritage: a new approach to investigate multi-material objects, Francesca Modugno, Jacopo La Nasa, Greta Biale, Francesca Sabatini, Ilaria Degano, Barbara Ferriani, Antonio Rava, Maria Perla Colombini

Collective discussion

9:45 – 10:35 SESSION A – Preservation, conservation, characterisation

- Degradation of closed-cell polyester urethane museum objects. Description, analysis of damage phenomena and preventive conservation, Elena Gómez-Sánchez, Susanne Brunner, Janine Köppen, Giulia Mazzon, Corentin Chaussat, Cédric Bouallag, Rebecca Zabar

- The Plastics Identification Tool: how to identify without analytical equipment, Suzan de Groot, Carien van Aubel, Olivia van Rooijen, Henk van Keulen, Lydia Beerkens

Collective discussion

SESSION B – Preservation, conservation, characterization

- Where Science meets Practice: Investigation of Synthetic Organic Materials and their Challenges at the Department of Conservation-Restoration of Modern and Contemporary Art at the Academy of Fine Arts Vienna, Valentina Pintus, Martina Pfenninger Lepage, Gerda Kaltenbruner

- Hard Rubber – Identification, Deterioration, and Treatment, Louise S. Beck, Clara Deck

Collective discussion

10:40 Meeting point to excursion to Leiria

13:00 – 14:30 Lunch (*Grelha* Restaurant)

15:00 – 16:00 Film viewing "All Things Bakelite" by Hugh Karraker (great grandson of Leo Baekeland) followed by debate

Round table: Hugh Karraker, Jeffrey Meikle, Robert Friedel, Susan Mossman, Tom Fisher, Penny Sparke, Jaime Rezola Clemente, Miguel Ritto, Paulo Almeida, Tiago Coelho, Pedro Gonçalves. Moderator: Maria Elvira Callapez

16:00 – 18:30 Visit to Plastics Exhibition at Museu Leiria (Vânia Carvalho, Sara Marques da Cruz)

Welcome reception, canapés and drinks will be served by the Mayor of Leiria

19:00 Departure to Lisbon

30 MAY 2019

Session A - Preservation, conservation, characterisation (8:30 – 9:45)

Investigating conservation materials for painted PMMA: Comparing light-aged BMA resins with nano thermal analysis (8:30 – 8:50)

Donald Sale (Art Conservation & Research, London), Angelica Bartoletti (Tate Conservation Department, formerly Division of Biomaterials & Tissue Engineering, Eastman Dental Institute, University College London), Laurent Bozec (Faculty of Dentistry, University of Toronto, formerly Division of Biomaterials & Tissue Engineering, Eastman Dental Institute, University College London), Marianne Odlyha (Department of Biological Sciences, Birkbeck, University of London)

Butyl methacrylate (BMA) resins have been used by artists as varnishes since the 1930s. Their exceptional clarity, resistance to yellowing, and solubility in aliphatic hydrocarbons have also been recognized by conservators, who have used BMA resins in treatments of oil paintings and PMMA art and design. Since the 1950s however, reduced solubility due to crosslinking has been identified in aged BMA. While these findings led conservators to discontinue their use as varnishes for oil paintings, BMA resins continue to be used for the treatment of PMMA, and as artists' varnishes for acrylic paintings. Further information concerning crosslinking of BMA under museum lighting conditions is warranted.

This presentation describes an investigation of conservation materials for painted PMMA that uses Nano Thermal Analysis (nano-TA) to characterize glass transition temperature (Tg) behavior associated with crosslinking due to light exposure and aging. Samples of 1:1 Paraloid B-67 (piBMA) / Paraloid F-10 (pnBMA) were exposed to museum lighting conditions (ambient, accelerated artificial, or indoor sunlight) for approximately 16 weeks, followed by natural aging for 23 years. The samples had not yellowed, and no molecular differences were identified initially, but Dynamic Load Thermal Mechanical Analysis (DLTMA) revealed a trend in bulk sample material Tg, suggesting increased crosslinking density related to the lighting conditions. Nano-TA corroborated the trend of Tg on the sample surfaces.

The trend in crosslinking density identified in these BMA samples suggests reduced solubility after exposure to museum lighting for a period equivalent to a temporary exhibition, followed by natural dark aging. While further investigation is necessary, these findings are compelling and may influence the continued use of BMA resins as conservation materials.

Nano-TA is useful for characterizing localized surface Tg associated with crosslinking of synthetic mediums due to aging conditions, and differences between surface Tg at nano-scale resolution and sample-averaged Tg of bulk material. In contrast to bulk thermal analysis, which involves lengthy procedures and comparatively large samples, the nano thermal probe enables rapid multiple and localized surface measurements, 40 in this study, without destroying the samples. Nano-TA appears useful in identifying environmental risks which influence conservation material selection and artist medium preservation.

Keywords: butyl methacrylate resins, crosslinking, glass transition temperature, dynamic load thermal mechanical analysis, nano thermal analysis, Paraloid B-67, Paraloid F-10

Strategies for teaching polymer chemistry in the cultural heritage field (8:50 – 9:10)

Rebecca Ploeger, Jocelyn Alcantara-Garcia (Department of Art Conservation, University of Delaware)

Plastics are becoming part of our cultural heritage. The type and variety of synthetic polymeric materials in collections is continuously increasing – design objects, sculpture, paints, conservation materials, audio/visual

equipment, etc. They range from art objects to practical materials, from composites to modern 3D printed items. As emerging conservators seek to tackle new issues in collections, knowledge of polymers and their stabilities and properties over time is critical. With this, educators are faced with the evolving challenge of engaging non-chemistry major students with complex polymer chemistry topics. A strategy to help art conservation graduate students absorb vast amounts of information while getting practical hands on experience with polymeric objects is to have them observe and to analyze damaged and degraded synthetic objects. Much like a conservation treatment, the student is encouraged to develop an in-depth connection with object – they should consider the context of the object, and look for tangible and visual clues of degradation that can be backed-up with scientific analysis, though human senses should not be dismissed. For example, the degradation of cellulose acetate via deacetylation is detected quickly by the human nose as "vinegar syndrome". This paper will describe strategies from the UD/Winterthur and SUNY Buffalo State art conservation graduate programs, both which can be used as strategies to teach polymer chemistry in other fields. WUDPAC teaches a first year of science that includes polymer chemistry, including synthesis, degradation and case studies, all which can be applied to a uniquely tailored research project during their second year. At SUNY Buffalo state, science classes are taken throughout both the first and second year, with a semester course dedicated entirely to polymer chemistry, with a term-long independent study on a degraded polymer object.

Keywords: Education, Art Conservation, Polymer Chemistry

P27 - Preservation Methodology for Acidic Plastic Objects in Estonian National Museum

Karoliine Korol (Estonian National Museum)

Preservation of plastics is a puzzling task and what makes it even more complicated is the fact that some older plastics become acidic over time. Not only does the acidic artifact promote hydrolysis of the object, it also creates an acidic environment. The primary materials emitting acids are cellulose nitrate (nitric acid), cellulose acetate (acetic acid) and vulcanized rubber (sulphuric acid).

Preventive conservation literature prescribes separation of acidic artifacts from others. The storage area needs to be well ventilated and the items open to circulating air to avoid accelerated deterioration. In practice, this set-up is costly and often difficult to achieve.

Many museum storage spaces house artifacts by type, eg. combs on one shelf, spectacles on another. By separating these item types out by materials instead causes unnecessary confusion for those managing the collections. The perpetual issue of space constraints compounds the storage problem, in that the well-ventilated shelf is not to be found.

How then to isolate the acidic items from other artifacts without physically moving them elsewhere? - put them in their own container! The risks of acidic compounds in a sealed container need to be addressed however so these compounds do not accumulate and begin to leak out. There is a need for the container itself to absorb the acids. The Estonian National Museum has developed a storage box that addresses this need by using archival card, acid-free tissue and microclimate filtration material.

Acid-detection strips confirmed that the microclimate filtration material succeeded in absorbing nitric acid, acetic acid and sulphuric acid in the closed container. The microclimate filtration material, adhered to the lid of the box, maintained environmental neutrality and did not permit the acid gas to leak into the environment outside of the box thereby ensuring that nearby items would remain unaffected. This system was deployed by ENM in the summer of 2018 and monitoring continues. Current estimations recommend renewing the storage box materials at least every 3 years, depending on the speed of degradation of the item contained.

Keywords: acidic, cellulose acetate, degradation, nitrocellulose, off-gassing, preservation

P28 - PlasCO_2 - Green CO_2 Technologies for the Cleaning of Plastics in Museums and Heritage Collections

Joana Lia Ferreira (Dept of Conservation and Restoration, LAQV-REQUIMTE - FCT NOVA), Ana Aguiar-Ricardo (Dept of Chemistry, LAQV-REQUIMTE - FCT NOVA), Sara Babo (Dept of Conservation and Restoration, LAQV-REQUIMTE - FCT NOVA), Teresa Casimiro (Dept of Chemistry, LAQV-REQUIMTE - FCT NOVA), Maria Natália Dias Soeiro Cordeiro (LAQV-REQUIMTE/Dept of Chemistry and Biochemistry - U. Porto), Susana França de Sá (Dept of Conservation and Restoration, LAQV-REQUIMTE - FCT NOVA), André Melo (LAQV-REQUIMTE/Dept of Chemistry and Biochemistry - U. Porto), Maria João Melo (Dept of Conservation and Restoration, LAQV-REQUIMTE - FCT NOVA), Anita Quye (Centre for Textile Conservation and Technical Art History, History of Art, School of Culture and Creative Arts, University of Glasgow), Ana Maria Ramos (Dept of Chemistry, LAQV-REQUIMTE - FCT NOVA), Yvonne Shashoua (Environmental Archaeology and Materials Science, National Museum of Denmark), Filipe Teixeira (LAQV-REQUIMTE/Dept of Chemistry and Biochemistry - U. Porto), Joana Tomás Ferreira (Deptof Conservation and Restoration, LAQV-REQUIMTE - FCT NOVA)

The conservation of 20th and 21st century collections is paramount for the sustainable preservation of Cultural Heritage. The presence of historic polymeric materials is ubiquitous in such collections, raising novel challenges in devising future conservation efforts. Unfortunately, satisfactory solutions to this problem are yet to be established.

The project PlasCO_2 - Green CO_2 Technologies for the Cleaning of Plastics in Museums and Heritage Collections will tackle the application of Supercritical Carbon Dioxide (CO_2) to the cleaning of modern materials, with the aim of developing a novel green cleaning technology for the long-term preservation of 20th and 21st Century Cultural

Heritage. Proof-of-concept for this technology has been achieved in recent years [1], however, fine-tuning such methods requires a multi-disciplinary team of natural–engineering-social sciences and humanities. PlasCO_2 gathers experts from these fields that share a common motivation to implement such technological advances. In particular, the project will explore the cleaning of poly(methyl methacrylate) and polyurethane using supercritical CO_2 at different conditions, and provide accurate measurements of the visual, chemical and thermo-physical properties of these materials before and after treatment. The data gathered within this project will provide new insights on how the properties and composition of these plastic materials relate to the outcome of different cleaning protocols. A Machine Learning strategy will be employed to highlight the relationships between the physical and chemical properties of these materials before treatment and the conditions of the cleaning procedure, with the ultimate goal of providing a user-friendly computational tool for determining the optimal treatment conditions and expected outcome. At the end of the three-year project, PlasCO_2 will provide novel solutions and protocols for the cleaning of 20th and 21st century cultural heritage, using an environmentally friendly approach.

Keywords: Green CO_2 technologies; 20th and 21st C. Heritage Preservation; Plastics Cleaning; Machine Learning

References:

[1] Sousa, M., Melo, M. J., Casimiro, T., & Aguiar-Ricardo, A. The art of CO2 for art conservation: a green approach to antique textile cleaning. Green Chemistry 2007;9(9):943–947.

P29 - Cesar's expansions: the challenge of polyurethane foam consolidation and the colorimetry contribution to reinstatement

Marjorie Nastro, François Duboisset (The CRAAC (Conservation restauration d'art ancien et contemporain), Marseille)

The expansions of the work art are fading, affirming an identity out of control. They constitute the sign of a renunciation of the total matter control and the acquiescence of the material which can last more by putting forward its intrinsic physical and mechanical qualities. Chance, duration, entropy are coauthors of a work where the creator organizes a dance that eludes him voluntarily.

The Chance, duration and entropy are the art coauthors where the creator organizes a dance that voluntarily eludes him.

In 1965, César discovers the polyurethane foam. The first expansions are made in public, occasions and happenings characterized by their ephemeral quality.

From 1967, the artist will try to find a process which allows the expansions lasting more in terms of work art but also preserving the inherent fragility of the material.

Our work concerns 3 recently restored works:

- Expansion contrôlée, 1967

- Expansion N°3 la lunaire, 1970

- Expansion, 1969

From a technological point of view, the expansions are produced in expanded polyurethane foams then lacquered and sometimes varnished. The color does not form a solid film (coloring matter + binder) and discernable from the substrate, but it is an integral part of the constituent material (the lacquered layer). The viewer is facing a smooth, shiny and iridescent surfaces.

The artistic instance and the aesthetic instance are coincident. The expansions aesthetic value are the result of the materials specific choice and also the desire to create a lasting result. This was one of the reasons why we really focused on reintegrating the gaps in the most illusionist way possible.

In the same way as of a classic work of art, the quality of the colored reintegration will depend on the

quality of the fillings, the choice of pigments, bindings and the implementations. The core and bulk consolidations will replace as a priority the missing areas before retouching.

Our consolidation approach is based on our own experience, the using of low toxicity natural products and the latest techniques of polyurethane consolidation based on animal protein by micro-nebulization and loaded with Phenolic Resin Beads.

For the reintegration, we chose the use of Mica pigments, applied by airbrush spray. This technique allowed us to obtain a smooth, brilliant and iridescent rendering, close to the original surface state. Preliminary tests were coupled to a colorimetric study. The aim of this study is obtaining a definition of the objective color, using numerical data and therefore will make it possible precisely to quantify the absolute value of the color. Using colorimetric systems allowed us to provide information on the colors used by the artist but also allowed us to choose the implementation of the retouching.

Keywords: ...

P30 - On the trail of Celluloid in Portugal

Artur Neves, Maria João Melo (Dept de Conservação e Restauro, LAQV-Requimte – FCT NOVA), Maria Elvira Callapez (CIUHCT-Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa)

Hyatt's Celluloid Manufacturing Company, established in 1871, in Albany (USA), developed an effective business strategy, providing unfabricated celluloid to companies licensed in the making of consumer goods. Celluloid was sold as sheets, rods and tubes to be converted into collars, combs, dolls and several other products. Although the wide array of applications, the licensed companies were specialized with a narrow range of products. In Continental Europe, this technology was set near Paris, in 1875. For many years, the *Compagnie Française du Celluloid* was the only producer of raw celluloid. By 1890, the celluloid industry was well established [1].

Celluloid's early influence disseminated into other European countries as Portugal, as shown by evidences of celluloid comb manufacture in the 1890's by *Dias & Irmão* [2]. In the mid-20th century, two known Portuguese companies at the time- *Luso Celulóide* and *Hércules* - kept still importing tons of celluloid, possibly from France, and producing various products, such as balls, toys or hand mirrors [3, 4]. However, a study of its cultural and technical impact has never been explored.

Indústrias Plásticas (1950) by António Rio de Janeiro, the first Portuguese technical book on celluloid's industry, is a fundamental primary source. Presented as the former technical manager of the Portuguese Society of Celluloid, the author's apparent practical knowledge on celluloid stands-out. References to Worden's *Nitrocellulose Industry* (1911) or Böckmaan's *Celluloid* (1907) books express Rio de Janeiro's knowledge and interest in the subject. However, there are no known records, and claims on any Portuguese patent related to celluloid.

In this poster, we intend to unravel Rio de Janeiro's professional career, seeking for the objects he might have produced. This search for material culture is the first step in an investigation aiming to value celluloid's significance in the Portuguese context.

Furthermore, it is examined how this research can be complemented by conservation science studies. Chemical analysis of historical objects gives information about degradation but also about manufacturing processes and materials. These insights may lead to specific formulations, patents or manufacturers, as the development of dating methodologies will place the historical objects in their cultural and production contexts.

Keywords: Celluloid, cellulose nitrate, material culture, manufacturing processes, Portuguese context, polymer degradation

References:

[1] Friedel, Robert. *Pioneer plastic: the making and selling of celluloid*. Madison: University of Wisconsin Press, 1983.

[2] *Catálogo da Exposição Industrial Portugueza, no Palácio de Crystal Portuense 1897*. Lisboa: Imprensa Nacional, 1900

[3] Henriques e Irmão Lda. *Fábrica Luso-Celulóide de Henriques e Irmão Lda.* Porto: Litografia Império, 1950

[4] Afonso Henriques. *Tabela de Preços da Fábrica Hércules*. Lisboa: Tipografia Casa Portuguesa, 1951

P30A - NEMOSINE: Innovative packaging solutions for storage and conservation of 20th century cultural heritage of artefacts based on cellulose derivatives

Ana Maria Ramos, Artur Neves, Élia Roldão, Joana Silva, Eva Marisole Angelin and Maria João Melo (Dept de Conservação e Restauro, LAQV-Requimte – FCT NOVA)

Photographs and movies have helped to preserve the cultural material that is a faithful witness of socio-cultural European evolution in the recent era. It encompasses not only the possibility to understand the development of new arts such as cinema, photography or graphic arts but also the preservation of the socio-cultural memories of citizens in major museums, local museums (real testimony of the history of cities and their people) located in many towns worldwide & in a huge number of private collections.

A huge percentage of the recent European cultural heritage can be found in movies and photographs produced between 1895 to nowadays, which were made using cellulose derivatives. More than 75 years of visual and audio memories are now in danger to be lost due to the natural instability of cellulose acetate and cellulose nitrate materials. Despite of the problems of conservation of these materials, the European funded R&D projects dedicated to the preservation of the European Cultural Heritage have focused mainly on the preservation of traditional fine arts as sculpture or painting and architecture.

NEMOSINE (http://www.nemosineproject.eu) is the first project sole dedicated to the preservation of cellulosic photography & cinema films. It aims to improve the traditional storage solutions, such as freeze storage (below 5°C), by developing an innovative smart package with the main goal of energy saving and extend the conservation time of cultural objects based on cellulose derivatives.

In this poster, we present the first prototype system for the storage for long term conservation of artefacts made of cellulose acetate and cellulose nitrate photographic negatives and cinema films. The complete solution for storage boxes proposed by NEMOSINE is based on nanomaterials multi-sensors for different gases (mainly acetic acid and nitric oxide) and a control software platform that simulates degradation processes and then measuring the off gassing, predicts on real time the need for accurate protective treatments. These innovative solutions will be shaped as three packages prototypes with different functionalities and target customers: preventive (basic & premium) and curative. Based on the same outside box possessing high barrier properties to oxygen, they differ on the devices inside: basic preventive package with a monitoring gas sensor; premium preventive with a gas sensor and an adsorbent device; curative package with an antifungal system.

The modular solution is one of main advantages of the innovative package. In this way, it can be adapted to different type of end users, balancing real value of the content and the package cost.

Keywords: conservation 20th century; photographic film negatives; cinema films; cellulose nitrate; cellulose acetate.

P31 - Cellulose acetate in works of art: exploring the causes of its degradation

Sofia Nunes, Eva Mariasole Angelin, Sara Babo, Artur Neves, Maria João Melo (Dept of Conservation and Restoration, LAQV-REQUIMTE - Faculty of Science and Technology, Universidade NOVA de Lisboa)

Dans la Plage and *Relevo Laranja* are two artworks on cellulose acetate (CA) dated from the 1960s by the Portuguese artist José Escada. They are both compositions of symmetric modules in CA sheets that have been folded and cut in different shapes. Being displayed vertically as paintings, their three-dimensional character allows the perception of various shapes and shades of colour, depending on the perspective of the spectator.

Dans la Plage (1968) is constituted by yellow and white modules, supported by a large orange sheet. On the other hand, *Relevo Laranja* (1966) is constituted only by orange modules glued on a sheet of the same material. Although both artworks are composed by CA, probably purchased in Paris by the artist in the same period (c. 1960s), their condition is quite different. *Relevo Laranja* presents warping, shrinkage and hardening of the plastic material which suggest the occurrence of degradation at a molecular level, not detected in *Dans la Plage*.

To understand the causes of degradation in *Relevo Laranja*, a molecular characterization of the polymer and additives has been carried out with the aim to find out if the composition is related to the artworks condition.

One of the major causes of degradation of CA is ester hydrolysis that will lead to the loss of physical properties. In this work, infrared spectroscopy will be used to assess the extent of hydrolysis, and the original substitution degree will be discussed [1,2].

Because of the difference in the artworks current condition, it is also interesting to explore the origin of the CA sheets. Was the selection of the plastics based on colour, durability or other characteristics? Also, the two artworks might had had different histories (storage, display, etc.). Was *Relevo Laranja* exposed to different environmental conditions?

This study will allow us to discuss the causes of degradation such as the role played by additives (plasticizers, colorants, etc.) and/or external factors (e.g. relative humidity, temperature) on the degradation rate.

Keywords: contemporary artwork; cellulose acetate; material characterization; polymer degradation

References:

[1] Littlejohn et al. (2013), *Investigation of the degradation of cellulose acetate museum artefacts*, Polym. Degrad. And Stab. 98, 416-424

[2] Samios et al. (1997), *Preparation, characterization and biodegradation studies on cellulose acetates with varying degrees of substitution*, Polymer, 38, 3045-3054

P32 - Modern Paint Composition and Limits: Material characterization and degradation processes

Valentina Pintus, Manfred Schreiner (Institute of Science and Technology in Art, Academy of Fine Arts, Vienna)

The paint manufacturers continuously modify the complex chemical composition of paint colours employed in modern and contemporary art, which results in a material with unknown or unclear chemical behaviour during ageing or interactions with other components. This represents particularly a challenge for developing conservation and restoration strategies of a specific art object.

This presentation intends to provide important and new information about the chemical composition of several types of modern paints based on alkyd, polyvinyl acetate (PVAc) and predominantly acrylic from different companies, which were purchased between 2010 and 2015.

Furthermore, their stability was studied systematically by applying accelerated artificial sunlight conditions using a Xenon arc solar simulator. This provides radiation with wavelengths from 295 nm, thus simulating sunlight outdoor conditions. The paint samples were investigated before and after different periods of ageing time

by using Pyrolysis Gas-Chromatography / Mass Spectrometry (Py-GC/MS), Fourier Transform Infrared spectroscopy in Attenuated Total Reflection mode (FTIR-ATR), µ-Raman, and colour measurements in order to gather evidence on their aging behaviour.

The collected data clearly show how the ageing behaviour of a modern paint is strictly dependant on their formulation, composed of a type of binder, pigments, and additives. The aging of any or all of these components can influence not only their chemical properties but also their physical properties resulting in a change of colour, opacity, and brittleness.

Keywords: Modern paint, ageing, Py-GC/MS, FTIR-ATR, material characterization

P33 - Development of a framework for assessing the light stability of plastic objects in heritage collections

Anna Pokorska (Institute for Sustainable Heritage, University College London), Lindsay MacDonald (Dept. of Civil, Environmental and Geomatic Engineering, University College London), Elise Talgorn (Philips Design, Netherlands), Boris Pretzel (Victoria and Albert Museum, London), Stuart Robson (Dept. of Civil, Environmental and Geomatic Engineering, University College London), Katherine Curran (Institute for Sustainable Heritage, University College London)

The complexity of plastic materials found in heritage collections has created an issue in terms of their identification and preservation. Plastics can contain small amounts of various additives which can affect their stability. Additionally, light stability of plastics has not been at the forefront of heritage science research so far which has led to underinformed museum guidelines. It is also rarely known what types of plastics are present in collections in the first place and systematic analysis of all possible material compositions is not possible. Therefore, a prioritising approach was employed with the aim of identifying factors which have the most influence over light stability of common plastics. Through an extensive literature review and a series of accelerated light degradation experiments, five 'influencers' have been identified: polymer type, colourants, light stabilizers/antioxidants, impurities, and previous exposure history. Since polymer type cannot be used on its own to judge the light stability of a plastic, we investigated the effect of colourants. The selected pigments are known to have a sensitizing effect on certain polymers when exposed to UV radiation, however their influence under visible light, as found in a museum environment, has not been explored. Cellulose acetate (CA) and polypropylene (PP) were selected as two chemically different test polymers. The former is an unstable plastic of historic importance, while the latter is a one of the most widely used polymers to date, which, nowadays, can also be found in collections but has not yet been much studied from a heritage perspective. PP is also known not to absorb visible light on its own but often contains impurities which can catalyse photodegradation even at longer wavelengths. Samples were exposed to intense visible light for 12 weeks (corresponding to 270 years on display at 200 lx, 10 hrs per day). Preliminary results show that, while some pigments do indeed accelerate oxidation of PP, it does not lead to significant physical changes to the material (such as discolouration or cracking). Future investigations will also look at the effect of previous UV exposure to account for museum objects having a previous history.

Keywords: plastic degradation, light stability, pigments, polypropylene

P34 - The challenge of time – Restoration of a 1960s PVC sculpture

Sara Russo (Accademia di Belle Arti "Aldo Galli"), Simone Caglio (Freelance, Scientific analysis for cultural heritage; Dept of Material science, Università degli Studi Milano-Bicocca), Tommaso Poli (Department of Chemistry, Università degli Studi di Torino), Bruna Mariani (Accademia di Belle Arti "Aldo Galli"), Isabella Villafranca-Soissons (OpenCare Restauri s.r.l., Milan)

In the conservation of contemporary artworks the balance between content and form is complex and it is important to work on the material in order to respect the artist's idea and message. When dealing with plastic artworks, it is of paramount importance to carefully calibrate investigations and interventions as plastic presents

subtle intrinsic balances and a slight variation could trigger unforeseen and unexpected outcomes. Moreover, being a fairly recent field of study, the literature on conservation plastic heritage is scant. The present work introduces the restoration of *Scultura Neve* (1965), a PVC work by Remo Bianco. The work consists of four plastic masks covered with an artificial snow finish and attached to a wooden support. The plastic was affected by deep fractures and the surface finishing was strongly dismantled. The procedures of consolidation, adhesion and the design of a new anchoring system are presented. The rationale and the analysis that led to the selection of materials and operational choices are exposed. Different series of mock-ups played an essential role in defining the procedural choices at the basis of the restoration intervention allowing a deep knowledge of the interactions between materials. The procedure of consolidation involved the adherence of the surface finishing. The bonding procedure was carried out through the testing of the mechanical properties and the aesthetic features of a range of products for the industrial treatment of PVC. To design a new system of anchoring 3D modelling and 3D printing technologies were used, which turned out to have strong advantages concerning the needs and constraints of the treated materials.

Keywords: plastic conservation, interventive conservation, PVC, adhesion, 3D modelling

P35 - Towards conserving PMMA in art and design: investigating solvent impact and aging with nano thermal analysis

Donald Sale (Art Conservation & Research, London), Angelica Bartoletti (Tate Conservation Department, Division of Biomaterials & Tissue Engineering, Eastman Dental Institute, University College London), Laurent Bozec (Faculty of Dentistry, University of Toronto, Division of Biomaterials & Tissue Engineering, Eastman Dental Institute, University College London), Marianne Odlyha (Department of Biological Sciences, Birkbeck, University of London)

Conservators treating architectural models, paintings, photographs, and sculpture made of poly(methyl methacrylate), or PMMA, requested guidance for safe solvents. Their key concern was the safety of xylenes in cleaning solutions, or as a diluent in adhesives, or inpainting and varnish mediums. Although the important plastic conservation publication POPART suggested xylenes for cleaning assessments of PMMA, manufacturers and various authors have identified risks with this solvent. In a previous study by this author, transparent PMMA samples immersed in xylenes were slightly reduced in weight and initially clouded, but no visible damage was apparent after aging. In this study, the thermal properties of these samples were characterized to investigate the long-term impact of xylenes on PMMA.

This poster describes an investigation of glass transition temperature (T_g) behavior of transparent PMMA immersed in conservation solvents and aged naturally for 27 years. The T_g values of samples immersed for one minute or one hour in a commercial xylenes isomer mixture used in conservation, were compared to the T_g of samples immersed in acetone and toluene, two solvents known to dissolve PMMA. The sample-averaged T_g of the bulk material was characterized with Differential Scanning Calorimetry (DSC) and the surface T_g was investigated with Nano Thermal Analysis (nano-TA).

DSC detected no differences in the T_g of any samples, not even in those that were partly dissolved. However, nano-TA revealed slightly lower T_g values on the surface of the samples immersed in solvents, when compared to controls, suggesting solvent-induced swelling and polymer chain-scission. While further investigation is necessary, the results suggest that xylenes impact was similar to the solvents known to dissolve PMMA, even though no visible damage was apparent. These findings lead to questions concerning the reliability of solvent cleaning tests, and the long-term impact of xylenes in conservation treatments.

Nano-TA is a promising technique for the characterization of plastics in modern and contemporary art and design. The technique is useful for local characterization of surface T_g at nanoscale resolution distinctly from sample-averaged T_g of bulk material. Nano-TA allows rapid multiple measurements directly on samples; 10 readings were averaged in this study. In contrast DSC requires large samples and lengthy procedures.

Keywords: poly(methyl methacrylate) (PMMA), polymer chain scission, glass transition temperature (T*g*), differential scanning calorimetry (DSC), nano thermal analysis (nano-TA), solvents

P36 - Use of PLA and ABS in 3D printing for Fine Art. Analysis of filament and print composition and long term behaviour

Margarita San Andrés, Ruth Chércoles, Eduardo Navarro, José Manuel de la Roja, Javier Gorostiza, Elena Blanch (Faculty of Fine Arts, University Complutense of Madrid (UCM))

3D printing refers to an *additive manufacturing* (AM) technique wherein a physical object is fabricated from a digital model, by binding material together to build up the final shape, usually in thin successive layers. The shapes that can be produced in this way can be extremely complex and impossible to manufacture otherwise, with applications of additive manufacturing ranging from industrial and medical, to those in design, fashion, architecture or art.

Despite the technology having its origin in the 1980s, several decades worth of research and development (including the expiration of several patents) have been necessary in order to take 3D printing to where it is today. These advances have enabled a wide and growing range of *additive manufacturing* processes, such as: stereolithography (SLA), selective laser sintering (SLS), direct metal laser sintering (DMLS), laminated object manufacturing (LOM), or fused deposition modeling (FDM) [1].

FDM is, at the moment, the most ubiquitous form of 3D printing, to the point that it is what most people refer to when using the term. In this process thermoplastic materials are fused and deposited via a computer controlled extrusion system. The range of polymers suitable for this process is quite varied, including: Acrylonitrile Butadiene Styrene (ABS), Polylactic Acid (PLA), Polyethylene Terephthalate Glycol (PETG), Nylon, Thermoplastic Elastomers (TPE), Thermoplastic Polyurethane (TPU), Thermoplastic Copolyester (TPC) and Polycarbonate (PC). They are available commercially in the form of 1.75 or 3.00 mm diameter filaments, in a range of different of colors. Some experimental builds have also been known to use pellets.

Today, contemporary artists may use 3D Printing as another tool for creating their work. As FDM has become the most accessible and prevalent process at the moment, with ABS and PLA filaments being the most commonly used, questions arise concerning the durability and conservation of artworks which employ such processes and materials. Some studies exist on the thermal degradation of PLA and ABS [2], however it would be of interest to collect data pertaining the combined effects of temperature, humidity and light on these polymers, in particular, from an art conservation standpoint.

For these reasons, this study proposes an in depth analysis on the composition of PLA and ABS filament (polymer matrix, fillers, and additives) as well as carrying out aging tests under controlled temperature, humidity, and light conditions. The analytical techniques used in this study are: Fourier Transformation Infrared-Attenuated Total Reflection spectroscopy (FTIR-ATR), Pyrolysis–gas chromatography–mass spectrometry (Py-GC-MS), Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA) and Scanning Electron Microscope-Energy Dispersive X-Ray Analysis (SEM-EDX).

This research has been supported by Research Project HAR2015-68680-P.

Keywords: 3D printing, contemporary sculpture, PLA filament, ABS filament, degradation, ageing tests

References:

[1] S. Singh, S. Ramakrishna, R. Singh: Material issues in additive manufacturing: A review, *Journal of Manufacturing Processes*, 25, 2017: 185-200.

[2] S-U Zhang: Degradation Classification of 3D printing thermplastics using Fourier Transform Infrarred Spectrsocopy and Artificial Neural Networks, *Applied Sciences*, 8, 2018: 1224

P37 - Synthetic materials in the modern library collections – national project

Petra Vávrová (The National Library of the Czech Republic, Collections Preservation, Development and Research Laboratories), Jiří Brožek (University of Chemistry and Technology in Prague, Dept of Polymers), Jitka Neoralová, Dana Hřebecká, Nikola Šipošová, Michaela Čermáková, Lucie Koukalová, Vítězslav Knotek (The National Library of the Czech Republic, Collections Preservation, Development and Research Laboratories), Radka Kalousková, Lenka Malinová (University of Chemistry and Technology in Prague, Dept of Polymers)

The main goals of the national project are:

a) Research and development of non-destructive survey and identification of various types of synthetic materials in bookbinding and their degradation processes.

b)Development and validation methodologies and working procedures of conservation and restoration of synthetic materials in modern library collection.

c) Methods of preventive care, storage, handling and accessibility of library collections containing synthetic materials.

Research and development is focused on all aspects of modern bookbindings, material composition, survey the damage, damage prediction based on the chemical and physical properties of materials and verification of the effects of restoration-conservation interventions. Researchers are also involved in the organization and evaluation of mass survey of the physical condition of large modern collections of the National Library of the Czech republic. Facilities include system Microfadometer for measuring the light fastness of materials for the effective protection materials of the cultural heritage which are sensitive to light. The research also includes SurveNIR, device for non-destructive analysis of paper and plastics, based on near infrared spectroscopy (NIR), based on the chemometric method are determined chemical and physico-mechanical properties of paper and the type of paper or is identified type of synthetic material. Using the system SurveNIR can statistically evaluate the physical condition of the paper in the large book collections and select the appropriate procedure for preventive care. A significant part of survey of bookbinding materials is performed by microscopic examination. A great benefit in survey of state and composition of the materials is a 3D digital microscope HIROX. With this device you can observe and analyze material or its damage in detail otherwise inaccessible to naked eye, including 3D display of surface. The digital image can be continuously modify including perform image analysis of 2D and 3D measurement, measure surface roughness, surface area, volume and others. With the 3D microscope you can identify bookbinding material, colored layers, performing microscopic analysis of the physical condition of material, identify the damaging pollution, control the effects of conservation and restoration work on the material microstructure and microbiological survey.

The authors would like to acknowledge the Ministry of Culture for financial support within the framework of the Program of Applied Research and Development NAKI (project no. DG18P02OVV001).

Keywords: non-destructive survey; bookbinding; degradation; SurveNIR, microfadeometer, 3D microscope

From microfibres to nanogels-conservation cleaning of plastics heritage (8:30 – 8:50)

Yvonne Shashoua, Margherita Alterini (Environmental Archaeology & Materials Science, National Museum of Denmark), Gianluca Pastorelli, Louise Cone (Centre for Art Technological Studies and Conservation, Statens Museum for Kunst)

Surveys of the condition of plastics heritage in Europe indicate that 70- 75% of collections require cleaning. Oily fingerprints, carbonaceous dirt and crystalline degradation products on plastic objects and artworks reduce their significances, chemical and physical stabilities. However, it is essential to balance the need to clean against the risks of mechanical damage from cleaning tools particularly scratches and of inducing chemical changes from aqueous- or solvent-based agents by mobilizing additives and solubilizing degraded polymers. Conservators must therefore consider scientific, aesthetic and ethical factors before developing a cleaning strategy for plastic objects and artworks.

Until around 2000, research into cleaning of plastics heritage used visual examination alone as an evaluation tool and concluded that dry mechanical cleaning was the most effective treatment offering the lowest risk of damage. In 2012, the EU 7th Framework Programme project POPART used optical- and scanning electron microscopy, changes in surface energy and gloss to conduct an exhaustive evaluation of mechanical, aqueous and non-aqueous cleaning techniques for their effectiveness at removing sebum and carbonaceous soils from cellulose acetate, polyethylene, PVC, polystyrene and polymethylmethacrylate. POPART concluded that applying anionic and nonionic detergent solutions with polyester microfiber cloth, cleaned more effectively and produced fewer scratches than using dry cleaning tools. Polyethylene and PS were the plastics found most vulnerable to scratching. In 2018, the Horizon 2020 research project NANORESTART added nanogels and -gums to the cleaning tools examined in POPART and infrared spectroscopy to the suite of instruments. The project concluded that nanogels based on polyvinyl alcohol, loaded with anionic detergent solutions and applied to plastic surfaces for between 5 and 20 minutes, were equally effective as microfiber cloths at removing sebum and carbonaceous soils but produced significantly fewer scratches. It is clear that twenty years of conservation research has dramatically increased the range of cleaning tools and cleaning agents available. In addition to the latest findings, this paper will use case histories to discuss how developments in conservation cleaning science influence cleaning practice for plastics heritage.

Keywords: Conservation, cleaning, plastics, surfaces, microfiber cloth, nanomaterials, infrared spectroscopy, conservation ethics

Identification of methodological protocols for the conservation of design plastic objects (8:50 – 9:10)

Alice Hansen, Antonella Russo (Fondazione Plart), Leonardo Borgioli (C.T.S. Srl)

The plastic artefacts from Plart's collection show very peculiar types of degradation and considerable conservation challenges. That is why the creation of the museum as a place of permanent exhibition of the collection was immediately accompanied by the idea of creating a laboratory for the study and the conservation of plastic objects. First step towards this goal was the cataloguing of the historical collection. Conducted according to national standards, the cataloguing enabled the investigation of the single artefacts in a double perspective: as historical and artistic heritage and as 'samples of materials' to be analysed in view of scientific experimentation. Several procedures for the preventive conservation of the collection have also been identified. The Plart Museum has promoted over the years a few conferences on the conservation of plastic artefacts and offers specialized training courses, focusing especially on the science, the technology and the identification of polymers, the degradation of plastic artefacts, the management of museum collections of objects made from synthetic materials, the conservation of acrylic paints, of synthetic textiles, etc.. The Department of Research, Conservation and Restoration of the Plart Foundation is now committed to researching and developing appropriate methods for the conservation and restoration of synthetic materials used in art and design, in collaboration with experts from public and private institutions with specific expertise in the field of conservation

of plastics in Cultural Heritage. The research activities are currently focused on the testing of materials for restoration and the identification of methodological protocols for the conservation of design objects made of plastic. Some of the issues encountered in relation to the various intervention procedures will be illustrated.

Keywords: synthetic polymers, semi-synthetic polymers, conservation, design, conservation, plastics heritage, documentation

Characterization of synthetic polymers in heritage: a new approach to investigate multi-material objects (9:10 – 9:30)

Francesca Modugno, Jacopo La Nasa, Greta Biale, Francesca Sabatini, Ilaria Degano (Department of Chemistry and Industrial Chemistry, University of Pisa), Barbara Ferriani (Barbara Ferriani s.r.l., Milan), Antonio Rava (Società Rava & C. s.r.l., Torino), Maria Perla Colombini (Department of Chemistry and Industrial Chemistry, University of Pisa)

Modern art materials introduced since the end of XIX century include a large number of formulations of synthetic polymers whose characterization requires specific analytical tools. Flash nalytical pyrolysis coupled with gas chromatography and mass spectrometry (Py-GC/MS) has proved highly effective in characterising Hipoms at a molecular level with high chemical detail. We will illustrateapplications of the technique to investigate paint materials in street art, and design objects from the Triennale Design Museum of Milan (ALRTDM IPERIONCH.it project).

Nonetheless, the interpretation of the pyrograms obtained from samples containing different components and analytes is in some cases not straightforward. For this reason, we explored the use of more recently developed pyrolysis-based techniques, such as evolved gas analysis coupled with mass spectrometry (EGA-MS) and multi shot Py-GC/MS, to analyze the different fractions of heterogeneous micro-samples. As a proof-of-concept for this approach we will discuss the analysis of a sample from a pop-art artwork made of painted polyurethane foam: "Disgelo" (1968) by the Italian artist Piero Gilardi (1942). We aimed at establishing the composition of the polyurethane, of the paint binder, and of the pigments using a minimal amount of sample (around 1 mg). EGA-MS analysis provided both thermal and chemical information in one analytical run, so that we could select the temperatures for use in a multi-shot Py-GC/MS analysis and thus to selectively study the different fractions evolved at different temperatures. Information on the various components of the mixture was obtained, including additives and organic pigments, separating them on the basis of their different thermal degradation temperatures. This case study represents the first application of EGA-MS complemented by multi-shot Py-GC/MS to a painted plastic sculpture, and demonstrated the uniqueness of this approach in resolving complex mixtures of polymers, pigments and additives without any sample pretreatment. Evaluating the relative amounts of compounds produced during thermal degradation also provides semi-quantitative information, thus making the approach extremely valuable in future studies on the degradation of materials.

Keywords: characterisation of Hipoms, chemical analysis, multi-shot analytical pyrolysis, evolved gas analyses, composite objects.

References:

Degano, Modugno, Bonaduce, Ribechini, Colombini, Recent advances in analytical pyrolysis to investigate organic materials in heritage science, *Angewandte Chemie -International Edition* 57 (2018) 7313-7323.

La Nasa, Biale, Sabatini, Degano, Colombini, Modugno, Synthetic materials in art: a new comprehensive approach for the characterization of multi-material artworks by analytical pyrolysis, 2018, *Heritage Science*, submitted.

Degradation of closed-cell polyester urethane museum objects. Description, analysis of damage phenomena and preventive conservation (9:45 – 10:05)

Elena Gómez-Sánchez (Deutsches Bergbau-Museum Bochum), Susanne Brunner (Deutsches Museum München), Janine Köppen (Hochschule für Technik und Wirtschaft Berlin), Giulia Mazzon, Corentin Chaussat, Cédric Bouallag, Rebecca Zabar (Deutsches Bergbau-Museum Bochum)

This paper deals with the degradation and conservation of polyurethane ester, based on a collection of twenty original miners' shoes from the German Mining Museum in Bochum (Deutsches Bergbau-Museum Bochum, DBM, fig. 1). The shoes were produced between 1988 and 1992 and used by the workers in the coal mines, where they were exposed to environmental influences such as water, heat, salts and mechanical stress. Today, the elastic closed-cell polyurethane ester outsoles show an advanced state of deterioration, some of them having lost cohesion and consisting mainly of fragments of different sizes (fig. 2).

Fig. 1: Mining workers' shoes in the former exhibition, installed like in the dressing rooms of the mines, in baskets hanging under the ceiling

Fig. 2: State of degradation of different poly- urethane soles (right)

In order to gain information about the natural ageing of this material, the degradation phenomena were first documented and classified visually into four main categories: enclosures, blooming, flaking and liquids, each of them containing up to five different sub-categories (fig. 3). The FTIR analysis of these degradation phenomena revealed that all types of enclosures and most of the blooming and flaking consist mainly of adipic acid. These results seem to suggest that at least some of the degradation phenomena observed may correspond to different stages of the degradation process.

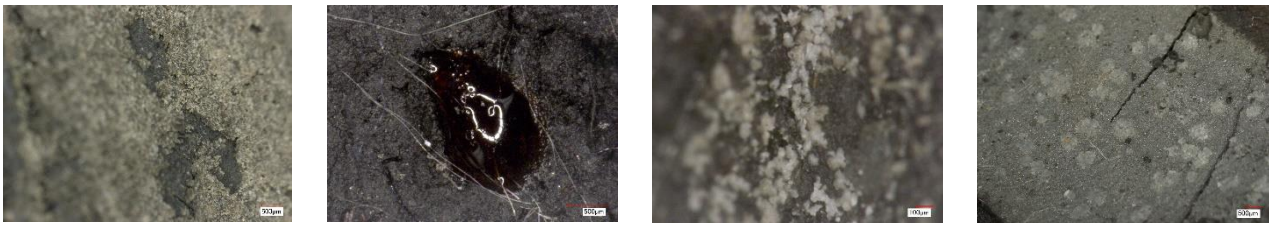

Fig. 3: Degradation phenomena of the polyurethane soles, from left to right: flaking, liquid, blooming on the outer surface and enclosures visible on a fractured surface

Additional information about the ageing process was gained from the comparison of natural and artificial aged samples. For this purpose, new test specimens were placed for eight weeks in a climate chamber at 70 °C and 98 % RH. During artificial ageing, changes in the mechanical properties were followed (Shore hardness, compression set). The results of the mechanical tests showed that the material did not significantly change in the first thirty days of artificial ageing, which marks a turning point as a dramatic worsening of the mechanical properties followed afterwards.

Regarding the conservation of the elastic polyurethane ester soles, racks and upholsteries were developed for each pair of shoes for safe storage and exhibition, in order to spare their fragile sole and leather from further losses and deformation (fig. 4). These constructions support the sole in carrying the weight of the shoe, freeing the fragile soles from mechanical stress.

Fig. 4: Rack made of stainless steel, individually fitted for each pair of shoes, inside upholstery sewn with cotton fabric and polyester-cushioning, stuffed with acid free tissue

Keywords: Polyester urethane, FTIR spectroscopy, degradation, artificial ageing, Shore hardness, compression set, conservation

The Plastics Identification Tool: how to identify without analytical equipment (10:05 – 10:25)

Suzan de Groot (Cultural Heritage Agency of the Netherlands (RCE)), Carien van Aubel, Olivia van Rooijen (Foundation for the Conservation of Contemporary Art (SBMK)), Henk van Keulen (Cultural Heritage Agency of the Netherlands (RCE)), Lydia Beerkens

Collections of contemporary art and design objects contain numerous artefacts made of plastic. To identify the material composition of these objects specialist knowledge is required which is often not present in museums without a laboratory. The Plastics Project[1] brings together conservation scientists, conservators, curators, and no less than ten major museums in the Netherlands.

The projects main products are a digital Plastics Identification Tool (PIT) and reference kit, by which administrators and conservators are able to identify the vast majority of the plastics in their collections themselves, to monitor them and take appropriate measures for preventive conservation.

Using the aspects sight, touch, smell, and sound, the answering of yes/no questions in PIT leads to an identification of the plastic. The reference kit plays an important role, as the main part of the questions compare the properties of the unknown with those of the reference materials. In some cases it may be necessary to take a micro sample to perform elementary chemical tests.

Additionally the Plastic Identification Tool includes information sheets for all identifiable plastics; these include information such as physical properties, degradation phenomena, trade names and information about preventive conservation measures.

The objective of the project is to improve the sustainability, visibility and accessibility of objects made of plastic. Therefore workshops, held in the ten participating museums, included surveys performed in the museums and storage areas where the participants have learned to identify plastics 'on the job'. When needed, additional in-situ research using Fourier Transform Infrared Spectroscopy (FTIR) portable equipment has been carried out.

[1] The Plastics project is coordinated by the Foundation for Conservation of Contemporary Art (SBMK) and the Netherlands Institute for Conservation, Art and Science (NICAS), a collaboration between the Cultural Heritage Agency of the Netherlands (RCE), Rijksmuseum, the University of Amsterdam and the University of Delft. Partners in the project are: Bonnefantenmuseum, Centraal Museum Utrecht, Gemeentemuseum The Hague, Kröller-Müller Museum, Museum Boijmans Van Beuningen, Schunck*, Stedelijk Museum Amsterdam, Van Abbemuseum, Rabo Art Collection and Collections of the RCE. This project has kindly been supported by financial contributions from the Gieskes-Strijbis Fund and Mondriaan fund.

Keywords: plastics, identification, DIY, properties, degradation phenomena, trade names

Where Science meets Practice: Investigation of Synthetic Organic Materials and their Challenges at the Department of Conservation-Restoration of Modern and Contemporary Art at the Academy of Fine Arts Vienna (9:45 – 10:05)

Valentina Pintus, Martina Pfenninger Lepage, Gerda Kaltenbruner (Institute of Conservation-Restoration, Department of Modern and Contemporary Art, Academy of Fine Arts)

At the Department of Conservation-Restoration of Modern and Contemporary Art at the Academy of Fine Arts Vienna, analytical investigation is mainly utilized to identify the main chemical composition of art objects and to assess and understand degradation processes as the first and most important step for developing a proper and effective conservation strategy. This need of science to meet practice is considered fundamental, and their being taught in parallel at the university level is an important task of the Conservation-Restoration program. At the Academy, the students have the opportunity to learn the theoretical aspects of preservation and subsequently perform both analysis and conservation of an original work of art.

In this context, the Fourier Transform Infrared Spectroscopy in Attenuated Total Reflection Mode (FTIR-ATR) in addition to other techniques has proven to be very useful for several case studies encountered so far by the students. Polymers such as fibre-glass reinforced polyester (GRP) of an indoor sculpture, cellulose acetate (CA) of a panel-painting, a phenolic-foam of a wall sculpture with open cells and a closed cells incorporated in a three-dimensional painting, which also included polyvinyl acetate (PVAc) and alkyd as paint binders, are just some examples of the investigated materials. Their various and complex chemical compositions provided a large array of issues to resolve from a conservation standpoint, such as chemical stability problems.

This work examines different types of synthetic organic polymers from different artworks obtained from prestigious museums such as the MUMOK in Vienna, which were investigated by means of FTIR-ATR at the Department of Conservation-Restoration of Modern and Contemporary Art at the Academy of Fine Arts. Further, it discusses how the analytical information obtained was used to understand their degree of degradation as well as the challenges conservators are facing.

Keywords: Academy of Fine Arts Vienna, FTIR-ATR, Modern-Contemporary Art, Synthetic Organic Materials

Hard Rubber – Identification, Deterioration, and Treatment (10:05 – 10:25)

Louise S. Beck, Clara Deck (The Henry Ford Museum of American Innovation)

Hard rubber, referred to by the trade names Ebonite and Vulcanite, is a vulcanized rubber with a very high sulfur content. First developed in 1844, hard rubber was used well into the twentieth century; an easily molded material, it was popular for combs, pens, and ornamental items. Perhaps the most extensive use of hard rubber, however, was in scientific, industrial, and mechanical apparatus, as it had useful insulating properties. It is because of this that hard rubber has a large presence in historical and scientific museums.

While hard rubber is more stable than other forms of rubber, its presence on mixed-material objects poses challenges. As hard rubber ages, sulfurous gaseous degradation products are emitted. When hard rubber is in contact with copper alloy materials, a unique, layered corrosion product is observed. This corrosion can be aggressive, even catastrophic. Analysis was conducted on degrading hard rubber historic materials and their associated corrosion products using Scanning Electron Microscopy (SEM) with electron-dispersive x-ray (EDX) elemental analysis. This analysis provides insight into structure and elemental contents, allowing for an understanding of the process of this corrosion.

Conservators have known for some time that this material has inherent vice and should be isolated from other components when practical, but this is not always possible in industrial and electrical collections. As The Henry Ford has large collections in these areas, conservators at this institution have had to face the issue of stabilizing

and treating complex composite objects. Broadly-applicable protocols have been developed for the identification of hard rubber and the treatment of objects containing hard rubber. Guidelines for identification in contrast to other types of rubber will be outlined, with the addition of illustration of the characteristic types of corrosion products found in composite objects containing hard rubber. Methods for the removal of these corrosion products as well as isolation and treatment of the materials in situ will be discussed. Relevant examples from the collection of The Henry Ford will be used illustratively to demonstrate the breadth of applications of hard rubber and the problems it can cause within museum collections of all types.

Keywords: hard rubber, ebonite, vulcanite, analysis, SEM-EDX, degradation, conservation

FRIDAY

FRIDAY PROGRAMME

31 MAY 2019

Museu Nacional dos Coches/ National Coach Museum

8:00 – 9:40 SESSION A – Hipoms' history

- Hermann Mark – The Father of Polymer Science, Tim A. Osswald
- Cellulosics – a circle of sustainability, Susan Mossman
- Factory life and gendered narratives: Leiria plastic workers' memories, Paula Mota Santos
- Making Connections: The Development of Relationships between Museum Visitors and Objects of Historic Polymeric Materials, Louise Dennis

Collective discussion

SESSION B – Museums, collections, archives

- Surviving After a Fire – Moving the German Plastics Museum, Lisa Burkart, Laura Bode, Johannes Heyn, Christian Bonten, Friederike Waentig
- Put a Plaster on It: Surveying plastics at IWM, Charlotte Marriott, Katie O'Brien
- Project 'Know, name and assess your plastics, Eline van der Velde
- An introduction to the Kartell Museum, Elisa Storace

Collective discussion

9:40 – 10:55 SESSION A – Hipoms' history

- The market of plastics in Romania seen through the eyes of Journal of Plastic Materials and newspapers, Elena Helerea, Laura Leluţiu
- Chemistry at the Deutsches Museum München: a collection of plastics, Susanne Rehn-Taube, Susanne Brunner
- Upwards and Inwards: Plastic Foam's Expansion from Military-Industrial Material to Female Flesh in the Postwar US, 1939 – 1976, Isabelle Marina Held

Collective discussion

SESSION B - Scientific Analysis for the Conservation of Cellulose Acetate Session

- Modelling and Measuring the Diethyl Phthalate Plasticiser loss from Cellulose Acetate indifferent ventilation scenarios, Argyro Gili, Rose King, Luca Mazzei, Josep Grau-Bové, Robert Koestler, Michael Petr, Odile Madden, Simoní Da Ros, Katherine Curran
- A critical assessment of AD strips used in degradation studies for artworks made from cellulose acetate, Joyce H. Townsend, Stephen Hackney, Mark Kearney

- A long-term degradation experiment: What really happens with plastic artworks in museum storage environments?, Simoní Da Ros, Isabella del Gaudio, Argyro Gili, Ida Ahmad, Joyce H. Townsend, Abby Moore, Deborah Cane, Katherine Curran

Collective discussion

10:55 – 11:30 Coffee break

11:30 – 12:45 SESSION A - Hipoms' history

- 85 years of the rise and fall of polyolefins, Geoffrey Mitchell, Fred Davis

- The birth of the Russian plastics industry. To the history of production of *Carbolite*, Elena Zaitseva-Baum

- Plastic Game Pieces and the Making of Jewish American Ethnicity, Annelise Heinz

Collective discussion

SESSION B - Preservation, conservation, characterization

- Progetto Aster: The Olivetti's creativity contained in a letter. Research into flattening methods for reshaping degraded cellulose acetate foils, Fabiola Rocco, Antonio Mirabile, Michela Cardinali, Anna Piccirillo, Giulia Germinario, Marcella Turchetti

- Cellulose Acetate in "The Transparent Figures" – the Significance of a Material for the History, Production, Condition and Conservation of Educational Models Made by the German Hygiene-Museum Dresden 1925 – 2000, Maria Lörzel

- Challenges in characterization of 3D-cellulose nitrate objects: Experimental design and preliminary results, Anna Micheluz, Christina Elsässer, P. Montag, Marisa Pamplona

Collective discussion

12:45 – 14:15 Lunch

14:15 – 15:25 SESSION A - Hipoms in art, design

- Plastic Vanitas, and how re-contextualising plastics can connect to life's precarious mortalities, Mariele Neudecker

- Restoring two "encapsulated" by Darío Villalba, Sara Liébana Molina

Collective discussion

Poster flash presentation: P38 – P47

- P38: When Present is becoming Past: Conservation Concerns of Plastics used in Photo Mountings, Mireya Arenas, Silvia Garcia Fernandez-Villa

- P39: Plastic pollution, climate change, sealevelrise: are 'Floating Cities' the solution?, Carolien Adriaansche

- P40: Seeking a New Form of Hybridity: Plastic Waste vs. Plants in Ecological Art, Aleksandra Ubertowska

- P41: PMMA: a survey on acrylic sheet in Portuguese art collections, Sara Babo, Joana Lia Ferreira

- P42: An Exhibition on Historic Polymeric Materials (Hipoms) at Leiria Museum, Sara Marques da Cruz, Maria Elvira Callapez, Raquel Ferreira Coimbra, Sofia Rodrigues, Vânia Carvalho

- P43: Establishing a Common Ground for Plastics Conservation in Norway: a Meeting Point for Conservators and the Plastics Industry, Anja Sandtrø

- P44: Archeological plastics in National Museum – Palace of the Grand Dukes of Lithuania collection: identification, conservation, and preservation, Medeina Steponavičiūtė

- P45: What happened with the new museum for the famous Compasso d'Oro collection award?, Sandra Vazquez-Perez

- P46: Plastics in the history Engineering Science, Laila Zwisler

- P47: Effectiveness evaluation of Molisch's Test for the identification of historical celullose plastics. First results, Silvia G. Fernández-Villa, Ruth Chércoles, Margarita San Andrés

SESSION B – Plastics and environment

- Plastics and Environment: a Threat or an Opportunity?, Carlos A. A. Bernardo

- Latin-American plastics and Colombian agriculture. Design, technology and culture, Juan Fernando Parra Castro

- Plastic Packaging and Ecology Between Attraction and Repulsion, Hejer Barbouch

Collective discussion

15:25 – 17:00 Posters/ Coffee break (coffee break starts at 16:30)

17:00 – 17:50 SESSION A – Hipoms in art, design

- The power of plastic in object based-learning: a consideration of the use of historical plastic objects as dynamic tools for learning and teaching in higher education, Kirsten Hardie

- On the history of the first phenolic resin desk lamp by Christian Dell, Günter Lattermann

Collective discussion

17:50 – 18:15 Closing Session, PHEA Poster Award, by Günter Lattermann (Auditorium)

18:30 – 20:00 PHEA Meeting (on special invitation) - Auditorium

Session A - Hipoms' History (8:00 – 9:40)

Hermann Mark – The Father of Polymer Science (8:00 – 8:20)

Tim A. Osswald (Polymer Engineering Center, University Of Wisconsin-Madison)

Herman Franz Mark is one of the founders of the field of polymer science and is the father of polymer education in the United States. His Institutes in Vienna and New York served as the incubators for some of the most notable polymer scientists of the second half of the twentieth century, aiding the creation and advancement of synthetic plastics. His brilliant carreer started the January of 1927, when Professor Kurt H. Meyer, one of the research leaders at the I.G. Farbenindustrie chemical giant's BASF labs in Ludwigshafen, convinced Mark to move to industry to apply his basic research abilities to industrial problems. Mark's association with Meyer and his collaboration with Hermann Staudinger and other German academic scientists of the time, served as one of the catalysts that propelled the field of polymer science. Mark and Meyer proposed a crystal structure for cellulose, rubber and silk, nearly identical to the ones still accepted today. Their theory was supportive of Staudinger's high molecular weight theory and refuted the commonly accepted colloidal association theory of the time. Mark's model for polymer molecules differed from Staudinger's in that the molecules were flexible, not rigid, as Staudinger suggested.

In the summer of 1932, as politics in Germany became uncertain for those of Jewish descent, Herman Mark and his family moved to Vienna where he became director of the first Chemistry Institute at the University of Vienna. With I.G. Farben funds, Mark was able to assemble an impressive team of scientists that included Eugene Guth, Robert Simha and Fritz Eirich. In Vienna, Mark published many fundamental papers on polymer physics including groundbreaking theories on polymer relaxation, polymerization kinetics and molecular weight distribution. After the Nazis marched into Vienna in 1938, Mark was able to escape to Canada via Switzerland, France and England. Two years later he moved to New York where he founded The Institute of Polymer Science at the Brooklyn Polytechnic University in New York, marking the official beginning of polymer science education in the United States. There he advised over 100 scientists that included Edmund Immergut, Herbert Morawetz and Charles Overberger. Some of his students went on as educators, multiplying the polymer science education all over the world. Eirich stayed at Brooklyn, Guth went to Notre Dame, Simha to Caltech and later to Case Western. Herman Mark died at age 96 in April of 1992.

Drs. Edmund Immergut and Daniel Caufield, two of Prof. Mark's former students, are acknowledged for sharing their stories.

Keywords: polymer science, polymer education, BASF, Brooklyn Polytechnic Institute

Cellulosics – a circle of sustainability (8:20 – 8:40)

Susan Mossman (Science Museum, London)

Cellulosics are an intriguing branch of semi-synthetic plastics and are a starting point for consideration of a cycle of thinking about the future of sustainable polymers – an increasingly important area in view of the ongoing and increasing furore around waste plastics and their environmental pollution of landscapes and our seas.

Originating in the nineteenth century, with Parkesine, Xylonite, Ivoride and then the most well-known example, Celluloid, these cellulose nitrate plastics are aesthetically pleasing, of value and very collectable - but fugitive as they degrade over time.

Cellulose acetate plastics – the next key step in the cellulosic chain – have many aesthetic qualities similar to those based on cellulose nitrate, but they share the transient nature of the earlier cellulose nitrate-based materials.

With one of the more recent links in the chain – lyocell – we have an opportunity to consider how the natural qualities and disadvantages of cellulosics can be turned to advantage – whether it be in looking at more user-friendly and sustainable methods of manufacture, material selection or by specifically harnessing the degradative properties of sustainably produced plastics in applications such as surgical dressings and sutures where the breakdown of the material over time is what is required .

Perhaps further consideration of this class of materials will give new inspiration to plastics inventors, designers and manufacturers, both in their formulation of newer plastics and in their manufacturing processes – moving from the toxic and dangerous production processes used to make cellulose nitrate and the earlier cellulose acetate-based plastics to the use of user-friendly and less toxic solvents such those used in the production of lyocell. The use of these more environmentally-friendly plastics in the production of single use plastic products may be a step forward in dealing with some of the critical issues of plastics global waste and its consequent environmental pollution.

Keywords: Cellulosics, Cellulose nitrate, cellulose acetate, lyocell, sustainability

Factory life and gendered narratives: Leiria plastic workers' memories (8:40 – 9:00)

Paula Mota Santos (Univ Fernando Pessoa – Porto & CAPP-ISCSP/Univ Lisboa)

The paper is presenting research work that is linked to the international project 'The triumph of Baquelite - a contribution to a history of plastics in Portugal'. In this context, one of the records made was that of the voices and memories of the men and women who were the workforce of that industry located in the Portuguese city of Leiria.

Because it is usually easier for history to construct itself through the narrative of the actions of men of importance (in this case, of the entrepreneurs who raised this industry), the project created an oral history work that aims to contribute to the retraction of a social universe which is usually outside the most obvious historical records: the laborer of the factories in question.

This communication presents data taken from the interviews carried out with former factory workers. It will focus on the differentiation of the worker reality according to the socio-anthropological category of 'gender'. The role played by factory work in the lives of men and women of what was at the time (middle 20th century) a rural region will be highlighted. The differentiation of the plastic factory's daily life when lived in the feminine and the masculine and its relations with the social universe beyond the factory floor of these social actors will be presented.

Keywords: Gender; factory work; narrative

Making Connections: The Development of Relationships between Museum Visitors and Objects of Historic Polymeric Materials (9:00 – 9:20)

Louise Dennis (Museum of Design in Plastics, Arts University Bournemouth)

This paper will explore how relationships are developed between visitors and objects of historic polymeric materials in the museum setting, and how this impacts on the general understanding of such materials and those that have followed.

In the 1990s, Susan Pearce wrote about the Western system of value, suggesting that mass-produced objects were boring and tasteless (Pearce, 1995). Others have suggested that by putting objects in museums they are placed 'beyond the realm of function' (Martin, 1999) and removed from their intended, social context (Luke, 2006). This removal of social context could be seen as a removal of the soul, and that the object dies and is placed, with or without ritual, in its tomb (the museum). Although the object is not in its intended context, by being part of a museum collection it is still in a real setting, objects become 're- rather than de-contextualised' (Dudley et al., 2012). The understanding of materials comes from our own experiential knowledge, influence of others, and cultural perception, such knowledge is generated through the production, application, and reception of products (Doordan, 2003). Historic polymeric materials have become the subject of nostalgia. They are materials used for plugs, light switches, pan and kettle handles, as well as radios and televisions. These are all objects that make physical connections with the body in a particular way that causes memories to arise on being reunited with them, 'aesthetics is primarily concerned with material experiences, with the way the sensual world greets the sensorial body and with the affective forces that are generated in such meetings' (Highmore, 2009). The museum setting allows the visitor, particularly younger ones without personal experience, to build relationships with historic polymeric materials and by doing so, the museum enables the visitor to develop relationships and appreciate the value of both them and their modern cousins.

Keywords: Relational materialities, museum collections, material understanding, nostalgia

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Surviving After a Fire – Moving the German Plastics Museum (8:00 – 8:20)

Lisa Burkart, Laura Bode (CICS - Cologne Institute of Conservation Sciences, University of Applied Sciences), Johannes Heyn, Christian Bonten (IKT - Institut für Kunststofftechnik), Friederike Waentig (CICS - Cologne Institute of Conservation Sciences, University of Applied Sciences)

The German Plastic Museum is not a conventional museum with a permanent exhibition space, the museum organizes traveling exhibitions in different places throughout Germany with the goal to document the scientific, technical, economic, social and cultural significance of plastics.

A fire in June 2016 confronted the German Plastic Museum (DKM) with the great challenge of recovering the collection of 20,000 objects and finding a new suitable storage. Fortunately, the collection was spared from the flames itself. However, the damaged roof resulted in moisture damage and soot on the objects. The catastrophic fire initiated the discussion about integration of the collection into an existing museum collection and to seeking for funds for enable scientific research. The LVR-Industrial Museum, part of the Regional Council of the Rhineland (LVR), took on this task and gave the collection a new home. So far the museum collection of the LVR included the coal and steel industries, the plastics industry has been excluded and the inclusion opens a new horizon for all participants.

Fortunately, the Federal Ministry of Education and Research (BMBF) is now funding a project, with focus on "the language of the objects". The four-year research project allows a transdisciplinary cooperation of art and design historians, plastic engineers and conservators. Together with the different disciplines it is possible to gather as much information as possible by reading the tracks of the objects, in the sense of the so-called material turn.

The project structured in three stages, the first stage includes the development of a comprehensive terminology, which considers the technical terms of the different fields (material science, humanities and social sciences, conservation science) and the selection of objects, which are significant for the technical-, economic-, social- and/or cultural development. Adapted to the respective objects, the second stage deals with further research, as well as material and structure analyses. The last stage contains the formulation of "object and material histories", which following the methodology of storytelling.

In this paper we will focus on explaining the methodology by taking one object exemplifying the approach.

Keywords: plastics, conservation, documentation, degradation, fatigue of plastics, object history, material history, collection management, plastics manufacturing

Put a Plaster on It: Surveying plastics at IWM (8:20 – 8:40)

Charlotte Marriott, Katie O'Brien (Imperial War Museum)

IWM has five branches across the United Kingdom; IWM London, IWM North, IWM Duxford, Churchill War Rooms and HMS Belfast on the river Thames.

IWM displays and preserves personal stories from international and domestic conflicts, from the last century to today. Our collection covers every material type and ranges from fine art to firearms, from dresses to drones. As war is often the propagator for new technology, it is a collection full of developments and firsts.

The surgical collection incorporates surgical kits, artificial limbs, medicines and emergency kits. Historically, these objects have been investigated for hazards, and for human material, but we are now looking at it for a fascinating insight; the use of plastics. Plastics provided an economic and robust method of keeping bandages and medicines sealed and clean, replacing earlier materials such as glass and paper. The collection contains plastics manufactured in the early 20th century to present day. For instance, there are early syringes and

dosimeters, Falkland War emergency ration packs and survival kits which include prophylactics for carrying water and fishing lines for catching food and for sewing up wounds.

Over the last six months, through surveys, FTIR analysis and other studio assessments, conservators at IWM have been able to identify a variety of different polymers in these collections. Forms of degradation have also been noted such as cracking, residue formation, as seen on the emergency kit EPH 9962.1 (Figure 1) and liquidation of polymers. These features not only aid identification but are also crucial to understand better how the degradation can affect other objects in close proximity.

We shall present our findings and demonstrate how this information is helping to develop a preservation strategy for this collection and others at IWM.

EPH9962.1 Emmergency Survival Kit, c.1980. Imperial War Museum Collection.

Keywords: plastics, museums, collections, history, HIPOMS, plastics history, collecting, conservation, documentation, degradation.

Project 'Know, name and assess your plastics' (8:40 – 9:00)

Eline van der Velde (Design Museum Gent, Stedelijk Museum voor Actuele Kunst (S.M.A.K.))

The project is an initiative taken by the Design museum and the S.M.A.K. in Gent, supported by the Royal Institute for Cultural Heritage in Belgium (IRPA/KIK) and the Cultural Heritage Agency of the Netherlands (RCE). It will be a testing ground for building up expertise, in both museums with the view of sharing all the gained knowledge with the heritage institutes of Flanders and beyond.

The care of plastics starts with knowing which plastics you are dealing with. Cascading down from this need is the necessity to have a set thesaurus concerning plastics materials and techniques in one's database. This enables one to categorize and write a proper inventory. A digital database in which you can search correct information is essential. A lack of both an efficient thesaurus and the knowledge of the plastic collections brought us to set up this project.

The first phase of the project (October 2018 – June 2019) focusses on the development and implementation of the thesaurus, dividing plastics into care groups and starting the identification of the plastics objects by research. Phase two (July 2019 – June 2020) comprises condition surveys and identifying plastics by using the Plastics Identification Tool (PIT) –the latter being developed within the current project of SBMK and RCE. In phase three (July 2020 – June 2021), the plastics which could not be identified using PIT will be identified using analytical equipment and guidelines will be implemented for cleaning, storing and exhibiting our plastic collections.

The current focus lies in building the thesaurus, which will be tested internationally, so that it is widely supported by the field. Different international institutions were contacted to gauge their current situation in plastic

registration. What are the needs in different collections? Which terms are used for plastics, chemical names or trade names? So far, an efficient thesaurus is missing in many institutions.

One of the main goals is to make the thesaurus multilingual and available to all interested institutions via Open Data and ultimately submitting it to the Art & Architecture Thesaurus (Getty Research Institute).

At the Plastics Heritage Congress we would like to shed light on the importance of such thesauri and introduce it to a wide range of international institutions, and present an overview of the project and our initial results.

Keywords: plastics, documentation, data bases, thesauri, identification, preventive conservation

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An introduction to the Kartell Museum (9:00 – 9:20)

Elisa Storace (Curator of Kartell Museum)

The Kartell Museum was founded in 1999 on the occasion of the company's 50th anniversary with the aim of diffusing to the public, the knowledge of industrial design and the processes of aesthetic-products linked to it. In 2000, the Museum won the Guggenheim Enterprise and Culture Prize as best company museum and made its international debut collaborating with the Centre Pompidou in Paris for an exhibition of Kartell's design.

The Museum tells the story and the identity of the Kartell firm (founded in 1949) and its collection consists of a heterogeneous set of objects among which are prototypes, multi-brand objects of proto-design in plastic, Kartell products (auto-accessories, household goods, lighting fixtures, instruments for laboratories, furniture) and communication material. The Museum preserves about 10,000 products, 15,000 photographs and 5,000 technical drawings. Within the archives, special openings are possible under request for university researcher or groups and the Kartell products, designs, photographs, production printings and catalogues can be consulted on request.

The Museum is housed in the exhibition hall of the Kartell's headquarter in Noviglio (Milano). The layout of the permanent exhibition includes more than 800 items produced by Kartell from 1950 to the present. The exhibition layout is conceived in keeping with the original architecture of this space, an exhibition hall on three levels that open up to a central court. This area of the factory was the last to be built as part of the 1967 design by architects Anna Castelli Ferrieri and Ignazio Gardella.

In April 2015, the new display layout by architect Ferruccio Laviani, according to the curatorial project by Elisa Storace, enriches the chronological order of the former permanent exhibition (inaugurated in 2000) with a thematic approach, with rooms dedicated to topics like modularity, transparency and artistic experimentations. The display highlights the relations among objects and among the different designer's approaches to the project and showcases a greater number of items presented in spacious vitrines that emphasize their aesthetical and almost sculptural value. While the upper levels of the space are dedicated to the display of historical pieces, the ground floor houses one-off pieces and the collaborations with artists and fashion designers.

Kartell Museum is member of Museimpresa, the association of Italian company museums and archives.

Keywords: industrial design, designers, Kartell company, museum, archives, history, heritage, collection, auto-accessories, household goods, lighting fixtures, instruments for laboratories, furniture, aesthetical value.

The market of plastics in Romania seen through the eyes of Journal of Plastic Materials and newspapers (9:40 – 10:00)

Elena Helerea, Laura Leluţiu (Transilvania University of Brasov)

In this paper we studied the plastic materials market in Romania, as presented in specialized journals and local newspapers, in order to better understand the characteristics of plastic materials market in Romania, the impact of the plastics industry as well as the perception of consumers regarding the plastics.

Our research and documentation is done within the national and local newspapers, and in specialized Journal of Plastic Materials (in Romanian - Revista de Materiale Plastice).

Founded in the years 1960, at the beginning of the intensive development of the Romanian industry in general and the chemical industry in particular, the Journal of Plastic Materials, with a quarterly issue, was intended "to facilitate the exchange of experience between technical staff on technical and scientific issues related to current and future needs perspective and contribute to informing them about the most important achievements in the country and abroad".

In this journal, published in the period (1964-1990), there are found the papers in the field of research on plastics, elastomers, fibers, synthetic fibers, composites, as well as novelties in engineering and technology. There are many remarks on the political, economic and social issues of the Romanian Communist regime.

Using and studying the articles published in the Journal of Plastic Materials and in the local newspapers, our work deals with the analysis on how the research activity in the field of plastics was disseminated and dealt with, to what extent there were international cooperation and what was the impact of the implementation of the researches in the chemical industry in Romania.

Keywords: plastic materials market in Romania, impact of plastic industry, Journal of Plastic Materials, plastic research dissemination.

Chemistry at the Deutsches Museum München: a collection of plastics (10:00 – 10:20)

Susanne Rehn-Taube (Deutsches Museum München), Susanne Brunner (Technische Universität München)

At the Deutsches Museum, a chemistry exhibition has been in place ever since the museum was founded. The chemical collection includes about 10,000 objects. There are laboratory devices, chemical glassware and a large collection of synthetic dyes. An outstanding part of the collection is represented in numerous examples from the history of plastics and synthetic fibers. There are Bakelite toys as well as polyethylene flowers or a globe made from latex (fig. 1-3).

The presentation will give an overview of the most unique objects and their respective conservation challenges combined with an invitation to international restorers in need of research objects.

Fig. 1: Toy car (Bakelite, 1940s)

Fig. 2: Globe (latex, 1950s)

Fig. 3: coffin decoration (1980-90s)

Some very rare examples from the history of plastic research are the so-called "Kunststoffschulen", collections of various plastics samples published by Arbeitsgemeinschaft Deutsche Kunststoffindustrie. The product examples (fig. 4) were presented in binders together with sophisticated information about plastics syntheses and technology.

Fig. 4 left: "Margarinefigürchen", (collection figure as giveaway with every margarine package) "King" made of polystyrene from "Die Kunststoffschule", 1955;right: Wagner painting instructions for the whole Christmas series 1954 for kids from the collection Helmut Bitsch

Eight collections, dating between 1955 and the 1980s, were examined.[1] The variety of many different chemicals leads to a whole range of conservation challenges.

During the examination of the most enhanced "blue" collection, dating about 1962 (fig. 5), research was performed to understand its significance and to identify the many items in the folders.

Fig. 5: "Die Kunststoffschule", published by Arbeitsgemeinschaft Deutsche Kunststoffindustrie, Frankfurt am Main, 1962

Conservation treatments were developed and performed on the "green" Kunststoffschule of 1955, with focus on the stabilisation and storage of the broken and fragile Cellulose nitrate products (i.e. spectacle frame, comb and doll, fig. 6). Further solutions had to be found for the acidic degradation products of polyvinyl chloride and polyester urethane elastomers and foams, which lead to metal corrosion and catalysed degradation of the plastic objects. The hardened, fragile and browned polyurethane ester and ether foams from all the plastic collections were examined using microscope and pyrolysis gas chromatography (PYGCMS). First attempts were made to understand their changing compositions over the years and conservation treatments were considered, including the artificial ageing of flexible polyester urethane foam, the consolidation of the fragile structure and how to deal with adipic acid crystals on its cell structure.

[1] "Die Kunststoffschule" from 1955 was presented at previous "Plastic heritage" symposia (2014 catalogue, 2016 FTIR-database of plastics).

Fig. 6: Mounting the broken pieces of the Cellulose nitrate (CN) spectacle frame on acid free cardboard, dyed with plant's ash and gum Arabic, with acid free soft tissue as removable layer in contact with CN; right: fitting in the folder as a way for exhibiting

Keywords: plastics, museum collection, technical and natural science, conservation, polyurethane, cellulose nitrate

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Upwards and Inwards: Plastic Foam's Expansion from Military-Industrial Material to Female Flesh in the Postwar US, 1939 – 1976 (10:20 – 10:40)

Isabelle Marina Held (Victoria and Albert Museum / Royal College of Art)

At the end of World War II, when the allies entered Germany, teams of scientists from the United States military discovered advances in a new type of synthetic material technology; polyurethane foam. A highly technological and political material born of wartime synthetic autarky in 1930s Germany, polyurethane foam was eventually exported and domesticated on the US home front in the post war period, where it became a staple shaping material for padding out the glamorous American "bombshell" ideal.

In the 1950s the plastic foams industry and market rapidly expanded in the US, encompassing automobiles and other modes of transport such as airplanes, buses and train carriages, as well as bedding, clothing, shoes, shapewear, "falsies" and eventually implants. Petrochemical companies such as Mobay and DuPont feasted on polyurethane's otherworldly performative properties and demonstrated this alchemy in spectacular displays of technological prowess.

Polyurethane's flexible foamy materiality was locked in intimate everyday relations with the body, engulfing and cushioning it in daily encounters. Its malleability and transformative properties were also gendered, and exploited, to temporarily and permanently shape the female form. Foam became flesh when human tissue grew into and inhabited open cell plastic foam breast implants, eventually requiring amputation amongst transgender and cisgender women.

This paper employs an interdisciplinary approach, drawing on original archival material from traditionally dissociated fields such as surgeons' and chemists' papers, technical military intelligence reports on plastics, and grey papers from chemical companies, as well as engineers' textbooks on materials and their development, revealing a complex international network of actors.

Keywords: Technology transfer, gender, body, material feminisms, medical history, American history, international network, transgender, cisgender.

Modelling and Measuring the Diethyl Phthalate Plasticiser loss from Cellulose Acetate indifferent ventilation scenarios (9:40 – 10:00)

Argyro Gili, Rose King (UCL Institute for Sustainable Heritage), Luca Mazzei (University College London, Department of Chemical Engineering), Josep Grau-Bové (UCL Institute for Sustainable Heritage), Robert Koestler (Smithsonian Museum Conservation Institute), Michael Petr (The Dow Chemical Company), Odile Madden (The Getty Conservation Institute), Simoní Da Ros, Katherine Curran (UCL Institute for Sustainable Heritage)

Plasticisers are used during polymer manufacturing to modulate their properties (decrease glass transition temperature, increase flexibility). Diethyl Phthalate (DEP) is a common plasticiser for Cellulose Acetate (CA) artefacts. Plasticiser loss from plastic artefacts in museums and collections leads to brittleness and the presence of sticky residues and crystals on the surface of objects, which significantly affects their aesthetic value. Therefore, it is crucial to prevent plasticiser loss and maintain the value of artefacts.

Deterioration of a plastic artefact due to plasticiser loss can depend on museum storage conditions, including ventilation and temperature. Storing plastic artefacts in sealed or vented boxes is a common tactic by which conservators in museums seek to limit degradation. In this work, a novel mixture of mathematical modelling and accelerated ageing experiments is used to predict and measure plasticiser loss from CA samples under different ventilation scenarios. Commercial CA (Degree of Substitution = 2.5) was plasticised with 20 wt% DEP under reflux in acetone. Dried samples were aged for 1 month at 70 °C/ 50% RH. Samples were aged inside aluminium tubes to replicate sealed and vented conditions. Plasticiser content was measured by 1H NMR spectroscopy after 1, 3, 8, 14 and 28 days.

Mathematical modelling of relevant processes such as diffusion and evaporation of DEP from plasticised CA samples, which has not been used extensively in the heritage field to date, was applied to predict plasticiser loss over time in different ventilation scenarios. Plasticiser loss can therefore be foreseen during the lifetime of the artefact, including its exposure to varying environments as it is being transferred from storage to display and vice versa. This model can also predict loss by providing an association between object dimensions and the volume of enclosure. This could facilitate conservators in decisions on dimensions of the storage used.

Preliminary work (modelling and experimental) reveals greater plasticiser loss in a vented area and highlights the benefit of enclosure. Future modelling research will investigate loss in varied temperature and relative humidity environments and balance the benefit of ventilation in contrast to sealing for preventing degradation attributed to more than one deterioration factors.

Keywords: Cellulose acetate, plasticiser, diethyl phthalate, museum storage

A critical assessment of AD strips used in degradation studies for artworks made from cellulose acetate (10:00 – 10:20)

Joyce H. Townsend (Senior Conservation Scientist, Tate Britain), Stephen Hackney (Retired Head of Conservation Science, Tate Britain), Mark Kearney (SEAHA doctoral student, UCL)

Solid phase microextraction gas chromatography mass spectrometry (SPME-GC-MS) has already been proved useful for investigations into the degradation of polymers in museum objects, to have potential as an early indicator of the onset of degradation of polymers, and to contribute to understanding of the mechanisms of deterioration occurring in particular objects made from cellulose acetate (CA). For such purposes, a SPME fibre is exposed for 24-48 hours with a packed object, to collect volatile organic compounds (VOCs) emitted during polymer degradation and/or from packing materials. However, the significant resource costs of the SPME methodology to identify the captured VOCs limit the application of this method. Commercially-available acid detector (AD) strips have been proposed as a non-material-specific indicator of degradation for deteriorating

movie film stock based on cellulose acetate, and can also offer a cheaper means of pre-screening groups of objects to select those in need of further investigation with SPME-GC-MS. CA which generates acetic acid as a degradation product, and cellulose nitrate which generates nitric acid as it degrades, are candidate polymers for such pre-screening. The two polymers were used separately and together by the sculptor Naum Gabo c.1920s-70s, and today some of these artworks are degrading to a significant extent. VOCs within their packaging are currently being investigated.

The typical visual assessment of colour change in an AD strip exposed to volatile acids can be improved by using colour measurement and published calibration studies. Aspects such as the (poor) reliability of AD strips beyond 6 months exposure, the several days exposure necessary to assess enclosed environments, the need to assess them rapidly in situ, their sensitivity for acids other than acetic acid, and the useful level of indicative but only semi-quantitative information they offer in practice, will be presented. The usefulness of placing AD strips with packed cellulose-based artworks, instead or during the deployment of SPME fibres to monitor the degradation of plastics, will be assessed critically. The results will give guidance on the limitations and benefits of using AD strips as a low-cost passive monitoring tool for cellulose-based plastics objects whose condition gives cause for concern.

Keywords: cellulose acetate degradation; VOCs; ADA strips; passive monitoring, SPME-GC-MS

A long-term degradation experiment: What really happens with plastic artworks in museum storage environments? (10:20 – 10:40)

Simoní Da Ros, Isabella del Gaudio, Argyro Gili (Institute for Sustainable Heritage, University College London), Ida Ahmad, Joyce H. Townsend (Tate, London), Abby Moore (Museum of London), Deborah Cane (Tate, London), Katherine Curran (Institute for Sustainable Heritage, University College London)

Plastics are a statement of fashion taste, technology and science, becoming part of museum collections. The conservation of historic plastics such as cellulose nitrate (CN) and cellulose acetate (CA), constitutes one of the main challenges of museums, owing to their susceptibility to chemical and physical degradation. This work takes a new approach for studying the role of environmental factors, such as relative humidity (*RH*) and temperature (*T*), on the decay mechanisms of CA and CN.

The environmental factors promoting CA and CN degradation have long been investigated and it is well known that exposure of CN and CA materials to high levels of *RH* and *T* favours degradation. Cold storage (~-16 °C) has been suggested as a preservation alternative for cellulose triacetate (CTA) films, owing to acidity measurements which suggested lower rates of acid formation in comparison to CTA films stored at ambient conditions.

Due to costs, time involved and the rarity of museum artefacts, the influence of *RH* and *T* on original artworks' features has been investigated mostly by using artificially accelerated ageing methods at conditions very different from those usually found in museums. To the best of our knowledge, there has been no study assessing the role of ambient and cold storage conditions on the physical and chemical degradation of CN and CA artworks (non-CTA films). This project investigates for the first time the long-term effect of natural ageing at common storage environments adopted by Tate and Museum of London on the physico-chemical properties of historic CN and CA artworks. Six distinct experimental storage conditions are evaluated for three years, involving cool (~10 °C) and freezing (~-20 °C) temperatures and the samples storage in closed and open ambient conditions presenting different levels of *RH* and *T* experimental fluctuations. Analytical methods involving FTIR and NIR spectroscopy and SPME-GC/MS will be employed to assess the physico-chemical properties of CN and CA samples stored at the different storage conditions at specific ageing times. Thus, this work will present preliminary results from the initial ten ageing months to evaluate the environmental condition effects on the CA and CN physico-chemical properties.

Keywords: Cellulose acetate, cellulose nitrate, long-term ageing, museum storage

85 years of the rise and fall of polyolefins (11:30 – 11:50)

Geoffrey Mitchell (Centre for Rapid and Sustainable Product Development, Institute Polytechnic of Leiria), Fred Davis (Department of Chemistry, University of Reading)

2018 was the 85th anniversary of the discovery of polyethene. This material developed from a material without applications at the time on to hula hoops and became the polymer used in the largest quantities throughout the world. The properties of polyethylene can be tailored for low cost bags to bullet proof vests. Throughout the world it plays a critical role if the transport of safe and clean water and in the provision of safe electricity. The birth and subsequent development of polyethylene lead to the development of isotactic polypropylene, including the discovery of the precision control of the macromolecular chemistry leading to highly isotactic chains discovered by Natta et al (Giulio Natta, Piero Pino, Paolo Corradini, Ferdinando Danusso, Enrico Mantica, Giorgio Mazzanti, and Giovanni Moraglio J. Am. Chem. Soc., 1955, 77 (6), pp 1708–1710)

More recently, the development of metallocene catalysts has led to new polyolefin structures including polyethylene with long crystallisable side-chains. The zenith of these major scientific developments more or less coincided with the 75th Anniversary of the Discovery of polyethene. Around that time, there was a rapid growing awareness of the problems of the wide-spread use of high stability plastics and their impact on the environment. In the intervening time, the term plastic, as in the 1950s has negative rather than positive connotations; not least fuelled by the dreadful environmental damage caused by negligent disposal (as evidenced by problems with microbeads and the effect on wildlife) there is a clamour to limit the use of plastics without any balance of their technological importance or the positive effects their use has in areas such as food production and the built environment.

This presentation charts the scientific rise of polyolefins and identifies some of the challenges that this crusade generates for polymer scientists and explores the solutions which are possible.

Keywords: polyolefins, polyethylene, polypropylene, catalysis, water, electricity, waste

The birth of the Russian plastics industry. To the history of production of *Carbolite* (11:50 – 12:10)

Elena Zaitseva-Baum (Moscow State University)

The presentation will focus on the history of the creation of the Russian analogue of *Bakelite*, the so –called *Carbolite*. In this paper the features of the emergence of Russian technology and the main aspects of its development in the 1920-1930s years during the Soviet period are investigated in more detail. Numerous archives sources and materials of a number of modern Russian museums were involved in my research.

In 1909, L. Baekeland patented in the USA and European countries his own industrial method of obtaining *Bakelite* (process in the presence of an alkaline catalyst). For countries seeking to create a domestic industry of plastics, two ways were opened, respectively. The first is the purchase of a patent by Baekeland. The second is the creation of an independent patentable method that could ensure complete independence in this direction both domestically and on the world market. Russia went the second way.

In the years 1913-1914 a group of Russian chemists using the specific acidic catalyst of Petrov (known on the world market as "Kontakt P") obtained a phenol-formaldehyde resin called *Carbolite*. The catalyst (a mixture of petroleum sulfonic acids) was developed by the scientist G. S. Petrov earlier by studying of the treatment of petroleum oil with sulfuric acid. Initially it found wide application in soap production (for fat splitting).

In 1914 in the laboratory of the Brashnin's weaving factory near Orekhovo-Zuevo city, where the experiments were conducted, the scientists received the first pound of *Carbolite* phenolic resin. Already in 1916 was launched the plant "Karbolit", which began to produce the first articles: plates and rods of cast *Carbolite*.

The questions will be raised: What were the competitive advantages of Russian technology in an international context? Has it been used in other countries?

In the last part of my paper I shall discuss the rise of the plant's products based on the introduction of new technologies developed by G. S. Petrov with employees in the 1920s and 1930s. The *Carbolite* artefacts of that time will be demonstrated from collections of such Russian museums as the Polytechnic Museum, the Museum of Contemporary History (Moscow), the Regional Museum of Orekhovo-Zuevo city.

Keywords: phenol-formaldehyde resin, Bakelite, Carbolite, "Kontakt P", G. S. Petrov, Russian plastics industry

Plastic Game Pieces and the Making of Jewish American Ethnicity (12:10 – 12:30)

Annelise Heinz (University of Oregon)

Mahjong, a Chinese parlor game played with bone-and-bamboo or celluloid tiles instead of playing cards, swept American society in the early 1920s as a new and exotic "Oriental" consumer good. It died out as a national fad by the end of the decade, but after World War II it became a fundamental part of Jewish American women's culture. Without even meaning to do so, Jewish women effectively grounded an evolving modern Jewish ethnicity in a Chinese game increasingly played with Americanmade phenolic plastic tiles. Drawing from more than fifty oral histories, I argue that in the 1950s and 1960s, a recognizable national Jewish culture and familiar domestic object emerged at the same time as the proliferation of plastics.

Plastic became a way of producing the comforts of postwar prosperity, an optimistic vision of futuristic modernity, and the accessibility of leisure and consumerism. Mahjong tiles shed their exotic "ivory and bamboo" aura steeped in artisanal production and natural materials to retain their Chinese imagery as embossed in American plastic. Phenolic plastic – specifically Catalin – is part of the story of how mahjong became a symbol of a postwar Jewish middle class. The production of these tiles made that materiality possible. Moreover, the localized production of the game enabled the New York-based National Mah Jongg League to eventually change the form of what would become American mahjong. The white and marbled bars of Catalin that formed the raw materials for tiles and racks became the backbone of American mahjong manufacturing.

Ironically, plastic fabrication provided a space for traditional economic forms in a modern industry. It combined the growth markets of leisure goods and a new arena for manufacturing with the scales of family businesses and artisanal craftsmanship. Although growing, plastic was still a small economic sector, and unlike the corporate ownership over the production of plastic material itself, was not dominated by large corporations like the major areas of manufacturing such as automobiles, cotton textiles, iron, and steel. Family-run plastic fabricators created tiles with a recognizably Chinese aesthetic, which in turn helped create Jewish American distinctiveness.

Keywords: Catalin; social history; 1950s; games; American; gender and women's history

Progetto Aster: The Olivetti's creativity contained in a letter. Research into flattening methods for reshaping degraded cellulose acetate foils (11:30 – 11:50)

Fabiola Rocco (Foundation Conservation and Restoration Center La Venaria Reale), Antonio Mirabile (Paper Conservator), Michela Cardinali, Anna Piccirillo (Foundation Conservation and Restoration Center La Venaria Reale), Giulia Germinario (Department of Chemistry, University of Bari Aldo Moro), Marcella Turchetti (Associazione Archivio Storico Olivetti)

Cellulose acetate (CA) artefacts are an important part of modern and contemporary cultural heritage. A massive, yet completely unexplored, category of CA artworks is represented by the Olivetti's archival collection of original typeface drawings for typewriters. Olivetti's designers manually drew letters, punctuation marks, symbols and numbers on prefabricated A4 size CA foils matt on one side and clear on the other. Due to the overall lack of information about this peculiar type of drawing's support, the Aster typeface was selected as case study. The font includes 142 pencil drawings which share a common conservation history despite markedly differ in current state of preservation. 91 foils out of 142 exhibit a critical visual degree of degradation showing severe distortions, shrinkage, and extensive feather-like crystal efflorescence.

The aim of this study was to achieve a comprehensive characterization of the material and its degradation process in order to investigate novel treatments able to successfully recover the drawings original flat shape without changing the original foils' size or causing the drawings' distortion. In addition, the mock-ups experimentation focused on determining the long-term stability of CA foils subjected to flattening treatments by means of monitoring plasticizers and characteristic CA peaks alterations through infrared spectroscopy.

Visual observation allowed to discover that the degradation process followed a specific trend which started from the centre of the drawings pile and, subsequently, spread to the near drawings. FTIR-ATR spectroscopy allowed a rapid characterization of the plastic and of triphenyl phosphate (TPP) as plasticizer. Micro-samples were investigated by means of SEM-EDX and Py-GC/MS which allowed the elemental mapping of the material, the former, whereas revealed evidence of deacetylation, reversion to a cellulose-like structure, and confirmed the presence of TPP as main plasticizer, the latter.

Three flattening treatments options based on the combination of heat and pressure were tested on accelerated aged mock-ups with promising results. Especially the use of a vacuum table, which enabled to provide a gentle heating of the mock-ups, effectively improved the samples visual appearance avoiding any distortions of the pencil drawings. After treatment samples regained flat shape and the reshaping treatment is long lasting so far.

Keywords: cellulose acetate, deacetylation, plasticizer loss, FTIR-ATR spectroscopy, archival collections

Cellulose Acetate in "The Transparent Figures" – the Significance of a Material for the History, Production, Condition and Conservation of Educational Models Made by the German Hygiene-Museum Dresden 1925 – 2000 (11:50 – 12:10)

Maria Lörzel (HfBK Dresden and Deutsches Hygiene-Museum Dresden)

When the first Transparent Man was created between 1925 and 1930, cellulose acetate plates were a new material with sensational potential. The model gave a life-sized representation of a man – but with a transparent skin made of cellulose acetate (CA). The skeleton, the organs and the blood vessels were visible. It was displayed by the German Hygiene-Museum in Dresden in a theatrical setting, celebrating the creation of mankind. For visitors, there was no reference for such a transparent and light material, thus it was called "Der Gläserne Mensch" – "The Glass Human". The label "glass" stuck and was used for 70 years of production in the workshop of the museum and over 130 produced figures – women, men, horses, cows, pregnant torsos and other models. Even today a lot of people don't know the Transparent Figures aren't made of glass but of CA and later cellulose acetate butyrate (CAB).

While a wide range of other materials, e. g. aluminum, copper wire, PVC and paint - was used to construct the body parts and other components, the CA was what defined the figures and the workshop. Over the years a lot of minor processes changed, and they even tried to replace CA with PMMA (acrylic glass). Ultimately, CA and CAB stayed the materials of choice.

Today we see a lot of minor and major damages due to CA on the figures. The very distinct aging process with emissions of acetic acid and plasticizer as well as its auto-catalytic properties are the cause of degradation and damages not only in the plastics. We find corrosion, deformation, breakages, dissolution and flaking of paint as well as migration and drop formation of plasticizer.

Since 2016 an interdisciplinary team is researching the Transparent Figures at the German Hygiene-Museum Dresden regarding their history, production, material composition, condition and aging process to find suitable ways to actively and passively conserve them. The project is funded by the Volkswagen Foundation.

Keywords: cellulose acetate; cellulose acetate butyrate; production; educational model; material history; aging process; condition; conservation; plasticizer; Deutsches Hygiene-Museum Dresden; Transparent Figures; Glass Figures; Gläserne Figuren; Transparent Man; Transparent Woman

Challenges in characterization of 3D-cellulose nitrate objects: Experimental design and preliminary results (12:10 – 12:30)

Anna Micheluz, Christina Elsässer (Conservation Science Department, Deutsches Museum), P. Montag (PSS Polymer Standards Service GmbH), Marisa Pamplona (Conservation Science Department, Deutsches Museum)

On a long-term perspective, our research project aims to assess the effectiveness and harmfulness of several storage conditions below room temperature for 3D-cellulose nitrate (CN) objects and determine their feasibility for museum practice.

In this preliminary study, we aim to evaluate three analytical techniques for the chemical characterization of CN specimens with different condition states. EGA-MS, TD-Py/GCMS and GPC were selected for the characterization of specimens with good (**i**), moderate (**ii**) and severe condition states (**iii**) [**i**) unaged **ii**) aged: 104 cycles with varying RH between 10% and 98%, constant T = 70 °C; **iii**) aged: 4 weeks at T = 70 °C, RH = 100%] and naturally aged specimens (≥ 50 years, with severe cracks). With EGA-MS the volatile compounds (i.e. plasticizers) were detected, whereas with TDPy/ GCMS also the polymer matrix was identified. GPC was used to determine the average molecular weight (Mw) and the loss of nitrous groups.

The beginning and the duration of the volatile compounds evaporation, mainly camphor and NO_x compounds, measured by EGA, is specific for each condition state. The same volatiles and cellulose were identified by TD-Py/GCMS, pointing out an increase of their fragments for the more aged specimens.

The molecular weight (M_w) of the CN specimens decreased with progressive chemical degradation. In comparison to the unaged specimen **i**) and assuming that this has 100% nitrous groups, the moderate specimen **ii**) had 98% and the severe aged specimen **iii**) had 55%, whereas the naturally aged specimens had ca. 32%.

EGA-MS and TD-Py/GCMS gave similar results about the volatiles. EGA-MS is faster and simpler to apply, however semi-quantitative analysis can be performed with TD-Py/GCMS. For monitoring the loss of plasticizers in the future, the authors intend to develop the experimental design further.

GPC analysis characterized the chemical decay of polymer chains and it was used for monitoring the loss of nitrous groups for a relative interpretation of data. Future work could be conducted to compare the percentage loss of nitrous groups by GPC with the degree of nitration determined by Ion Chromatography.

Keywords: Cellulose nitrate, artificial aging, EGA-MS, TD-Py/GCMS, GPC

Plastic Vanitas, and how re-contextualising plastics can connect to life's precarious mortalities (14:15 – 14:35)

Mariele Neudecker (Bath Spa University)

'Plastic Vanitas' is a series of photographic works that hang together as an installation to look like a museum collection of historical Vanitas paintings. I developed the piece as part of a residency at the Museum of Design in Plastics and the Arts University Bournemouth (MoDiP, curated by Susan Lambert). My interest was to re-present the MoDiP's Plastics Collection as a set of vanitas still-life images, alluding to look like Flemish and Dutch 16th and 17th Century paintings.

MoDiP has put many thousands of plastic objects into a kind of order, or even a disorder: light objects at the top and heavy objects at the bottom of their shelves, resulting in catalogued boxes full of random mixtures - of objects that were all made of different kinds of plastics.

In the photo studio, I also created a set of empty still life images parallel to the "full sets". Whenever the plastic objects were taken off a table arrangement, were wrapped and put back into their archive boxes, the remaining scene seemed very 'potent': with an air of recent past and immanent future hanging over the table. The table tops became 'clean sheets', or 'clear decks' and were imbued with a new metaphorical authority, emphasised by their appearance as paintings.

By re-presenting the museum's collection and archives this way, I wanted to re-consider our relationship with museum collections, as much as our understanding of plastics as a decreasing resource; this has a huge environmental label of responsibility and increasing knowledge of immense irresponsibility attached to it, particularly for our oceans.

By re-contextualising plastics, we can metaphorically connect to life's precarious mortalities, both on a human and global level.

Keywords: Plastic collection, museum archive, painting, still-life, mortality

Restoring two "encapsulated" by Darío Villalba (14:35 – 14:55)

Sara Liébana Molina (Predoctoral fellow (Painting, University of the Basque Country – UPV/EHU))

Darío Villalba was one of the most influential and recognized artist throughout the last decades. He was characterized by the development of a personal language, far from the precedent abstract informalism and a pop art that he considered empty of meaning.

In 1970 he gained international recognition thanks to the artwork exhibited in the Spanish Pavilion of the Venice Biennale, "Encapsula-dos rosas", two sculptures with a pomp of transparent and pink methacrylate that protect characters inside. These sculptures were the first of a long serie of "encapsulated", among which are our case study.

The artworks that will be presented in this communication are two sculptures that consist of a wooden base on which an aluminium foil is attached, all covered by a polymethyl methacrylate capsule, one of them completely transparent and the other transparent and pink.

A Condition Report of the artworks was made and various problems such as deformations, lack of adherence, deep scratches and rests of old labels were detected. Consequently it was decided to begin a bibliographic and experimental research with the aim of identifying the type of plastic, knowing pros and cons of the different treatments, testing them in samples, and determining which were the most suitable.

This presentation will serve to communicate the results and conclusions obtained after a deep investigation of the aforementioned points; as well as the restoration details.

Keywords: Darío Villalba, encapsulated, polymethyl methacrylate, restoration.

P38 - When Present is becoming Past: Conservation Concerns of Plastics used in Photo Mountings

Mireya Arenas, Silvia Garcia Fernandez-Villa (Faculty of Fine Arts, Madrid)

In recent decades, multilayer photo mountings partially made up of plastics have become popular, and nowadays the main museums and contemporary art collections contain this type of works. The reasons for this widespread use lie in various reasons. Firstly, they present a striking and very demanded industrial appearance. Also, they do not require any kind of framing and large formats can be easily achieved using this kind of mounting. Finally, the bright and pristine appearance of their plastic surface is one of the most demanded aesthetic elements, both by the artists and the public (García Fernández-Villa, 2016).

Various plastic elements can be found in this type of multi-layer, among which the PMMA –cast or extruded- used as a protective element, or the plasticized PVC (PVCp) used as backing, are the most outstanding (Arenas; G. Fernández-Villa, 2017). In recent decades, many photo-mountings already have had important conservation problems related to the deterioration of both polymers. In the case of PMMA, deterioration caused by incorrect treatments or handling can be found, such as Environmental Stress Crazing (ESC) and superficial damages such as scratches and crazing. In other cases, degradation is due to inherent instability of the polymer: in the case of PVCp, yellowing, loss of mechanical properties and sticky surfaces can occur (G. Fernández-Villa, San Andrés, De la Roja, 2008).

This research describes the conservation problems of this kind of photo mountings, using as sources a comprehensive study on conservation of face-mounted photographs that is currently being carried out, as well as the conclusions derived from the survey performed to photographic laboratories, artists and photographers (Arenas; G. Fernández-Villa, 2015) This research also evaluates possible conservation-restoration treatments for the already degraded mountings and proposes preventive conservation strategies for the future.

Keywords: Face-mounting, PVC, acrylic, photo mounting, conservation

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P39 - Plastic pollution, climate change, sealevelrise: are 'Floating Cities' the solution?

Carolien Adriaansche (indecent artist)

Visual artist Carolien Adriaansche lives in The Hague, The Netherlands, -4.5 meters below sea level. In the Netherlands, that's normal, because 9 of the 17 million inhabitants live and work below sea level. In most countries they speak about their highest point above sea level, in the Netherlands this is the other way around. Our lowest point is near Rotterdam, about -6.7 meters.

Now that it is known that climate change will increase the sea level, the question is what consequences this will bring the Netherlands.

The climate change / sea level rise is indirectly caused by our 24/7 consumer society and plastic waste is a very visible symbol of this consuming behavior.

Adriaansche is a visual artist and is fascinated by the beautiful forms and colors of plastic, she is amazed by the way we deal with plastic by throwing it away without much thought about origin and destination. With her art she demands attention to our plastic addiction and the consequences that it entails.

Since 2015 she has built five 'Floating Cities' of plastic waste to draw attention to one of these consequences,

the sea level rise.

The different 'Floating Cities' are made up of color-sorted plastic waste that Adriaansche has collected in her studio for 25 years, such as shampoo and detergent bottles. For this project, however, larger objects were needed that she collected during her bicycle tours from home to her studio.

These are laundry baskets and buckets, broken or not. She also found the necessary waste in containers on construction sites.

The base of the cities is formed by plastic crates from the market. Fruit and vegetable crates that used to be made of wood or cardboard are often made of plastic nowadays. Beneath the crates, empty PET bottles create the floating power.

The Floating Cities have been floating in various color combinations in Dutch waters in the past few years.

Every year, objects of PET that are affected by UV radiation are replaced.

Some of these artworks have disappeared into the recycling bin.

Trash becomes art becomes trash.

Keywords: Art, plastic waste, environmental, sustainable

P40 - Seeking a New Form of Hybridity: Plastic Waste vs. Plants in Ecological Art

Aleksandra Ubertowska (Predoctoral fellow (University of Gdańsk)

The main thrust of my talk will be to examine the role of plastic elements in contemporary art dealing with the topic of the Anthropocene, the new geological era in which the impact of humans on nature cause the destructive changes in climate, landscape, biodiversity. I will focus on critical responses to the anthropogenic changes connected with - typical for late capitalism - overproduction, consumerism, production, consumption, and leaving huge amounts of non-biodegradable waste.

The "case study" tackling the aforementioned processes will be installations and media objects by Polish artist Diana Lelonek. "*The Center of Living Things*"(2016-2018), a research and artistic institution established by Lelonek, aims to popularize the new form of (human and non-human) hybridity, undermining anthropocentric hierarchies and values. The artistic objects shown within this project consist of plastic rubbish found by Lelonek

at illegal waste dumps. The plastic toys, polymer containers, and tubs are re-used as a breeding ground for moss, plants, and mushrooms growing on these objects, creating a new, counter-anthropocenic hybridity, blurring the boundaries between human and non-human. These highly sensual and evocative installations by the Polish artist underscore the relevance of non-hierarchical interdependence between genres and organisms that have been separated within an anthropocentric and capitalist paradigm.

Keywords: ecological art, plastic waste, environmentalism

P41 - PMMA: a survey on acrylic sheet in Portuguese art collections

Sara Babo, Joana Lia Ferreira (Dept of Conservation and Restoration, REQUIMTE/LAQV – FCT NOVA)

Acrylic sheet, *i.e.* poly(methyl methacrylate) (PMMA), is a twentieth century plastic material that found worldwide applications including in art. Developed during the 1930s, it was (and still is) commercialized primarily under the trade names *Plexiglas®*, *Perspex®*, and *Lucite®*. Its transparency, light-weight, strength, and ability to be moulded, made it suitable for aircraft canopies during World War II but also attractive to artists, like Naum Gabo and other members of the Russian *avant-garde*, who felt that the recently developed plastics represented modern technological materials of the industrial era. However, besides its use by these artists, PMMA, and plastics in general, were practically not seen in artworks until the 1960s, when synthetic materials became accessible to everyone.

PMMA has also been used by Portuguese artists but, to our knowledge, no studies have been made about its relevance in Portuguese art and its presence and condition in national collections. Aiming to fill this lacuna, the main Portuguese collections of modern/contemporary art have been surveyed regarding the artworks present with elements in PMMA. Selected collections were: Museu Nacional de Arte Contemporânea – Museu do Chiado, Museu Calouste Gulbenkian – Coleção Moderna, Coleção de Serralves, Museu Coleção Berardo, Colecção da Caixa Geral de Depósitos, Coleção Manuel de Brito, Museu de Arte Contemporânea de Elvas – Colecção António Cachola. Data related with each individual object observed was collected and organized in a database using *FileMaker Pro*.

The artworks identified as containing acrylic sheet during the survey belong to different categories like painting, sculpture, relief and photography. Observed tendencies and what may have oriented the choices of the artists to use (or not to use) this material will be discussed taking into consideration aesthetical and technical aspects of PMMA, as well as the context in which the artworks were created. The PMMA condition will also be analysed.

The goals and preliminary results of this survey have been presented at the Plastics Heritage Conference 2014, in the 2019 edition we will share the final conclusions of the project.

Keywords: Acrylic sheet; Poly(methyl methacrilate) or PMMA; artworks in plastic; collections survey; conservation of plastics.

P42 - An Exhibition on Historic Polymeric Materials (Hipoms) at Leiria Museum

Sara Marques da Cruz, Maria Elvira Callapez (CIUCHT – Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa), Raquel Ferreira Coimbra (Museóloga), Sofia Rodrigues (CIUCHT – Centro Interuniversitário de História das Ciências e da Tecnologia, Faculdade de Ciências, Universidade de Lisboa), Vânia Carvalho (Câmara Municipal de Leiria, Museu de Leiria)

As an ouptut of the Project entitled "The Triumph of Bakelite - Contributions for a History of Plastics in Portugal"[i], an exhibition, called *Plasticidade,* (in Portuguese, it works as an wordplay between "plastic age" and "plastic city") will be in display at the Leiria Museum (central Portugal), from April 2019-December 2020. Leiria was one of the pioneer regions of plastic industry in Portugal. This project aims to investigate and disseminate the history of plastic materials in Portugal, since the introduction of Bakelite in this country c. 1930s.

A campaign was launched throughout several media outposts in order to challenge private collectors, general public and industries either give or loan historical plastic items for the exhibition.

In this process we highlight two particular aspects:

1. Social dynamization – the collection of Historic Polimeric Materials (Hipoms) was based on an extensive collection campaign that reached a large community such as the plastics industry, museums, plastic artists and privates.
2. Controversy - The subject triggers very immediate reactions on any community, usually negative, due to the contemporary concern with the proliferation of plastic and the consequences of its misuse. So, there was a concern not to make a blind excuse for plastic, but also not to ignore its obvious advantages and achievements, such as its revolutionary effect in daily life (modification of patterns of consumerism and safety).

As a result of those two angles an opportunity was created for giving rise to a cultural parallel program to the exhibition, at Leiria Museum, in the form of: conferences, rotating exhibits, educational services on plastic for children and young students, etc.

The experience we have been carrying out during the project's running time has sparked a lively and rich discussion inside the Portuguese community on the importance of plastics as historical objects. On the other hand, they have been as familiar as they have been deeply interpenetrated in the social behaviours of the twentieth century, shaping new ways of thinking and acting.

The primary sources for this presentation are mainly the results of the plastics campaign's impact, the providers of the plastic objects and the voice of a great number of workers who devoted their careers to the plastic´s industry.

Key word: plastics, *Hipoms,* museum, collecting, community, Leiria

[i] Reference PTDC/IVC-HFC/5174/2014, from June 2016 to June 2019

P43 - Establishing a Common Ground for Plastics Conservation in Norway: a Meeting Point for Conservators and the Plastics Industry

Anja Sandtrø (National Museum of Art, Architecture and Design)

As part of a comprehensive research project running from 2017 to 2020 several museums and collections have grouped with researchers who design plastics for the industry, to establish a common ground for plastics conservation in Norway, and possibly develop procedures for stabilizing aged plastics. Through collections surveys as well as characterization and identification of selected objects by means of analytical and empirical methods, the partners gain a wider knowledge of their materials. Furthermore, we examine previous publications on conservation treatments to get a broader overview of established methods and materials as well as missing links and areas of interest. The literature review and collections survey results determine the focus materials and –methods for further research into possible post-stabilization of plastics.

This poster describes some of the methods used to do a collection survey in museums and collections across Norway. How we are establishing a common ground for nomenclature, and description of plastics, how we assist each other in characterizing and identifying plastics as well as research on what type of plastics are most frequently found in our collections, and what damages and signs of degradation are more frequent in these plastics.

Hopefully, the project may contribute to moving the focus away from consumerism of plastics towards a more sustainable approach of care and maintenance. Furthermore, a better knowledge about our plastics collections will guide our heritage management in terms of preventive means, such as planning and tailoring the storage solutions to prolong the life of our plastics collections.

Keywords: Collection survey, documentation, literature survey, plastics, degradation, stabilization

P44 - Archeological plastics in National Museum – Palace of the Grand Dukes of Lithuania collection: identification, conservation, and preservation

Medeina Steponavičiūtė (National Museum – Palace of the Grand Dukes of Lithuania)

National Museum Palace of the Grand Dukes of Lithuania was established in 2009. The collections in the museum currently consist of around 0.5 million finds from the archaeological research in the territory of Vilnius Lower Castle and the newly formed collection of the acquired authentic cultural values. Archaeological finds date back to the Stone Age and until the 20th century the first half and includes WWI and WWII. Among the numerous ceramic, metal, wood and leather founds, objects from natural polymers, biopolymers and synthetic polymers are found.

Polymeric objects are dated very differently from the fifteenth century to the first half of the twentieth century. Such various and different exhibits cause a lot of problems not only in restoring them but also in preserving or exhibiting. In many cases, these polymeric items come to a conservationist from an archaeological excavation site in a particularly poor condition. It is often not always possible to determine precisely from what they are made since various degradation processes often change objects material structure unrecognizably. So, to bring such exhibits back to life and understand their story, work with them requires much more knowledge, patience and efforts.

Keywords: archeology, identification, ATR-FTIR, conservation

P45 - What happened with the new museum for the famous Compasso d'Oro collection award?

Sandra Vazquez-Perez (Conservation and Restauration PhD Student, CITAR (Research Centre for Science and Technology of the Arts - School of Arts) - Portuguese Catholic University; Centro Conservazione e Restauro La Venaria Reale)

From 1954, the ADI-Association for Industrial Design, has been organizing the Compasso d'Oro TAward, which constitutes the oldest and most influential international design award in the world.

The Compasso d'Oro Historical Collection is the result of a simple collection of objects that received the award from the first edition to the present day and has the unique property to expand to encompass the selected products with each new edition of the award, held once every three years. In 2004, the collection was declared, Italy's National Heritage to be "of exceptional artistic and historical interest".

The spaces available to the ADI, currently located in areas insufficient to contain the numerous activities and in particular the two thousand pieces of the collection, are currently located in different external warehouse, places inaccessible to the public. The objects were packed away and stored without a particular attention being paid to correct conservation and the objects awarded are starting to show the signs of the time.

From 2010, in order to preserve its integrity, the ADI and the CCR La Venaria Reale have launched a research project for the conservation of the collection, thanks to the generous financial support of the Miroglio Group [1,2,3]. As most of the objects are made of in polymeric materials, the development of this activity has allowed us to begin to deepen the study and systematic observations on materials and production technologies that have characterized the creation of objects of the second half of the twentieth century. After the restoration it was necessary to store the objects in a better place for their conservation.

A resolution with the proposal to place a new space for the collection, dates back to 2010. The ADI and the Municipality of Milan launched a competition for ideas with the aim of permanently hosting the new headquarters of the ADI and its Foundation.

At that time, the deadline for the works was 2013, but only in February 2018 the works began and maybe the project will be completed in June 2019 and the famous collection will finally have the opportunity to be exhibited and visited for everybody in Milan [4].

Keywords: ADI, Compasso d'Oro Collection Award, Museum,

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P46 - Plastics in the history Engineering Science

Laila Zwisler (History of Technology, Technical University of Denmark)

John Law writes about the function of technology as heterogeneous engineering, which brings all the bits and pieces together and make them behave as a whole. In the historical collection of The Technical University of Denmark, plastic is prominent. It is clear that plastic play a special role in the bringing the whole together. Recently, historical research has experienced a material turn. In history of science and technology materials are not just either the objects of scientific research or faithful servants, bowing to our needs. Materials have agency in engineering science and the construction of knowledge. Also, David Edgerton encourages looking at the use of things, rather than pursuing innovation centric studies of technology and the historical collection through light on use.

In this paper I will talk about the different roles of the plastics in the collection. Plastics often act as the moldable extension of creativity. It is the enabler and provides opportunities for prototypes and models. Sometimes it is the thing in itself but at other times it is the everyday workhorse - flexible and cheap. It is an issue that plastics often decay rather quickly and are used for intermittent creations; and hence plastics are disappearing fast. Also, plastics often carry negative cultural connotations. Surely, plastic is for disposal, not valuable heritage! I will also address this issue in the paper – how do we ensure, that plastics get their rightful place in the tale of academic engineering.

Keywords: Material turn, engineering science, creativity, decay, cultural value

P47 - Effectiveness evaluation of Molisch's Test for the identification of historical celullose plastics. First results

Silvia G. Fernández-Villa, Ruth Chércoles, Margarita San Andrés (Predoctoral fellow (Faculty of Fine Arts, University Complutense de Madrid)

A wipe method called Molisch's Test -usually used to detect cellulose- can be used to identify modified cellulose plastics such as cellulose nitrate and acetate (REMILLARD, 2007). Although currently there are many analytical

techniques that allow us to identify this type of semi-synthetic plastics (for example, ATR_FTIR) (G. FERNÁNDEZ-VILLA; DE LA ROJA; SAN ANDRÉS, 2009), they are not always accessible for the collectors and conservators. Therefore, this identification test is very used in this context, as it is very simple, reachable, and also has the advantage of being minimally destructive.

In practice, the accurate identification of plastics is essential to ensure its future conservation (G. FERNÁNDEZ-VILLA; SAN ANDRÉS; DE LA ROJA, 2010). This is the case, especially, of the cellulose derivatives plastics, given that both plastics have critical conservation. In addition, each of them requires specific and different environmental parameters, which also involves the differentiation between both, to ensure their permanence.

According to the Molisch's test, and depending on its colour results, each plastic could be differentiated since they produce singular reaction products. However, these moulding plastics were often manufactured using fillers in order to modify the qualities of the polymer mixture (colour, weight, opacity, among others). These fillers may also include cellulose compounds such as wood flour, paper, and cotton, which can also give false positive results. Furthermore, false negative results can occur, for example in case of lignin presence, giving a brown coloration (BRAUN, 2013).

For all this, this research focuses on the effectiveness evaluation of this test, using different case studies of identification of historical cellulose plastics. Thus, the differences in coloration obtained with each type of plastic are evaluated and compared with other results obtained with other historical plastics with cellulose fillers. Possible interferences and false positives that may be produced by certain components of the polymer mixture are also evaluated.

Keywords: Cellulose nitrate, cellulose acetate, Molisch Test, Identification, Polymer, Plastic

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Plastics and Environment: a Threat or an Opportunity? (14:15 – 14:35)

Carlos A. A. Bernardo (Department of Polymer Engineering, Minho University)

In western countries and in the US concerns about the limits of exploitable resources and the waste resulting from human consumption has led to plastics being often perceived as ecologically undesirable. Ultimately, the driver for this perception was twofold: (1) the rapid expansion of plastics consumption worldwide, and (2) their high resistance to degradation by natural agents that keeps them more or less intact in nature for a long time. On the plus side, the many superior characteristics of polymeric products – they are lighter, stronger, cheaper, less degradable, easier to process, etc., etc. – made them dominant in many economic sectors, often substituting alternative materials.

Applying quantitative methodologies, like life cycle assessment (LCA), it is possible to conclude that, in general, using plastics to make a part generates the smallest environmental impacts in all life cycle phases up to and including the use phase. However, their end of life is often difficult to manage. In any case, the rates of "environmentally friendlier" plastic waste treatments, like recycling and incineration with energy recovery, are increasing, whereas deposition in landfills has declined consistently. Irrespective of that, it is fair to say that the environmental impact of plastics (and materials, in general), namely as post-consumer waste, is nowadays, in many applications, the limiting step in their entire life cycle. This problem is paramount in applications of great ubiquity and rapid obsolescence, like packaging, which are under increasing legislative limitations. For example, a European Strategy on Plastics was recently announced and a new Directive is being prepared to ban one-way plastic products, such as disposable tableware, cutlery, etc..

In spite of these threats, the environmental context also provides big opportunities for plastics processors: to design for reuse, recycling or just for a more value-efficient end of life. But, ultimately, technology can only go so far. To end the negative impacts of post-use plastics, information and education will remain the most important tools, namely in Asiatic countries, were most of the pollution (namely ocean pollution) comes from. Once these problems are overcome, plastics will continue to be the dominant materials of the XXI century as they were in the XX.

Keywords: Plastics; Environment; Development; Sustainability

Latin-American plastics and Colombian agriculture. Design, technology and culture (14:35 – 14:55)

Juan Fernando Parra Castro (Faculty member – Universidad Antonio Nariño, PhD student – Universidad Nacional de Colombia)

Plastic is a set of materials which has not been elucidated at all, a thousand shapes material, copycat, contradictory, useful, democratizing; a reflection of all 20th century achievements, time of its development, massification and fallout. This session comes from a wider research and will focus in the ways plastic contributed to define Latin- American culture by design, designs for local consumption, to satisfy a modernizing society needs determined by the distinction between the rural and urban landscapes. Farmers, small agricultural producers, adopted new materials–plastics between them–as means of globalization and local urban market expansion, which also collude a transposition of simulacra, in the terms of Jean Baudrillard, and environmental contradiction. Plastic culture in Latin-American agriculture is presented by the using of singular plastic objects, tools for farming which became symbol of Colombian modernization process during the 70s and 80s, when technology and design contributed to establish the profile of a particular and distinctive compound of Latin-American culture: *el campo*.

Keywords: Plastics, Latin America, Colombia, Agriculture, Design, Technology

Plastic Packaging and Ecology Between Attraction and Repulsion (14:55 – 15:05)

Hejer Barbouch (University Assistant and Doctor of Science and Technology of Design, Higher Institute of Fine Arts of Sousse, Tunisia)

If the use of plastic multiplies in our society, it is because the consumer wants it. In what follows, it will be a question of exposing the behaviours and the actions of use that exude our gestuality with the "familiarity" with the plastic packaging. So we try to question the sense accorded by the packaging gestures and its behaviours that confer a packaging to understand the concept of transposition of a consumer product and single use to a purpose of use for this packaging does not pass not fast in the trash.

Currently, plastic packaging plays an important role in our daily lives. From our own observations, in some households and as a result of household reuse, plastic containers have many lives and will not be abandoned until they are converted to another use. Although, the actions and the practices of the users with regard to the packaging after use make that they become sources of proliferation and pollution for some and for other sources of economic and organization.

These actions of keeping and reusing are not new to the Tunisian consumer, since the latter is known for his "craze to keep everything". Some Tunisian consumers, keep the objects in general and plastic boxes in particular because they cannot separate. Reasons undo these reactions. First, there is the factor of attachment to the object, on the other hand the apprehension of needing it one day and finally the feeling of guilt to get rid of it. This way of thinking objects, could be an opportunity for innovation for designers and for the environment.

Our interest as a designer for this concept of use with respect to the plastic packaging at the end of the life time, leads us to make a dive into everyday life: it appears important to us and relevant to think on the action exerted on the products of single use in the daily life by the end-user.

Each plastic packaging has attractive attributes and repellent characteristics. The attractive ones are the bases of the scenario of the appropriation of the packaging. They delight the individual in the appropriation and reuse of the packaging. Contrary to the repulsive stimuli, they are the base of the rejection, the non-confidence and the non-adoption of the packaging.

Keywords: Plastic packaging, Quotidian practice, Product design, Ecology

The power of plastic in object based-learning: a consideration of the use of historical plastic objects as dynamic tools for learning and teaching in higher education (17:00 – 17:20)

Kirsten Hardie (Arts University Bournemouth)

This paper examines the use of historical plastic objects as powerful tools for learning and teaching in Object-Based Learning (OBL) in higher education. It explores how, for example, a pair of 19th horn scissors, a 1930s shellac record and a 1950s Bakelite hairdryer, can engage students in the study of key design considerations such as notions of form and function, ergonomics, taste and consumer culture. Importantly, the paper considers how students' study of plastic objects can be enhanced when students encounter objects which they are familiar with in terms of form and function, but they are not familiar with the object being made from plastic or made from a particular type of plastic (for example student surprise when they learn that there are natural plastics). Plastic objects can therefore provoke surprise and consternation. The paper thus considers how the objects' plastic nature - the plastics' properties, qualities and associations - can intrigue and arrest learners' attention and can promote and provoke important debate and contemplation as students consider, evaluate and indeed re-evaluate attitudes regarding plastic.

The study examines undergraduate workshops that use objects from the Museum of Design in Plastics (MoDiP), Arts University Bornemouth, UK. It considers and how students physically handle, scrutinize and interrogate objects. The paper is informed by key OBL texts (e.g. Chatterjee and Hannan, 2015; Chatterjee and Duhs, 2010, Boddington, Boys and Speight (2013) Hennigar Smith, 1999 and Hooper-Greenhill, 1999) that advocate the value of OBL. Key texts that discuss objects and how we relate to them also inform this paper (e.g. Meikle, 1997; Sudjic, 2009).

The paper's concludes that historical plastic objects in OBL can facilitate dynamic and deep learning: that plastic objects can be alluring and intriguing and can be powerful pedagogic tools to encourage learners to examine and evaluate/re-evaluate plastics' contribution to design from a variety of perspectives. It concludes that students plastic objects can help students to consider further their attitudes to this ubiquitous material and, importantly, to consider the wider and changing attitudes and sensitivities regarding plastics in society.

Keywords: object-based learning; plastic as tool for learning; higher education learning and teaching; learning and teaching with museum objects

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On the history of the first phenolic resin desk lamp by Christian Dell (17:20 – 17:40)

Günter Lattermann (University of Applied Scienece, Technology and Economy HTW Berlin)

The first desk lamp made from ‚plastics' was designed by Christian Dell around 1929 and press-moulded from phenolic resin from 1930 onward by the H. Römmler AG in Spremberg, at that time one of Germany's largest companies, producing and press moulding synthetic resins. The electrical equipment was installed by the company Stotz-Kontakt in Mannheim, Germany. Both, Römmler and Stotz-Kontakt belonged to the big Brown, Boveri & Cie, (BBC).[1] In this time of new beginnings in industry (the Bakelite patents had run out) and the deep economic depression caused by the Wall Street Crash, the plastics industry was looking for the first time for new ways of presenting and marketing its products. It used the capacities of design in selling articles – today we would say the product design as a component of marketing. This was done for the first time, in USA the same idea came up ca. four years later. This development was further encouraged by the new design principles, which have been extended from the Bauhaus principles and evolved from the necessities of the moulding technology. The resulting 'Matrix Design' began to play its role for a decade (1930-40).[2]

Christian Dell - one of four nearly forgotten pioneers of plastics design in the 1930s - was the former technical head of the Bauhaus metal workshop in Weimar and at 1929/30 head of the metal workshop at the famous Art School in Frankfurt am Main. There, he designed as one of his first articles the phenolic resin desk lamp in the typical forms of the 'Matrix Design'.

After the war, two variants appeared in East Germany until ca. 1960, varying the shape of the reflecting cupola slightly.[3]

Interestingly, the desk lamp in the original design of Christian Dell was also produced in the Soviet Union from ca. 1934 onward until the 1970/80s, as new, ongoing research revealed. This lamp became the most 'famous' ubiquitous lamp in mostly every office in the USSR and was known there as the 'KGB lamp'.

Historic reports and photos even put in place it in Stalin's personal offices. Until today, apparently nobody in Russia knows its origin from a former Bauhaus master.

Keywords: Phenolic Resin, desk lamp, Christian Dell, Bauhaus, plastics design, pioneer, Matrix Design, soviet lamp, KGB lamp

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PARTICIPANTS LIST

A

Adriana RIZZO	adriana.rizzo@metmuseum.org	USA
Agata MENDYS	amendys@mnk.pl	United Kingdom
Aleksandra PAPIS	aleksandra.papis@auschwitz.org	Poland
Aleksandra UBERTOWSKA	ubertowska@wp.pl	Poland
Alexandre Ferreira XAVIER	Alexandre.xavier.ax@gmail.com	Portugal
Alice HANSEN	fondazioneplart@gmail.com	Italy
Aline Assumpção de OLIVEIRA	alineoliveira@campus.ul.pt	Portugal
Alla NUDEL	ainudel@polytech.one	Russia
Amaro REIS	amaro@sacos88.pt	Portugal
Ana BAILÃO	ana.bailao@gmail.com	Portugal
Ana Isabel BORGES	anaborge@adp.pt	Portugal
Ana RAMOS	ana.ramos@fct.unl.pt	Portugal
Ana SIMÕES	aisimoes@fc.ul.pt	Portugal
Ana COELHO	ana.coelho@sumolcompal.pt	Portugal
Anastasija SKOPENKOVA	skopenkova@inbox.lv	Latvia
Angelica BARTOLETTI	Angelica.Bartoletti@tate.org.uk	United Kingdom
Anita QUYE	anita.quye@glasgow.ac.uk	United Kingdom
Anja SANDTRØ	anja.sandtroe@nasjonalmuseet.no	Norway
Anna ANDRZEJEWSKA	a.andrzejewska@umk.pl	Poland
Anna GIATTI	anna.giatti@gmail.com	Italy
Anna KLISIŃSKA-KOPACZ	aklisinska@mnk.pl	Poland
Anna KLOSOWSKA-KLECHOWSKA	aklosowska@mnk.pl	Poland
Anna MICHELUZ	a.micheluz@deutsches-museum.de	Germany
Anna PICCIRILLO	anna.piccirillo@centrorestaurovenaria.it	Italy
Anna POKORSKA	anna.pokorska.15@ucl.ac.uk	United Kingdom
Anne BIBER	biber.anne@web.de	Austria
Annegret GELBRICH	a.gelbrich@googlemail.com	Germany
Annelise HEINZ	heinzam@uoregon.edu	USA
Anthi SOULIOTI	egg_anthaki@hotmail.com	United Kingdom
Antonella RUSSO	info@plartonline.it	Italy
Antonio MIRABILE	antonio.mirabile@gmail.com	France
Argyro GILI	a.gkili@ucl.ac.uk	United Kingdom
Ariana MCSWEENEY	amcsweeney@mountauburn.org	United Kingdom
Armando MORAIS	aj.morais@poliversal.pt	Portugal
Artur NEVES	al.neves@campus.fct.unl.pt	Portugal

B

Balazs LENCZ	lenczb@gmail.com	Hungary
Benjamin KEMPER	Kemper@hfbk-dresden.de	Germany
Berta BLASI	taller@bertablasi.com	Spain
Bianca GONÇALVES	bianca.goncalves@masp.org.br	Brasil
Boris PRETZEL	boris.pretzel@vam.ac.uk	United Kingdom

C

Caitlin RICHESON	caitlin.richeson@gmail.com	USA
Caitlin SOUTHWICK	caitlin.southwick@gmail.com	The Netherlands
Cancy CHU	cancyc@student.unimelb.edu.au	Australia
Carien van AUBEL	carienvanaubel@hotmail.com	The Netherlands
Carlos BERNARDO	cbernardo@dep.uminho.pt	Portugal
Carlos SILVA	carlossilva@joluce.pt	Portugal
Carole MAÎTRE	c.maitre@schaulager.org	Switzerland
Carolien ADRIAANSCHE	carolienadriaansche@kabelfoon.net	The Netherlands
Casey HELFRICH		
Charlotte MARRIOTT	cmarriott@iwm.org.uk	United Kingdom
Christian BONTEN	christian.bonten@ikt.uni-stuttgart.de	Germany
Christian JÜRGENS	christian.juergens@leipzig.de	Germany
Christina ELSÄSSER	c.elsaesser@deutsches-museum.de	Germany
Clara DECK	ClaraD@TheHenryFord.org	USA
Colin WILLIAMSON	c.j.w@zen.co.uk	United Kingdom
Cordelia BUCHER	cordelia.bucher@bluewin.ch	Switzerland
Costanza CUCCI	c.cucci@ifac.cnr.it	Italy
Costanza MILIANI	costanza.miliani@cnr.it	Italy

D

Damla TONUK	damlatonuk@gmail.com	Turkey
Dana HREBECKÁ	Dana.Hrebecka@nkp.cz	Czech Republic
David PIMENTA	davidpimenta@apip.pt	Portugal
Dietmar LINKE	dietmarrichardlinke@gmail.com	Germany
Dominika WOJCIECHOWSKA	dwojciechowska@polin.pl	Poland
Donald SALE	donssale@gmail.com	United Kingdom

E

Eduardo NAVARRO	eduardonavarro@ucm.es	Spain
Elena GÓMEZ-SÁNCHEZ	elena.gomezsanchez@bergbaumuseum.de	Germany
Elena HELEREA	helerea@unitbv.ro	Romania
Elena ZAITSEVA-BAUM	baumzai@mail.ru	Moscow
Eléonore BERNARD	eleonore.vergoldung@gmail.com	Switzerland
Élia ROLDÃO	elia.roldao@gmail.com	Portugal
Eline van der VELDE	eline.vandervelde@stad.gent	The Netherlands
Elisa CARL	elisasophiecarl@gmail.com	Switzerland
Elisa STORACE	curator@museokartell.it	Italy
Elise TALGORN	elise.talgorn@philips.com	The Netherlands
Ellinor GUNNARSSON	ellinor.gunnarsson@vgregion.se	Sweden
Emilia GARDA	emilia.garda@polito.it	Italy
Enrica CABIANCA	Enrica212@hotmail.it	Italy
Erich JELEN	erich.jelen@umsicht.fraunhofer.de	Germany
Erik Santos de JESUS	erick.santos@masp.org.br	Brazil
Erika KRZYCZKOWSKA-ROMAN	ekrzyczkowska@polin.pt	Poland
Ernst HOMBURG	e.homburg@maastrichtuniversity.nl	The Netherlands

Estelle De BRUYN	estelle.debruyn@kikirpa.be	Belgium
Eszter MATYAS	matyaseszter@textilrest.com	Hungary
Eva Mariasole ANGELIN	e.angelin@campus.fct.unl.pt	Portugal

F

Fabiola ROCCO	fabiola.rocco1991@gmail.com	Italy
Florian RUHLAND	florian.ruhland@georgfischer.com	Switzerland
Francesca CARDINALI	francesca.cardinali@gmail.com	Italy
Francesca Caterina IZZO	fra.izzo@unive.it	Italy
Francesca MODUGNO	francesca.modugno@unipi.it	Italy
Francesca ROSI	francesca.rosi@cnr.it	Italy
Francisco Toscano RICO	ftrico@cvrlisboa.com	Portugal
Friederike WAENTIG	friederike.waentig@th-koeln.de	Germany

G

Gabriela VYSKOČILOVÁ	gabriela.vyskocilova@mail.muni.cz	Czech Republic
Gabriella RUSSO	fondazioneplart@gmail.com	Italy
Geoffrey R. MITCHELL	geoffrey.Mitchell@ipleiria.pt	Portugal
Gianluca PASTORELLI	gianluca.pastorelli@smk.dk	Denmark
Giovanna CASSESE	presidente@isiafaenza.it	Italy
Giulia GERMINARIO	giuliagerminario83@gmail.com	Italy
Gonçalo LOPES	glopes@cm-leiria.pt	Portugal
Günter LATTERMANN	guenter.lattermann@uni-bayreuth.de	Germany

H

Hanna M. SZCZEPANOWSKA	hannams2013@gmail.com	USA
Hannah HENDRICKX	hannah.hendrickx@stad.gent	Belgium
Heike WINKELBAUER	h.winkelbauer@akbild.ac.at	Austria
Hejer BARBOUCH	barbouchhejer@yahoo.fr	Tunisia
Heleen van SANTEN	heleen.van.santen@gmail.com	The Netherlands
Henrique LEITÃO	hjleitao@fc.ul.pt	Portugal
Hugh KARRAKER	hugh@allthingsbakelite.com	USA

I

Ida AHMAD	ida.ahmad.17@ucl.ac.uk	United Kingdom
Inês MATOSO	inesmatoso@gmail.com	Portugal
Inês SOARES	i.soares@campus.fct.unl.pt	Portugal
Inguna NAMIKE	inguna@safin.com	Latvia
Ion SERES	office@plastor.ro	Romania
Isabella del GAUDIO	isabella.gaudio.17@ucl.ac.uk	United Kingdom
Isabella Villafranca SOISSONS	Isabella.Villafranca@opencare.it	Italy
Isabelle Marina HELD	isabelle.held@network.rca.ac.uk	United Kingdom
Iyun Olushola PETER	iyun-p-olushola@zolarsbkayltd.com	Nigeria

J

Jaime Rezola CLEMENTE	jclemente@baquelite.com	Portugal
Jake KANER	jake.kaner@ntu.ac.uk	United Kingdom
Jamie LARKIN	jlarkin@chapman.edu	USA
Janine KÖPPEN	janinekoeppen1@web.de	Germany
Javier GOROSTIZA	jarshvor@gmail.com	Spain
Jeffrey MEIKLE	meikle@mail.utexas.edu	USA
Jefta LAMMENS	jeftalammens@hotmail.com	Belgium
Jirí BROŽEK	Jiri.Brozek@nkp.cz	Czech Republic
Jitka NEORALOVÁ	JItka.Neoralova@nkp.cz	Czech Republic
Joana Lia FERREIRA	jlaf@fct.unl.pt	Portugal
João CORTEZ	jocortez@celoplas.pt	Portugal
João JANZ	jjanz01@gmail.com	Portugal
João NETO	joao.neto@anf.pt	Portugal
Joaquim MENEZES	j.menezes@yahoo.com	Portugal
Jocelyn ALCANTARA-GARCIA	joceag@udel.edu	USA
Johannes HEYN	johannes.heyn@ikt.uni-stuttgart.de	Germany
Jole Narva BOTTI	botti.jole@gmail.com	Italy
Jorge MONIZ	jorge.moniz@omnova-pt.com	Portugal
Joy BLOSER	joy_bloser@moma.org	USA
Joyce H. TOWNSEND	joyce.townsend@tate.org.uk	United Kingdom
Juan Fernando Parra CASTRO	jotaefepece@uan.edu.co	Colombia
Judith BÜTZER	judith.buetzer@web.de	Germany
Judith HUBER	ma.ju@bluewin.ch	Germany
Julia BECKER	julia.becker@talm.fr	France
Julia DEMETER	julia.reischl@googlemail.com	Germany
Julia SAWITZKI	julia.sawitzki@kunsthaus.ch	Switzerland
Julia WAGNER	julia.johanna.wagner@gmail.com	The Netherlands
Julianne BELL	julianne.bell@unimelb.edu.au	Australia
Julio M. del HOYO-MELÉNDEZ	jdelhoyo@mnk.pl	Poland
Jurga BAGDZEVIČIENĖ	jbagdzeviciene@gmail.com	Lithuania

K

Kamilla ØDEGÅRD	k.oedegard@gmail.com	Switzerland
Karoliine KOROL	karoliine.korol@erm.ee	Estonia
Kateřina HRICKOVÁ	tomsovak@vscht.cz	Czech Republic
Katharina HAIDER	katharina@bacon-studios.com	Germany
Katharina SCHIRMBRAND	K.Schirmbrand@gmx.at	Austria
Katherine CURRAN	k.curran@ucl.ac.uk	United Kingdom
Kathryn KRUMMECK		
Katie O'BRIEN	KOBrien@iwm.org.uk	United Kingdom
Ke-Shiuan HAN	tracyhan1206@gmail.com	The Netherlands
Kirsten HARDIE	khardie@aub.ac.uk	United Kingdom

L

Laila ZWISLER	lazw@fysik.dtu.dk	Denmark

Laura BODE	laura.bode@th-koeln.de	Germany
Laura LELUŢIU	laura.lelutiu@unitbv.ro	Romania
Laura PAGNIN	l.pagnin@akbild.ac.at	Austria
Laura WOLFKAMP	l.wolfkamp@gmail.com	The Netherlands
Laurent BOZEC	l.bozec@utoronto.ca	Canada
Leila SABOUNI	leila.sabouni@gmail.com	
Leonardo BORGIOLI	l.borgioli@ctseurope.com	Italy
Lindsay MACDONALD	lindsay.macdonald@ucl.ac.uk	United Kingdom
Lisa BURKART	lisa.burkart@th-koeln.de	Germany
Liv RAMSKJAER	LR@museumsforbundet.no	Norway
Lorena ESCOLANO	lorenaescolano@gmail.com	Spain
Louise CONE	Louise.Cone@smk.dk	Denmark
Louise DENNIS	ldennis@aub.ac.uk	United Kingdom
Louise S. BECK	LouiseB@TheHenryFord.org	USA
Lucile POURRET	pourret.lucile@gmail.com	The Netherlands
Lucrezia MICOTTO	lucrezia.micotto@gmail.com	Italy
Luis MONTELOBO	Luis.Montelobo@cires.pt	Portugal
Lydia BEERKENS	lydia.beerkens@planet.nl	The Netherlands

M

Marcella TURCHETTI	marcella.turchetti@archiviostoricolivetti.it	Italy
Marcello PICOLLO	m.picollo@ifac.cnr.it	Italy
Marcus BROECKER	m.broecker@schaulager.org	Switzerland
Margarita San ANDRÉS	msam@ucm.es	Spain
Margherita ALTERINI	margherita.alterini@stud.unifi.it	Italy
Margrit BORMANN	margrit.bormann@auschwitz.org	Poland
Maria Antonietta Di MARCO	maria.antoniettadm95@gmail.com	Italy
Maria ARAÚJO	mearaujo@fc.ul.pt	Portugal
Maria Elvira CALLAPEZ	mariaelviracallapez@gmail.com	Portugal
Maria João GUERRA	mjguerra@janz.pt	Portugal
Maria João MELO	a1318@fct.unl.pt	Portugal
Maria LEITE	maria.leite@aerp.pt	Portugal
Maria LÖRZEL	Loerzel@hfbk-dresden.de	Germany
Mariana ESCAMILLA	mcescamillam@gmail.com	Germany
Marianne ODLYHA	m.odlyha@bbk.ac.uk	United Kingdom
Mariele NEUDECKER	mail@marieleneudecker.co.uk	United Kingdom
Marika MANGOSIO	marika.mangosio@polito.it	Italy
Marina HIGASHIMORI	m.tsukada.tnm@nifty.com	Japan
Marisa PAMPLONA	m.pamplona@deutsches-museum.de	Germany
Mário COELHO	mcoelho@cm-leiria.pt	Portugal
Mark KEARNEY	mark.kearney.15@ucl.ac.uk	United Kingdom
Marta PALMEIRA	2021@2021.pt	Portugal
Mary M BROOKS	mary.brooks@durham.ac.uk	United Kingdom
Masahiko TSUKADA	m.tsukada.tnm@nifty.com	Japan
Medeina STEPONAVIČIŪTĖ	m.steponaviciute@valdovurumai.lt	Lithuania
Michaela CERMÁKOVÁ	Michaela.Cermakova@nkp.cz	Czech Republic

Michela CARDINALI	michela.cardinali@centrorestaurovenaria.it	Italy
Miguel RITTO	mritto@psaplast.com	Portugal
Mireya ARENAS	sgfv@ucm.es	Spain
Miriam SCHANZ	miriam.schanz@gmail.com	Germany
Monika JADZINSKA	monika.jadzinska@asp.waw.pl	Poland

N

Natalia Hervás FERNANDEZ	nachiherv@yahoo.es	Spain
Nevena ILIC	nillich@gmail.com	Portugal
Nikola ŠIPOŠOVÁ	Nikola.Siposova@nkp.cz	Czech Republic
Nuno FROIS	nf@sie.pt	Portugal
Nuno GUIMARÃES	nuno@agi.pt	Portugal

O

Oséias de SOUZA	crmetaissouza@gmail.com	Portugal

P

P. MONTAG	pmontag@pss-polymer.com	Germany
Paula DIOGO	mpd@fct.unl.pt	Portugal
Paula GASSMANN	paula.gassmann@student.akbild.ac.at	Austria
Paula Mota SANTOS	pmsantos@ufp.edu.pt	Portugal
Paulina MATA	mpm@fct.unl.pt	Portugal
Paulo ALMEIDA	paulo.almeida@plasgal.pt	Portugal
Pedro GONÇALVES	pedro.goncalves@cires.pt	Portugal
Pedro Paes do AMARAL	pamaral@interpolimeri.pt	Portugal
Penny SPARKE	P.Sparke@kingston.ac.uk	United Kingdom
Petra VÁVROVÁ	Petra.Vavrova@nkp.cz	Czech Republic
Petronella NEL	pnel@unimelb.edu.au	Australia
Pina di PASQUA	dipasqua@plart.it	Italy
Pjotr JUGA	Peter.Juga@ringve.no	Norway

R

Rachel DELPHIA	DelphiaR@cmoa.org	USA
Raúl CASTRO	raul.castro@cm-leiria.pt	Portugal
Radka KALOUSKOVÁ	Radka.Kalouskova@vscht.cz	Czech Republic
Raquel Ferreira COIMBRA	raquel.coimbra@gmail.com	Portugal
Rebecca PLOEGER	ploeger@buffalostate.edu	USA
Rebecca TIMMERMANS	R.Timmermans@stedelijk.nl	The Netherlands
Richard S. BLACKBURN	R.S.Blackburn@leeds.ac.uk	United Kingdom
Richard SCHOEVAART	richardschoevaart@gmail.com	The Netherlands
Richard THOMMERET	richard.thommeret@solvay.com	Belgium
Robert FRIEDEL	friedel@umd.edu	USA
Rose KING	rose.king.16@ucl.ac.uk	United Kingdom
Ruth CHÉRCOLES	msam@ucm.es	Spain
Ruth KELLER	ruth.keller@htw-berlin.de	Germany

S

Sandra VAZQUEZ-PEREZ	vazquezperezsandra@yahoo.es	Portugal
Sandra WEERDENBURG	S.Weerdenburg@stedelijk.nl	The Netherlands
Sara BABO	sara.sbabo@gmail.com	Portugal
Sara Liébana MOLINA	sara.liebana@ehu.eus	Spain
Sara Marques da CRUZ	saramarquesdacruz1@gmail.com	Portugal
Sara RUSSO	artsara.russo@gmail.com	Italy
Sarah Caldwell STEELE	sarahebor@gmail.com	United Kingdom
Sherry KARRAKER	sherryk5@optonline.net	USA
Silvana BESSONE	sbessone@mncoches.dgpc.pt	Portugal
Silvia G. FERNÁNDEZ-VILLA	sgfv@ucm.es	Spain
Simoní Da ROS	s.ros@ucl.ac.uk	United Kingdom
Sofia NUNES	sar.nunes@campus.fct.unl.pt	Portugal
Sofia RODRIGUES	sofia.pinto.rod@gmail.com	Portugal
Stefan POSER	poser@hsu-hh.de	Germany
Stuart ROBSON	s.robson@ucl.ac.uk	United Kigdom
Susan MOSSMAN	Susan.Mossman@sciencemuseum.ac.uk	United Kingdom
Susana França de SÁ	susana.sa@fct.unl.pt	Portugal
Susanne BRUNNER	s.brunner@deutsches-museum.de	Germany
Susanne REHN-TAUBE	s.rehn@deutsches-museum.de	Germany
Suzan de GROOT	s.de.groot@cultureelerfgoed.nl	The Netherlands

T

Teresa DONNER	teresa.donner@posteo.de	Germany
Thea van OOSTEN	vanoostenthea@gmail.com	The Netherlands
Thyl FEUERSTEIN	info@t-feuerstein.de	Germany
Tiago COELHO	tiago@agi.pt	Portugal
Tim A. OSSWALD	tosswald@wisc.edu	USA
Tom FISHER	tom.fisher@ntu.ac.uk	United Kingdom
Tomas MARKEVICIUS	tomas.markevicius@th-koeln.de	The Netherlands

U

Ulrich LANG	atelier@dierestauratoren.de	Germany

V

Valentina PINTUS	v.pintus@akbild.ac.at	Austria
Valentina VILLA	valentina.villa@polito.it	Italy
Vânia CARVALHO	vcarvalho@cm-leiria.pt	Portugal
Viola HOFMANN	viola.hofmann@tu-dortmund.de	Germany
Vítězslav KNOTEK	Vitezslav.Knotek@vscht.cz	Czech Republic

W

Wolfgang SCHEPERS	wolfgangschepers@aol.com	Germany

Y

Yoel BERGMAN	yoelb062@gmail.com	Israel
Yvonne HED	yvonne.hed@norner.no	Norway
Yvonne SHASHOUA	yvonne.shashoua@natmus.dk	Denmark

ORGANIZER

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