
Flock Association
of Europe
ALL ABOUT FLOCK
26th INT. FLOCK SYMPOSIUM
24. - 25.03.2022, Barcelona

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PROGRAM OF LECTURES

LECTURES 1ST DAY

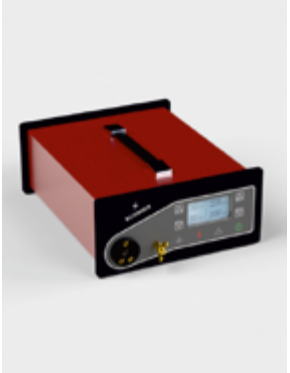
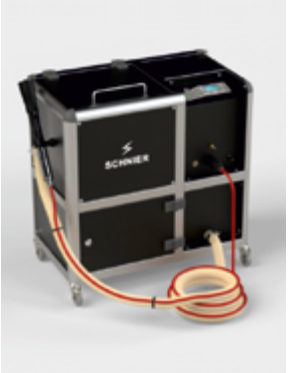
LECTURES 2ND DAY

SCHNIER

FLOCK

FLOCK Checker
simple and precise

it has never been
so easy to measure the
conductivity of your flock fibers

MINI Flocker Evo	EASY Flocker	AIR Flocker Pro	FLOCK-o-Skop	EASY Checker
				

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Preamble

Dear Participant,

the Board of the Flock Association is very pleased to welcome you personally to our 26th intern. Flock Symposium here in the lovely city of Barcelona.

In the last two years, personal meetings and the organisation of events have been almost impossible. A long period of isolation and home-working is now behind us - all the more, we now look forward to welcoming you to our one year, COVID delayed, symposium. After enduring so much, we are all eager to regain the familiar „normality“ step by step. Much has changed in the last two years, habits have changed and adapted anew.

Together with you we take this chance to look into the future of our industry, to network, to experience and learn new things - because „Flock creates connections“.

Our speakers this year are looking forward to informing you about innovations that affect our industry. We have again deliberately sought contributions from different sectors of the industry in order to be able to present you with a varied and interesting programme.

Please do not hesitate to contact me if you have any questions about our symposium or our Flock Association. On behalf of all the board members of the Flock Association, I wish you a successful, enjoyable symposium and networking!

Yours

Stephanie Wegner
CEO, Flock Association of Europe

The Association

Achieving goals together

The Flock Association of Europe was founded in 1981 in Büdingen (Germany) and sees itself as the central representing of the interests of all companies involved in flock-technology. The elements of the organisation are the members-assembly and the board. Our members and interested parties are supported in questions related to all aspects of flock, its application and use.

JOIN US...

... to establish FLOCK as a high tech solution in functionality and comfort.
... to establish FLOCK as a premium solution for application.
... to get inspiration from international events.

MEMBERSHIP

We welcome all who are interested in flock, its uses and applications. More information about flock, and our association, along with a membership form, can be found online at www.faoe.eu.

GET IN TOUCH!

1. DOMO's Performance Fibers with enhanced biodegradability

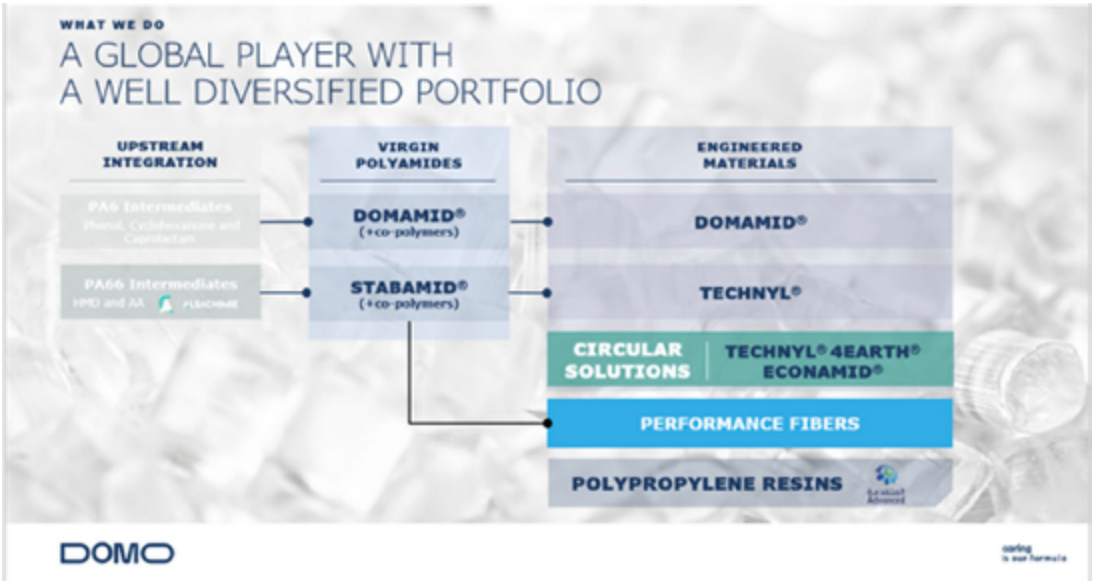
Florent Cottin
Domo Chemicals

Abstract

DOMO Chemicals is a leading engineering materials company and highly integrated solution provider committed to the sustainable future of polyamides.

Caring is our formula to create value – for our customers and consumers, for our teams and our people, for our shareholders as well as for the wider society and communities, in which we operate.

As a family-owned company with its roots and headquarters in Ghent, Belgium, DOMO Chemicals serves customers and partners globally. DOMO Chemicals has nine production sites and several sales offices around the world.



DOMO Performance Fibers offers high value-added solutions based on polyamide 6.6 fibers (staple fibers, crimped tow and tow for flock). Based in Valence, France, DOMO Performance Fibers has been producing world-class PA66 fibers since 1955 for such industries as nonwoven for abrasives and aeronautics, flooring for carpets, high performance textiles, flock for upholstery, automotive interiors and flooring, and many other consumer products.

Sustainability is deeply anchored in the company's vision and mission and is one of its strategic pillars. DOMO is implementing a carefully planned transformation for its sustainability journey to be successful.

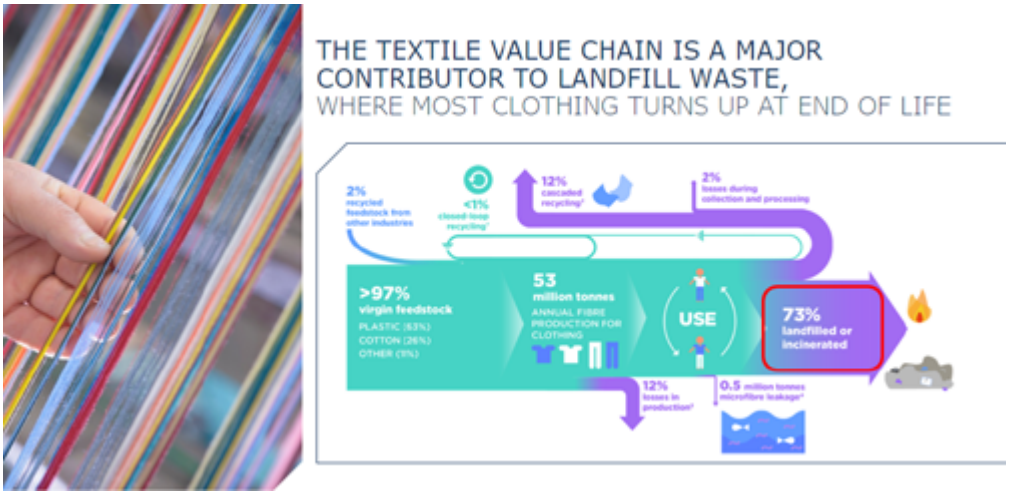
DOMO is also pledging to support its customers by enhancing its offering of sustainable solutions.

This symposium will present one of DOMO's "outside of the box" sustainable solutions that transforms synthetic polyamide 6.6 fibers into biodegradable materials once landfilled.

Enhanced biodegradability

The pollution generated by the textile industry has a huge impact on the planet, and the reasons are quite easy to understand. Clothing is probably the most common item that people buy in today's world. In recent years, the average number of items of clothing purchased annually by individuals has increased drastically, ultimately leading to major environmental problems, such as water, air and solid waste pollution.

According to the Ellen Mac Arthur Foundation, more than 70% of end-of-life clothing is landfilled or incinerated. When landfilled (under anaerobic conditions), traditional synthetic materials like nylon 6.6 may take between 50 and 100 years to decompose. Compare this to DOMO's polyamide 6.6 fibers with enhanced biodegradability, which may take less than five years to decompose.



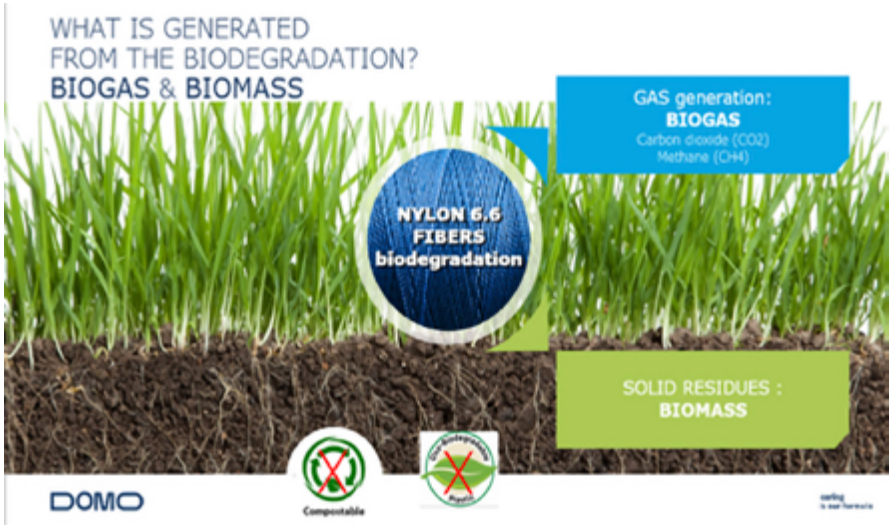
This is possible thanks to the addition of special additives in the polyamide 6.6 matrix.

These additives facilitate the access of bacteria to the microscopic structure of the fiber, by "swelling" the fiber when exposed to high humidity, and by triggering the biofilm formation process through a biological mechanism known as "quorum sensing".

Once the biodegradation process starts, the polyamide 6.6 is intrinsically food for bacteria, thanks to its chemical structure based on carbon and hydrogen.

What is generated from the polyamide 6.6 fiber biodegradation? Just biogas and biomass.

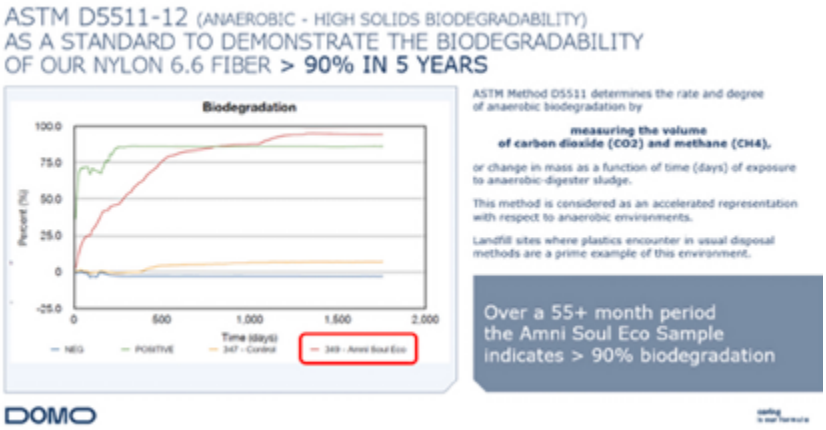
What is generated from the polyamide 6.6 fiber biodegradation? Just biogas and biomass.



Carbon dioxide and methane are greenhouse gasses. However, in well-controlled landfills, biogas is not released directly into the atmosphere, but burned. In more sustainable landfills, biogas is even used for power generation.

The residues of polyamide 6.6 fiber biodegradation are basically organic compounds, in the same way as residues from other natural biodegradable materials, such as paper and cotton. In theory, the residues could even be used as fertilizer, though this is not done in practice, as residues from landfills remain buried indefinitely in the soil.

In our specific case, we have demonstrated a biodegradation of more than 90% in less than five years. We have used the ASTM D5511-12 standard* to demonstrate the real biodegradation in anaerobic conditions.



Therefore, our polyamide 6.6 fibers with enhanced biodegradability are not compostable products and are not subject to certification standards for compostable products but have been specifically developed for landfill disposal.

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*Standard Test Method for Determining Anaerobic Biodegradation of Plastic Materials Under High-Solids Anaerobic -Digestion Conditions (equivalent to ISO 15985)

NOTES

Flock Association
of Europe

2. Geometries in electrostatics – 3D printing opens up completely new possibilities

Olav Schnier
Schnier Elektrostatik GmbH

Introduction

In electrostatic flocking, voltages of up to 80,000 V are usually used. These high voltages always pose challenges for developers of flocking devices. For this, we first have to look at air creepage distances.

Air has an average breakdown field strength of 3.3 kV / mm. So in theory, to isolate 80 kV, a distance of just over 24 mm would be sufficient. However, the breakdown field strength of air depends on many factors, including air pressure. Much more decisive for electrostatics, however, is that we release ions through the electric field. An ion is an electrically charged molecule or atom. In our case, this means air ions. Ions have the property that they are not only charged but also conductive. Over time, the air, which is still well insulated at the beginning, becomes more and more conductive. Another aspect is that these ions also like to accumulate on insulating surfaces and make these insulating surfaces conductive. The current standards for electrostatic coating specify that a minimum distance of 2.5 mm/KV must be maintained. At 80 kV, this is at least 200 mm. Let's look at the insulating distance using the example of a hand-held fock cable:

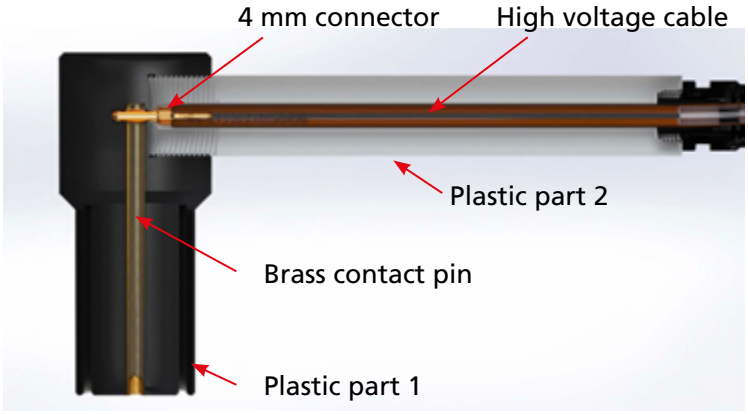
Fig. SCHNIER hand flock cable

In the example of the HV connection of a hand-held flock cable, the minimum distances or minimum insulation distances are still relatively easy to realise. The high-voltage connector is axial and the mechanical parts can be manufactured on a lathe, for example.

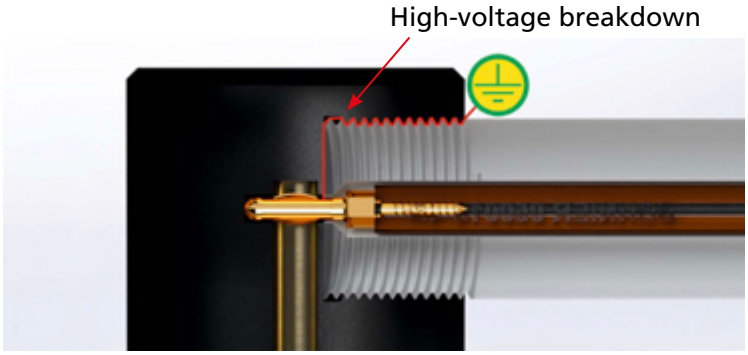
The situation is different here, for example, with an angle connection for flock applicators, as in the following example:

The angle connection must be made from several parts and then assembled. Let us take a look at a sectional drawing:

The threaded connection of plastic part 1 and plastic part 2 is problematic. This connection will not be highly voltage-tight via the thread alone. If an earth comes close to the outside, there is a risk of breakdown.



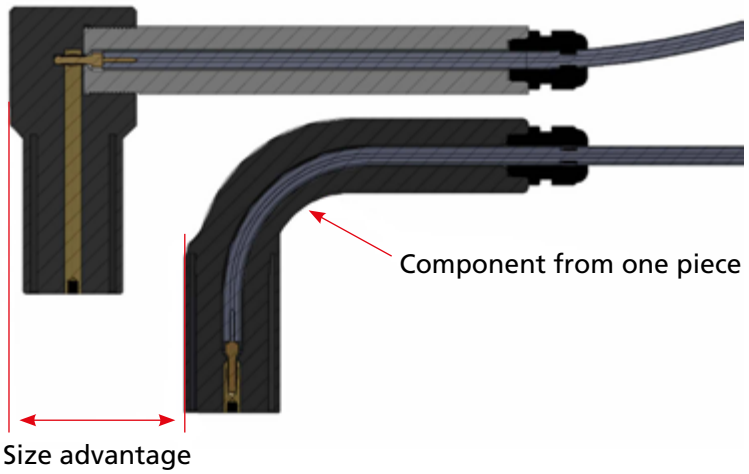
High-voltage-resistant bonding is also not without problems, as plastics that have good high-voltage properties, such as POM, cannot be bonded easily. Also, a bonded joint is often no guarantee for high-voltage resistance.



3D printing offers unimagined possibilities here. If the same right-angle connector is designed for 3D printing technology, it could look like this:

In comparison, the sectional view of the construction for 3D printing technology:

Comparison of both constructions in sectional view:



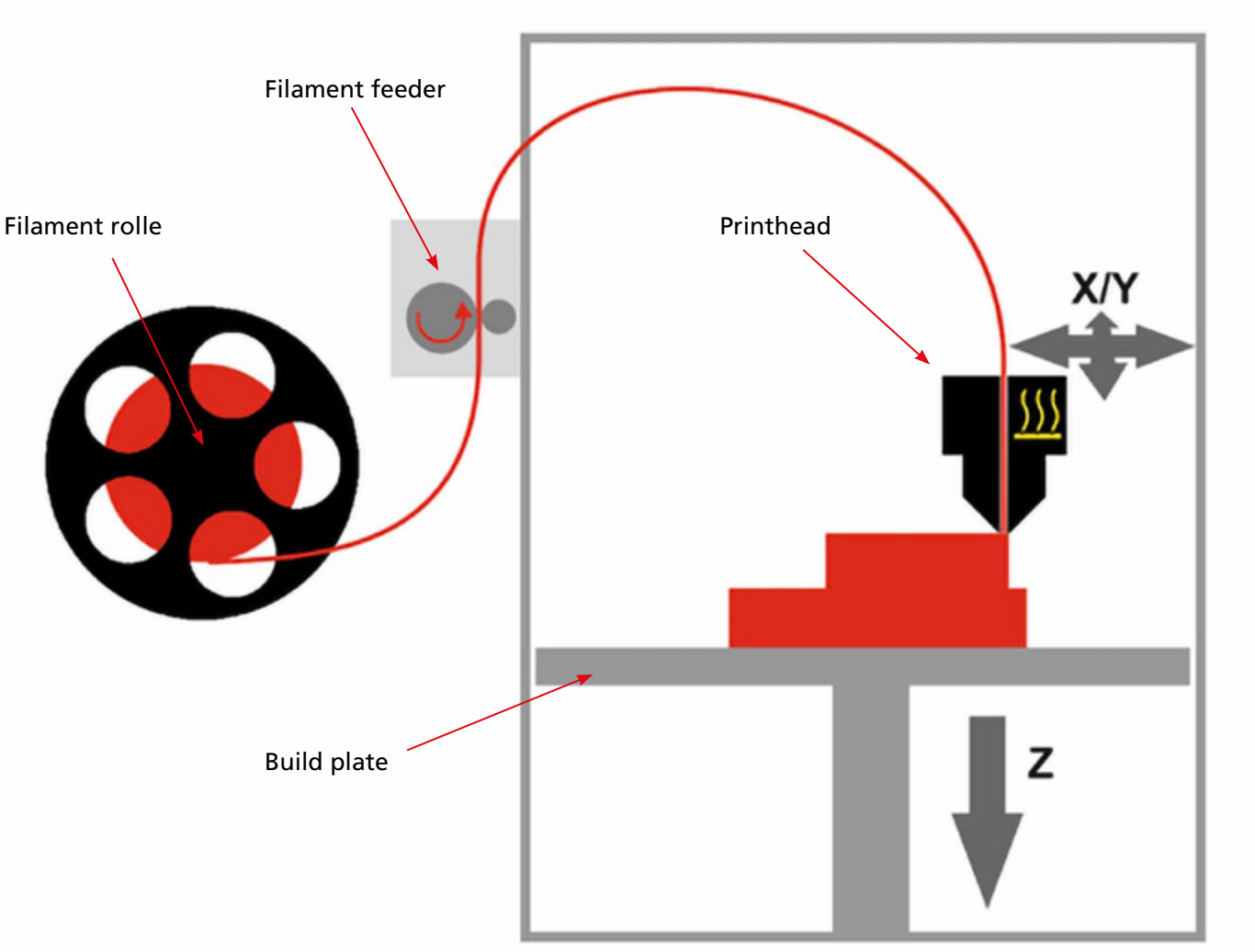
Advantages in design through 3D printing technology:

- Component significantly more compact with the same insulating distance
- Due to the pressure in one piece, significantly better and more durable insulating ability (no „predetermined breaking point“ in the thread area)
- Usually cheaper for small series
- Much more freedom in design - complex geometries possible
- Less stock-keeping, as „just in time“ printing is possible
- Cost-effective and fast production of prototypes
- The degree of filling of the components can be freely determined, thus reducing weight and costs
- Wide range of materials, especially with FDM printing
- Several materials can be processed in one component

3D printing techniques currently used at SCHNIER Elektrostatik

1. FDM Printing – Fused Deposition Modeling

In simple terms, FDM printing is a type of hot glue gun that is guided along an X/Y axis. The filament (printing material) is on rolls and is transported via a filament feeder to the heated print head and pressed in a defined way through the hot nozzle. The first layer is printed on a printing plate via the X/Y axis. When the first layer has been printed, a Z axis lowers the printing plate by one layer thickness. Then the next layer is applied. In contrast to the SLS process, only material remains where it is actually printed. Overhangs can therefore only be printed within a very limited angle. Alternatively, support material can be printed, which supports the overhang and must be removed again on the finished model. Layer thicknesses are usually in the range of 0.025 and 1.25 mm, depending on the application. The finer the layer thickness, the more precise the component, but this has a significant effect on the printing speed and thus on the manufacturing costs.



Advantages:

- Inexpensive printers available
- Easy material and part handling
- Many materials available which are much cheaper compared to SLS powder
- Two different materials can be processed in one print
- Favourable printing costs
- Significantly lower energy consumption compared to SLS

Disadvantages:

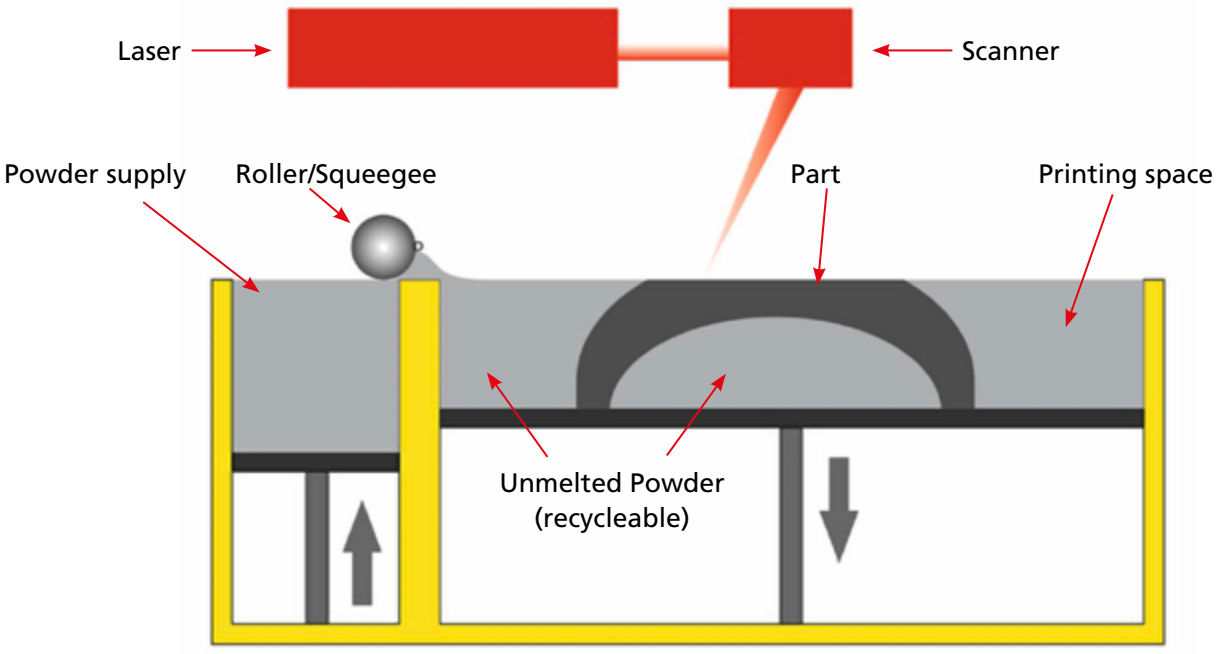
- Possible geometries significantly more limited than with SLS printing
- Surface more uneven
- Depending on the material, vapours can arise which have to be extracted

Due to the significant differences in manufacturing costs, SCHNIER Elektrostatik prints in the FDM process whenever possible. SLS is always used when the geometries require it.

SCHNIER FDM printer farm

2. SLS – Selektive Laser Sintering:

In the SLS process, a 1 to 200 µm thick layer of powder is applied to the entire surface of the build platform with a roller or squeegee. As a rule, the entire build area is heated and after the powder layer has been applied, a laser beam melts the powder at the points where a component is to be created. The build platform then lowers by the thickness of the powder layer. The next layer of powder is then applied and again fused with the laser beam at the desired locations. After the print is finished, the complete build platform is removed. The powder that has not fused can be removed and what remains is the printed part. This is usually reworked, e.g. by sand-blasting, to remove all excess powder. Most of the non-fused powder can be reused



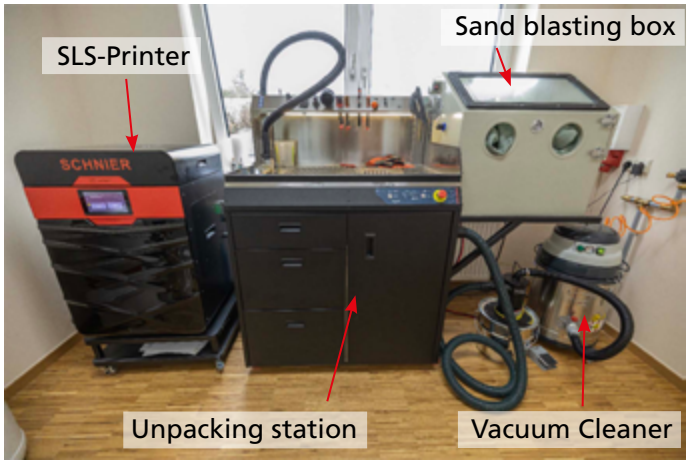
Advantages:

- The non-fused powder forms the support structure for the next layers, thus any overhangs can be produced without any problems.
- Uniform surfaces.

Disadvantages:

- High investment costs of the printer.
- High powder prices - thus high production costs
- Limited choice of materials
- Significantly higher handling costs

We work in-house with a relatively inexpensive SLS printer from Sinterit. Investment costs incl. unpacking station approx. 22,000 €. The biggest disadvantage of this printer is the extremely slow printing speed.



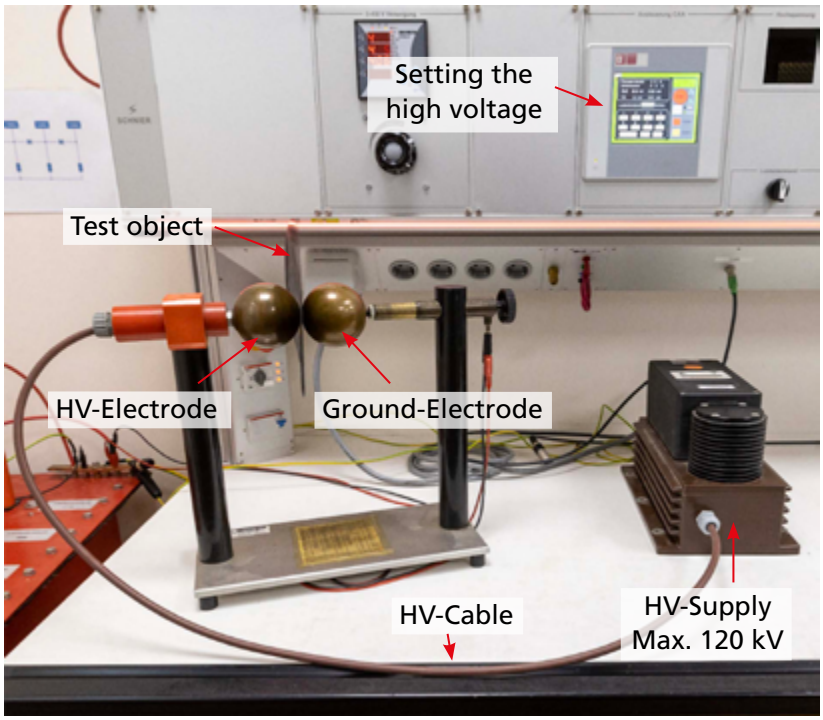
We usually have series parts printed externally on EOS machines. Investment costs for an EOS SLS printer from approx. 200,000 €.

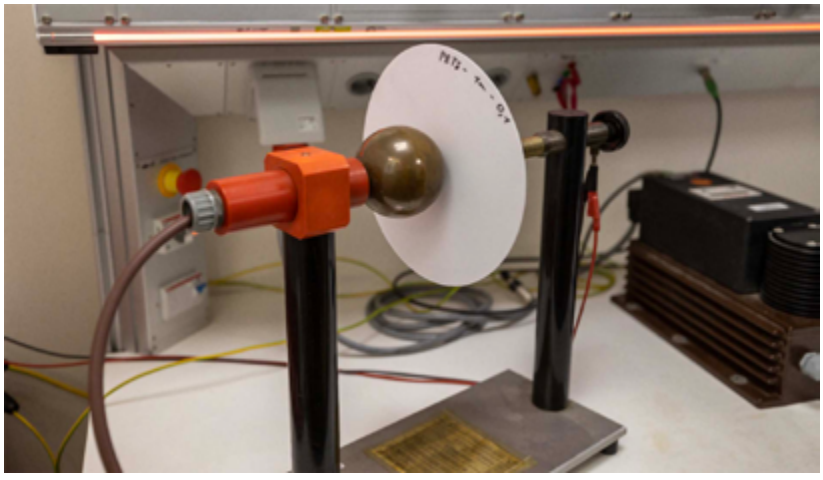
Investigation of the dielectric strength

In addition to the geometry, the dielectric strength is also of decisive importance in the field of electrostatics. To define these, a test was carried out with different materials. For this purpose, discs with a diameter of approx. 220 mm were produced from each material. Especially with the potting materials it was not possible to create a defined layer thickness, but also with the printed materials there were different layer thicknesses due to tolerances. The layer thicknesses were therefore measured before each test. Experience shows that the dielectric strength is not linear to the layer thickness, so the following results should not be seen scientifically, but more as a comparison of the materials. In addition, insulating materials age and the dielectric strength decreases with increasing age. For resins we reckon with 2/3 of the original dielectric strength after 3 years and 1/3 after 10 years. The geometries of the electrodes are also decisive. In our study, two spheres were used, which can be considered ideal and thus leads to very high dielectric strength.

Layer thickness measurement:

Experimental setup:



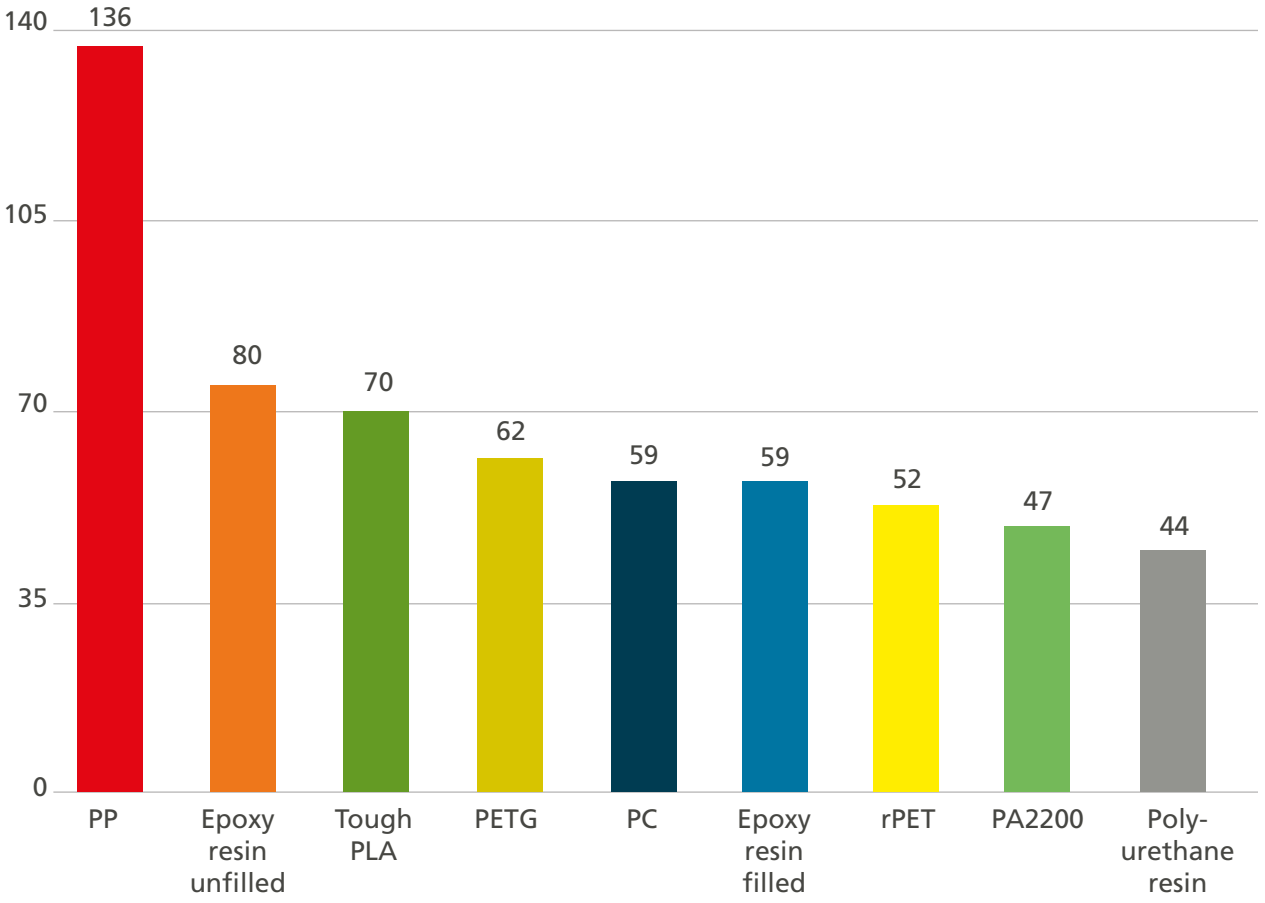


Examined materials/result:

Material	Manufacturing	Layer thickness [mm]	Breakdown voltage [kV]	Dielectric strength [kv/mm]
Tough PLA	FDM-Print	0,99	70	70
PETG	FDM-Print	0,89	55	62
PC	FDM-Print	0,93	55	59
rPET	FDM-Print	1,05	55	52
PP	FDM-Print	0,88	>120	>136*
PA2200	SLS-Print	1,29	60	47
Epoxy resin filled	Vakuum casting	1,35	80	59
Epoxy resin unfilled	Vakuum casting	1,52	>120	>80*
Polyurethane resin	Vakuum casting	1,70	75	44

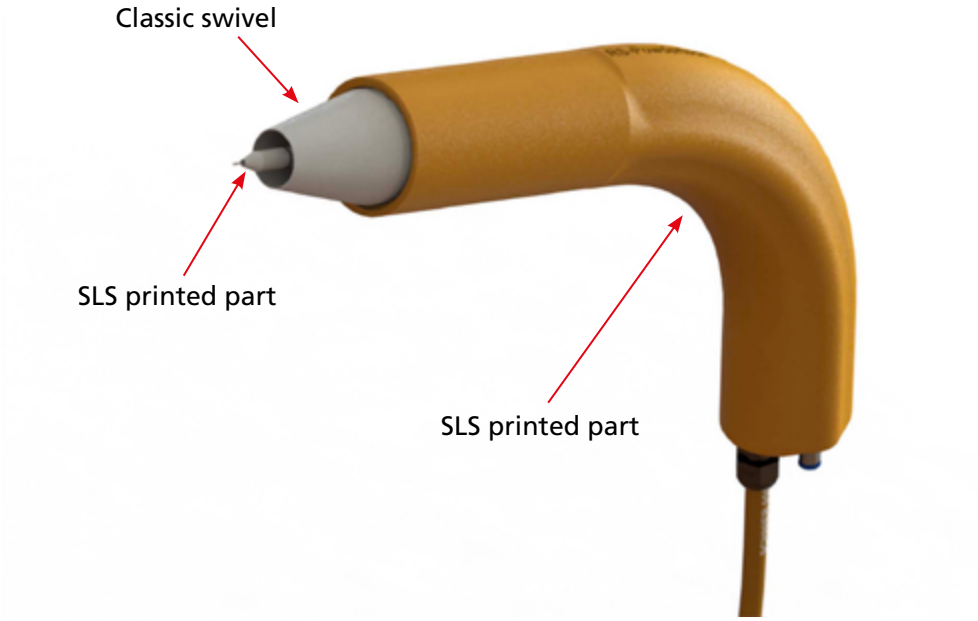
* No breakdown at 120 kV (maximum voltage of the high-voltage generator)

Dielectric strength [kV/mm]



Practical examples of SCHNIER series parts in 3D printing:

Powder coating gun for the application of talc.
Printed from PA 2200 on an EOS SLS machine



Requirements:

In the curved part of the powder gun there are 3 channels, which also cross each other.

- Channel 1 - Channel for powder delivery
- Channel 2 - Channel for the high voltage cable
- Channel 3 - channel for feeding a rinsing air of the needle electrode

Housing parts for HOBBY Flocker Pro

Internal duct for high voltage line

Requirements:

- Inexpensive production without tooling costs
- Ergonomics
- Internal guidance of the high voltage cable
- Flexibility in terms of quantities

Housing parts MINI Flocker Evo

Handle printed from conductive PLA

High voltage part printed from Tough PLA

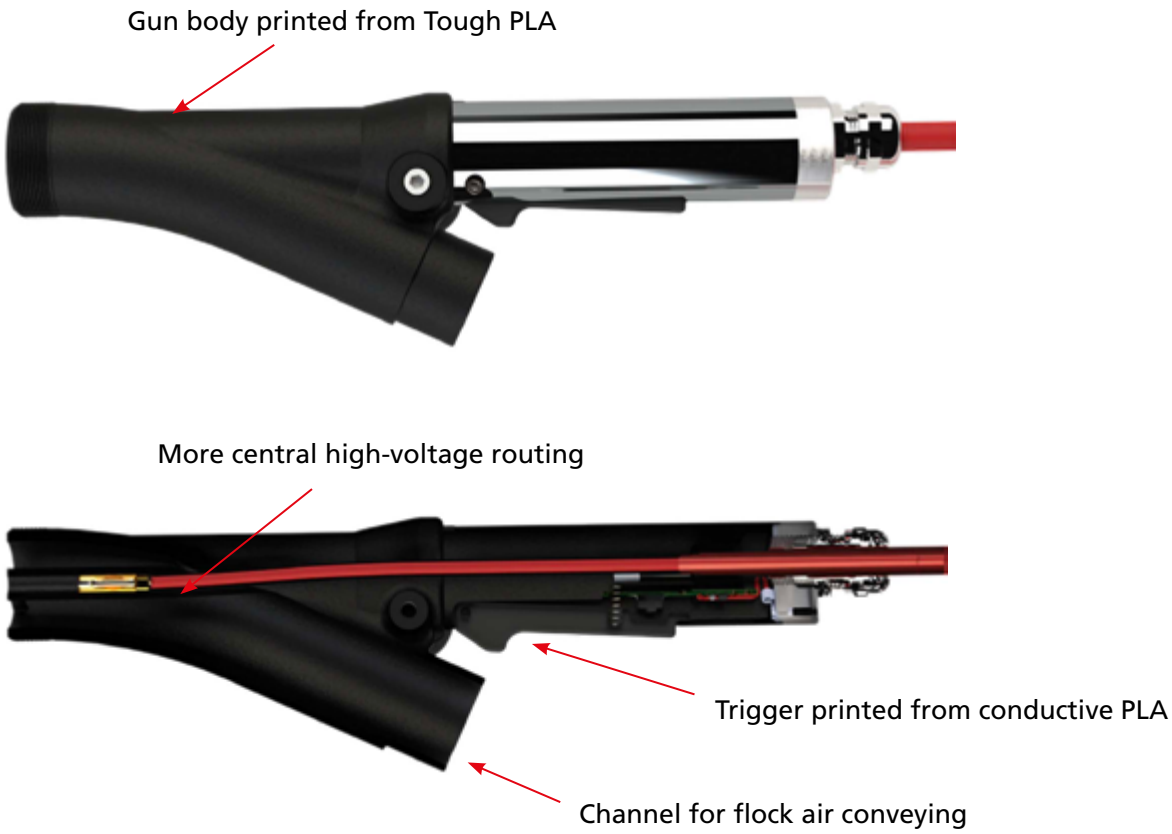
Flock applicator classic injection moulded

Screen printed from flexible PP

Requirements:

- Compact design
- Handle ergonomic and conductive
- No high tool costs
- Flexibility in the range of sieves as far as mesh size is concernedcable

Housing parts MINI Flocker Evo



Requirements:

- Handle with maximum diameter of 40 mm for comfortable geometry even for small hands
- Central high-voltage guide for best possible insulation to the outside
- Easy contacting of the electrodes
- Simple construction
- Smooth trigger for fatigue-free work even over longer periods of time

NOTES

Flock Association
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3. Flock feels good!

Dr Kirsten Hardie
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Short biography

Dr Kirsten Hardie is a National Teaching Fellow and is Associate Professor at the Arts University Bournemouth, UK. She has extensive teaching experience and has an international reputation for innovative approaches to learning and teaching. Kirsten works internationally, cross-discipline, and her activities extend to a significant number of collaborative and advisory roles across Higher Education - including External Examinerships, Peer Review work and member of various journal editorial boards. She is Vice Chair, Group for Learning in Art and Design (GLAD) and co-founder of the International Federation of National Teaching Fellows. She is a Design Historian and an experienced exhibition curator and event manager. Her research includes flock; packaging design; plastics; artificial flowers; and Object-Based Learning. Kirsten is a passionate collector of design... and notably has an extensive flock collection. She curated the Flock! exhibition at Bournemouth University, UK, in 2020 and was co-curator of the popular Flockage exhibition (2008) at the Russell- Cotes Art Gallery and Museum, Bournemouth, UK.

Fig. 1. Experimenting with flock. (2019). Variety of items flocked by K. Hardie. [photograph]. J. Beal.

Introduction

Flock – Feels Good

Flocking is an important process and surface treatment revered for its numerous qualities. Its many attributes and uses are widely identified and promoted, and the Flock Association of Europe, and its members, provide important explanation and showcase of such. Flock is versatile, for example it can help to protect and insulate objects and it can decrease noise and reduce condensation. It serves many needs, and it is used extensively,

applied to an array of surfaces in a diverse range of contexts. As flock manufacturer Electroflock Limited (2019) comments 'A flocked finish imparts a decorative and/or functional characteristic to the surface. The flocking process is used on items ranging from retail consumer goods to products with high-technology military applications.' Flock is used and exists within various areas, including, for example, interior design, fashion, vehicle interiors, publishing and packaging.

From flock-lined yellow rubber gloves used in cleaning, to nasopharyngeal flocked swabs for Covid-19 testing, people's encounters with flock may be increasingly regular, and the Flock Association of Europe (2022) website states, 'Flock – a fascinating technique. Almost unknown and yet always and everywhere in use'. On occasion the term flock and its use and presence may not be readily recognised or understood. Flock may be misidentified as being velvet, felt or suede. On occasion its presence may be hidden, understated or overlooked, for example its use in cutlery drawers, jewellery boxes or on shoehorns and curtain linings.

For many, flock may be readily recognised and appreciated. It can be seen as aesthetically pleasing; a delight to have and to hold, to own and to use. Flocked objects, such as wallpaper and ornaments, can appeal to many consumers who may readily display and enjoy flocked designs in their homes. From flocked books and toys to floor covering and furniture, flocked furry surfaces can feel and look good. Flock covers and enhances a wealth of objects as its decorative, colourful and tactile qualities can be alluring, pleasing…and fun.

Fun can be identified as enjoyment. Fun activities and experiences can produce various responses, for example the emotional state of happiness and a feeling of joy, as Bryant and Forsyth (cited in McManus and Furnham, 2010, p.159) observe, 'Fun is a source of enjoyment, pleasure, amusement, and even excitement.'

Through an exploration of flock's various qualities and applications, and a consideration of some historical and contemporary examples of flocked objects, this study notably considers how flock can be considered to be fun. It considers flock in relation to the idea of surfaces and discusses the surfaces of flocked design examples. The study considers flock's diverse use, its aesthetic appeal, beyond its profound and critical functional qualities. It considers how the process of flocking and the results of flocking can be fun. This study ultimately considers and celebrates why velvety, fuzzy and furry flock surfaces can feel good and can appeal on both a visual and tactile level. The work draws upon the author's empirical exploration of flocking and their extensive collection of flock objects.

Surfaces

Fig. 2. Flocked small boulder, 2020. K. Hardie [photograph] In the possession of the K. Hardie.

The look and feel of surfaces are important in our daily lives. We are situated within and navigate a variety of spaces and places where we encounter, experience and use a plethora of objects and materials that have different surfaces. Whether floors, walls and furniture or transport, clothing, and packaging, different surfaces exist that surround, shape and reflect our lives. Surfaces can offer distinct and different visual and tactile experiences, for example wood, plastic and textiles can look and feel different; each surface has particular properties and qualities that can offer different experiences and opportunities in its use. Surfaces support us and engage us in many ways; as Amato (2013, p.18) comments,

> *'Once framed into images and representations, surfaces become kings and corridors of perception, signalling immediate reactions, eliciting habitual responses, exciting associations, and awakening and establishing memory.' (p.22).*

Amato (Ibid, p.18) continues to state that surfaces 'offer touch and feel; direct and shape perceptions and elicit attention; excite expectations; and stimulate urges. Arousing our curiosity and even our concentrated stare, they lure our probing hands.'

Flock surfaces can be particularly luring; flock's fuzzy, velvety, soft or bristly feel can entice the touch of hands and the sensations of touching flock can prove to be both satisfying and memorable. The choice of flock and the selected flocking process can capture the fine details or patterns of an object and offer a rich and pleasing look and feel. For example, the light and gentle flock coating upon an object can add a soft finish that enhances certain aspects of the design's decoration whilst enhancing its visual presence. Flocked surfaces can arrest attention and shape perceptions of objects. They can appeal to the senses of sight and touch whether felt, stroked, smoothed or grasped. Flock surfaces can offer visceral experiences. A touch of flock may provoke a sense of surprise or evoke memories of a childhood flocked toy for example. We may see flock and recognise the promise of the particular feel we have encountered previously.

Flocked surfaces appear in a variety of contexts and serve a range of diverse uses. Flock provides engaging surfaces that satisfy a range of needs. Flock can create a variety of textured surfaces: from those that are soft and satisfying to touch, such as a peach-like effect, to others that are more coarse and rugged, such as a fine bristle brush feel. To touch flock can trigger various emotions, for example, a Valentine's card's flocked heart design can help emphasise a declaration of love communicated by the cards. The touchy-feely surface can add a certain intimacy as the card can be caressed and treasured. The potency of touch can create a pleasurable emotional connection.

Flock and fun

Flock can be considered to be fun in a variety of ways depending upon its intended use and the context of its use, and how an individual encounters, experiences, engages with, understands and relates to flock. A flocked lipstick applicator and a flock paint roller, sport flock for functional purposes primarily, and may not be regarded as being particularly fun. By comparison flocked wallpaper and flocked shoes can provoke pleasure and create a sense of fun, whilst serving additional functions.

The attitudes and responses towards flock can vary depending upon the context in which flock appears, is used, and is experienced. Flock may be respected as a vital surface, a luxury finish, a utilitarian provision or it may be dismissed as purely decorative, frivolous or a gaudy gimmick. Flock can provoke various feelings through its visual and tactile qualities and through the type of flock used.

Mundane items, such as boxes and bottles, can be made more appealing, and fun, when flocked. Flock can make packaging distinct and give a product shelf-appeal and a greater competitive edge potentially. Flock can invite touch, and as observed, 'Flocked materials engage a customer's touch sensation, a sense that is not usually stimulated during the purchasing process' (Geoff/ Euro Extrusions limited, 2018). For example, the flock coating of the small parrot-shaped glass bottle for anise-flavoured liqueur, produced by El Lorito Benetúser Valencia Distilleries, Spain (early twentieth century), adds colour, texture, and detail to the design. The flock adds a sense of novelty to the distinctive, fun glass bottle whilst potentially adding an easier grip to the design.

Flocked packaging can appear as luxurious as its rich texture can be sumptuous. For example, the glass bottle of the Polish Debowa brand Gold Cherry Wisnia (cherry vodka liqueur) (2021) is encased within a red flocked cylindrical container. The design may be equated with sophistication and perhaps decadence and its surface is a pleasure to touch. When gold foil detail is added to flocked packaging, as with the Gold Cherry example, the relationship of the two surfaces and finishes can provide a rich look. This is further evidenced by the black flocked box, with gold foil detail, for the perfume Aphrodisiac by the lingerie brand Agent Provocateur (2019). The packaging appears distinguished thanks to flock and foil juxtaposition.

Some flocked packaging examples can be seen to be designed to be kept; to be cherished. Fun designs may be prized, for example a rich red flocked box celebrating the 1953 Coronation of Queen Elizabeth II endures as a souvenir of a historic moment; the box remains majestic in its flock robe. The packaging of the Elvis Presley The Blue Suede Shoes Collection CD box set (RCA, USA, 2001) rocks a blue suede-like flock with an embossed image of Elvis. The flock may amplify the uniqueness of the King and emphasises this particular product as special.

Other flocked packaging examples present fun, playful designs. For example, the packaging for the Sex and the City: The Essential Collection DVD box set (2008) features a black flock lace-like butterfly pattern on a vibrant pink background. The intricate, delicate, feminine and stylish feel and look of the design can be seen to echo the television programme. The Harajuku Lovers perfume brand, founded in 2005 by pop musician Gwen Stefani (with the products originally manufactured by Coty in 2006) presented the glass perfume bottles as cute, pretty, colourful, doll-like females with bright flocked hair. The fun appearance of the bottles is emphasised by the flock that is touched by the consumer each time they use the perfume. Thus, packaging can enjoy the benefits of flock that attracts consumers and offers a hands-on experience.

In childhood flock can appear to add fun, encourage play and to support the education and development of a child. Its tactile qualities can please small hands as they explore the covers and contents of flocked books, for example, flocked illustrations of animals may be stroked. The children's book Braille Animals (2016) by UK publisher DK was produced in consultation with the Royal National Institute of Blind People (RNIB). The visual and tactile reference book, one in a series created for blind and partially sighted readers, provides important education and fun. 'Braille accompanies text and visuals, and features such as flock, die-cuts, foil, embossing, sand varnish and gloss varnish add key tactile experiences' (Hardie, 2020). The use of flock is thoughtful to maximise the learning opportunities as, DK senior editor, Fleur Star (2016), comments 'One advantage of the flocking we used is that you can see the printed image through it.' The use of flock provides a rich touch that enhances the learning experience.

A further example of a learning experience through flock is exemplified by the toy brand Rubbabu™ products. Rubbabu™ toys are made from '100% pure natural rubber foam' and have very smooth and brightly coloured flocked surfaces. Young children may enjoy playing with the toys and in particular they may enjoy the feel of flock. The toy's flocked forms provide, as the brand claims, 'child development' and 'great sensory stimulation' (Rubbabu, 2022).

Some objects may be flocked purely to enhance their aesthetic appeal rather than to create any developmental or sensory experience for the user. For example, the small and often intricate patterns on the heels of some hosiery products present an intriguing example of flock's decorative use for aesthetic pleasure. Nylon stockings and tights can feature decorative flocked details, often in black, positioned just above the shoe's heel line. Dainty flocked patterns such as bows or flowers may feature, and whether on beige, black or other coloured tights and stockings, the flock adds detail to attract attention to the leg and the ankle. Occasionally, flocked patterns may give the appearance of being lace and some designs, for example polka dots and animal motifs, may feature more prominently and extensively, extending up the leg. Flock designs can present a range of looks: fun; luxury; stylish; formal and can appeal accordingly. The little touch of flock can help flatter a leg and secure an arresting look.

Thus, the decorative and aesthetic appeal of flock can be the dominant motivation for its application and use. Flock can be added to objects such as ornaments and clothing for decorative effect. In some instances, flocked objects exist as purely for fun and humorous amusement. As a result, some flocked objects may therefore be considered to be kitsch, or particularly kitsch because they are flocked. Kitsch can be regarded as a popular aesthetic that appeals as fun, playful and humorous. Kitsch can also be criticised as bad taste, as Congdon and Blandy (2005, p.200) comment

> *Kitsch can appeal to all of the senses, and has been closely linked with fakery, depravity, sentimentality, vulgarity, crassness, and the formulaic, but it is also about parody, irony, and satire. Kitsch has been associated with low art, the uneducated, and it is economically cheap, mass produced, and often considered tacky.*

Kitsch is associated with, and identified by, a number of characteristics including, for example, imitation, copy, synthetic, cheap, novelty, decoration, ornamentation (Hardie, 2007, p.13). The very kitsch nature of some items may be the very essence of their delectation: they may be considered to be fun.

A flock surface can signal or add to an object's kitschness and may generate joy and satisfaction accordingly. The bond of flock and its use on particular objects can be seen as inextricably linked. For example, Christmas decorations that are flocked white to mimic snow.

Flock can transform an otherwise unremarkable object into one that can be deemed as kitsch – simply because of the flock. For example, a statue of Buddha in bright green flock, or a fuschia pink flocked figure of Jesus, can be seen as kitsch through the incongruous fusion of the texture and colour of the flock upon an otherwise non-kitsch object. Flock can be associated with being kitsch, and fun, depending upon what it is applied to and where it appears. Further examples that may be considered as kitsch are the large brown flocked teddy-bears (with monograms on their feet) that appeared playfully in the shop windows of the Max Mara fashion brand in Edinburgh in 2019. The overtly large fuzzy stylized bears, approximately one metre in height, posed like furry models to attract consumers' attention. Likewise, flocked shop display items were created for the clothing brand White Stuff in 2019. Green flocked plastic vacuum moulded mantlepieces appeared in the brand's windows. The unusual fuzzy covered imitation mantlepieces, accompanied by flocked bedheads, evidenced the amusing visual appeal of flock and how flock can make a fun appearance in unexpected places.

Flock wallpaper

A traditional environment for the presence of flock is the walls of buildings where flocked wallpaper, reportedly, has been used since at least the late 17th century (Victoria and Albert Museum, 2019). Flocked wallpaper has thus enjoyed enduring popularity and its design and development is discussed in a variety of sources (Victoria and Albert Museum, 2019; Taylor, 2018; Fabric of Britain, 2013). This paper does not aim to provide a discussion of flock wallpaper's historical development; however, it considers examples of flock wallpaper in relation to how they appeal as an important surface covering and how their designs may be considered to be fun.

Whilst the popularity of flock wallpaper can change across time, today, flock wallpapers appear in a variety of interiors ranging from private homes, restaurants, and hairdressers to hotels, nightclubs and stately homes. Traditional flock wallpaper designs can make a bold and colourful statement and flock wallpaper's presence in key locations is noteworthy. For example, in the Palace of Westminster, the home of the UK parliament, flocked wallpaper hangs on the walls of the Members' Dining Room and in the Strangers' Dining Room of the House of Commons. The wallpaper in the Strangers' Dining Room is identified as the 'elaborate red flock wallpaper – designed and favoured by [the architect and designer] Augustus Welby Northmore Pugin (1812-52)' (UK Parliament, 2021). At Balmoral Castle, Scotland, a residence of Queen Elizabeth II, grand flocked wallpaper features on the walls near the Ballroom. Designed by William Morris in 1887 for Queen Victoria, 'The design features a repetition of lozenges containing thistles, crowns and the initials VRI (Victoria Regina Imperatrix)' (Yale Center for British Art, 2021). These flocked wallpapers are regal and have significant value and importance.

Today some wallpapers are available that reflect some traditional flock designs. For example, wallpaper manufacturer Cole and Son® produces the design Pugin Palace Flock and explain that

> *'The palaces and grand houses of the mid-1800s designed by A. W. Pugin were the inspiration behind the striking damask of Pugin Palace Flock. Taken from an original block print, the Cole & Son Design Studio have injected an opulent elegance to the design whilst retaining original symbolic motifs [...].'*

The wallpaper presents a rich design that the manufacturers refer to as decadent [Ibid.]. The enduring appeal of such designs evidences the pleasure that flocked wallpaper can provide.

Today, key manufactures, such as Graham & Brown, Cole and Son®, Eijffinger and Osbourne and Little, provide an array of contemporary flock wallpaper designs. Revered designers have created vibrant designs for wall-

papers that are elegant and fun. For example, designer Barbara Hulanicki's Skulls wallpaper (Pattern number 19911, 2019) for Graham & Brown, where 'Black flock skulls of several different sizes sit piled up against one another' and as the manufacturer comments the skulls 'may not become apparent until closer inspection, making it a great talking point feature for social occasions!' It is suggested that the wallpaper is the 'perfect choice for those with a taste for the mischievous and the macabre!'(Graham & Brown,2022) – what can be seen as a touch of flock for fun.

Flocked wallpapers produced by Graham & Brown evidence the creation of other prominent designers such as Kelly Hoppen, Julien Macdonald, and Marcel Wanders. From the flocked tiger stripes of Macdonald's Easy Tiger wallpaper, 2019 (Pattern number 31-173) to the fairy-figures holding keys in Wander's Key Muses wallpaper, 2019 (Pattern number 30-987), the wallpaper designs are fresh and playful.

Another interesting example of flock wallpaper was created by the British Telecommunications company, Virgin Media (UK) inc.. In 2007 it created its own flocked wallpaper for staff offices that was then used in the company's retail outlets in c.2012 (Bashford,2019). The red wallpaper's repeat pattern featured a woman's face, swirling shapes, images of mobile phones and the Virgin logo (Hardie, 2020). The brand-specific and brand-explicit wallpaper presented a proud and fun celebration of the brand.

Fun Flock Examples

Flock can add soft covering and detail to an object to suggest or mimic a feel and appearance that relates to, or is associated with, nature and natural objects. In the book Pretense Design: Surface over Substance (2019, n.p.), author Per Mollerup discusses his concept of pretense design as design pretending 'to be something that it is not' and 'not totally authentic' (p.24). Some flocked objects can be considered to be pretense designs, for example flocked decoy ducks used in hunting. The flocked coating of the plastic decoy is used intentionally to deceive real birds, to make the artificial bird appear as real. The flock surface helps to disguise the artificiality of the decoy's substance – its plastic body. The flock also masks the plastic to avoid any shine that may reveal the decoy as fake. Mollerup discusses the idea of the fake, the imitation, with reference to Hofstadter and Sander's term fauxthenticity (2013, cited in Mollerup, 2019, p.219): as Mollerup explains „Fauxthenticity," a portmanteau of „faux" and „authenticity," stands for the results of making something false appear true' (Mollerup, 2019, p. 129).

A sense of the unreal being real can be achieved to some extent by an application of flock. Sometimes the feel and look of flock can be likened to animal fur and the down of birds and thus flock continues to be used to coat the surfaces of fun decorations, toys and jewellery etc that are in the form of animals or birds. Examples of flocked beasts include flocked metal zoo animals, produced by the Timpo company (UK) in the 1940s, that now may exist with missing flock patches that suggest the scars of time and play. Flock and play is further evidenced by contemporary mouse-shaped cat toys. As if to trick a cat, the flock (although often in unnatural colours) suggests mouse fur and the inflatable plastic body squeaks when squeezed or bitten. An illusion of the real can be suggested by flock.

By comparison, the flock fronted novelty postcard produced by the Pittle Supply Co., USA, made in Germany c.1920, presents a slightly different use of flock. The postcard's flocked surface sports a colourful stencilled design of a parrot, with a red glass eye, sitting on a branch. On the postcard's back the manufacturer's message 'Squeeze me and listen' is printed. Interestingly the tactile lure of the flock works with the card's invitation to 'squeeze' and 'listen' and encourages the recipient to press the card's middle. When squeezed gently, the card produces a small tweet-like sound as air is expelled from the card's double layer. Flock encourages this gentle touch – a touch of fun.

A proliferation of flocked items during annual and seasonal events and celebrations can be seen to equate flock with fun also. For example, Chinese New Year decorations, such as lanterns, and Hongbao (red envelopes used to gift money), can include rich red flock details. Flocked rabbit decorations often appear to hop to the fore at Easter.

In particular the Christmas festive season sees what can be considered to be as a time where flock flourishes and there is an acceptance and celebration of flock for aesthetic and fun purposes primarily. Flocked festive delights abound – flocked baubles and ornaments displayed with pride, flocked Christmas cards positioned with glee, and flocked wrapping paper presented as a luxurious accompaniment to a gift.

Flock's use as artificial snow can add an alluring touch to Christmas trees. A snow effect on Christmas trees within the home has long been desirable and flock can help to create the illusion of crisp freshly fallen snow within the warmth of the home. Whilst pre-flocked trees are available, the do-it-yourself application of a white flock coating has been a popular way to spruce up a Christmas tree. Hand-held equipment to flock trees was advertised in the 1950s and 1960's in American. For example, the 1960 magazine advertisement for the Sno-Flok™ brand, manufactured by General Mills, enthused 'just hook up your vacuum and spray Sno-Flok on your Christmas tree. Half the fun is in the doing!' The advertisement's reference to fun highlights the enjoyment that can be achieved through the flocking process and by the flock's results.

Flocking kits and materials have enabled such home flocking. Their availability for some significant time, evidences the popularity of do-it-yourself flocking. Hobbyists, crafters and do-it-yourself enthusiasts can home flock with easy-to-use flock equipment. Flocking can be enjoyed at home and is used in various hobbies, for example by model railway enthusiasts where flock creates detailed scenery. For convenience, pre-flocked materials are also available and offer useful grass, foliage and trees (Fig. 3)

Fig. 3. Sample of flock artificial grass (c.2019) Manufacturer unknown. [Photograph]. In the possession of: the author.

Various flock brands have advertised to the hobby and handicraft market over the years where flocking is presented as pleasurable… and profitable. For example, the advertisement for 'MORDANT FLOCK' in the 1956 UK publication the Handicraft Annual: The Home Handyman's Yearbook (p.26) claims that their flock provides 'great enjoyment' and is 'inexpensive, easy to apply to any household article' (such as vases, trinket boxes, lamp shades) (ibid) and emphasises the use of flock in the context of handicrafts. Interestingly the advertisement asserts 'FLOCKING IS PROFITABLE'. Likewise, the FLOK-KRAFT™ full page advertisement featured in the American Popular Mechanics publication in 1952 (p.41) promotes FLOK-KRAFT™ as an 'Amazing New Miracle Finish' that 'covers fabric, metal, glass, plaster, wood, plastic or - any surface!'. The advertisement calls to 'MEN-WOMEN!' in its attempt to arrest the attention of the readers, who may be assumed to be hobbyists and do-it-yourself enthusiasts, that may be interested in the product and its potential. Enthusiastically, the advertisement declares that FLOK-KRAFT™ can be used for 'for profit or pleasure' and as 'A SENSATIONAL NEW HOME BUSINESS!! A NEW INDUSTRY' that could make the user '$5.00 to $10.00 per hour and more!'. The advertisement's proclamations 'Paint it with suede!' and 'Spray on rainbow colors' present FLOK-KRAFT™ as easy and rewarding, and apparent testimonials from users are positioned to underscore the brand's claims. The brand presents its product with gusto and urges readers to 'Grasp this lifetime opportunity.' The potential financial benefits of flocking are exalted (if not perhaps unrealistically), whilst the pleasure of the activity and its results is emphasised.

Fun and flocking experimentation

An exploration of the flock process and experimentation with flock, notably within the context of do-it-yourself home flocking using hand-held equipment, can produce a particularly satisfying, fun-filled, foray. When the theory of flocking is put into practice, flocking - almost like magic - can be witnessed. Using a flocking applicator, small colourful strands leap, fly through the air, and land upright on adhesive-coated substrates. The flock stands proud (if done correctly). An exploration of a mix of flock lengths and colours can create serendipitous results and intriguing visual outcomes, for example, applying different flock to a range of large stones to gauge how flock can appear natural-like but also unnatural (fig. 1 and 2). Long green flock standing sparsely within short flock presents a moss-like appearance whilst vibrantly dyed purple flock adds an odd bacteria-like growth look (fig. 4).

Fig. 4. Flock and stones. Hardie, K. (2019). Flock in Petrie dishes and flocked stones. [photograph]. In the possession of the author.

Different surfaces can present a pleasurable opportunity to test flock's durability and versatility. To create a flocked coat on a sponge surface (fig. 5) or a crinkled spread of aluminium foil (fig.6) can present a captivating study of contrasting materials, surfaces and effects. To flock a chocolate, a chunk of cheese or an ice cream cone is not necessary but it can feel so good to do so – it's fun – and the results can be arresting. A hairy cheese, a furry cone, flock's velvety smoothness on a shiny chocolate… may be seen as tasteless in a number of ways … but the pleasure can be all mine. The fun abounds as the process and the outcome are both engaging and satisfying.

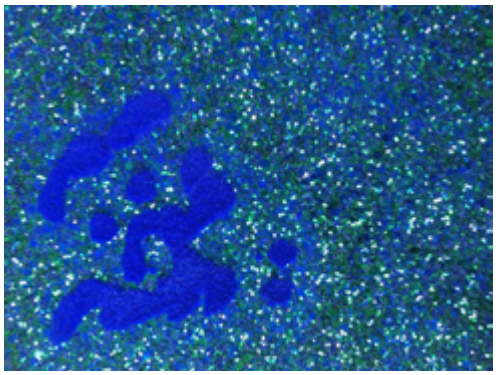

Fig. 5. Flocked sponge. Hardie, K. (2020). Flock on sponge. [photograph]. In the possession of the author.

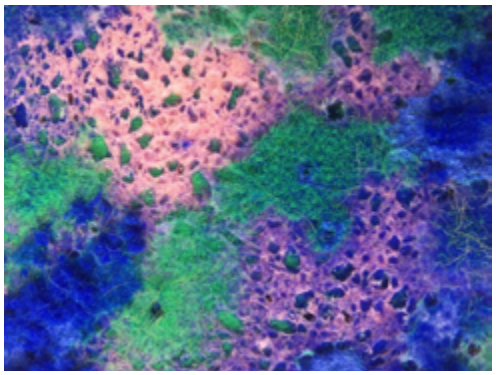

Fig. 6. Flock and glitter. Hardie, K. (2019). Flock and glitter on felt. [photograph]. In the possession of the author.

Conclusion

Flock is omnipresent. A variety of surfaces feature flock from the utilitarian to the purely aesthetic and the kitsch. Flock is an important part of many aspects of daily life and serves many critical needs. We may grow up using flock and we can draw pleasure and derive numerous benefits from its application to surfaces that we have contact with. Flock has many unexpected uses and exists in a wide variety of contexts. The appearance of some flock may be discrete or unremarkable; it may sit beneath, behind or within an object, and may not readily be seen or recognised. However, it may be accepted that flock is quietly doing its job and it is effective in its role.

Flock can fascinate our senses through sight and touch. It can be memorable and rewarding to touch and can provide visceral experiences. Flock can evoke emotions and memories and we may anticipate how it may feel by relating to our prior experiences of encounters we have had with flock.

Whilst flock's attributes are identified, it is recognised that attitudes towards flock can vary. Flock can be misunderstood and its use within certain contexts, and application to specific objects, may raise questions regarding its intention and appropriateness. Flocked surfaces can be bold and colourful and can command attention and comment, whether that be appreciative or critical.
This study has considered, and provides a brief overview, of how flock can be considered to be fun and how flock's use may be pleasurable. However, fun is subjective, can be transient, and depends upon personal perspectives and experiences at any given time. How individuals view and determine what is fun varies as McManus and Furnham (2010, p.165) comment 'Fun however differs for different people' (McManus and Furnham, 2010, p.165).

Flocked surfaces can be fun and provide pleasure. A flocked surface can communicate a variety of meaning and associations, as Amato (2013. p.201) states 'Surfaces define the appearance, fit, and use of things.' From wallpaper to packaging, hosiery to religious figures, flock has been used to provide decorative detail that may be seem as fun. Flock can provide a robust and resilient finish to items that may be deemed as fanciful. The vibrant colours of flock and the rich surface feel can provide pleasing and pleasurable sensations. There may be humour in the appearance of an object that is flocked; flock can make people happy. We may live with flock within our homes and feel affection and admiration for flock's richness. Flock has been enjoyed for a long time; long may flock be enjoyed.

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NOTES

4. Sustainability and energy management in the flock industry

Michael Wagner
Maag Flock GmbH

Sept. 2020	CEO	Maag Flock GmbH
2019-2020	Master International Sales Management	Master John Deere
2014-2019	Bachelor of Engineering Mechanical Engineering	HTWG Hochschule Konstanz Siemens Logistics Breyer GmbH Maschinenfabrik
2011-2014	Apprenticeship Precision mechanic	FTS Schwenningen

Lecture Content

„A sustainable development is one that satisfies the needs of the present without compromising the conditions of future generations."

The presentation „Sustainability & energy Management in the flock industry" by Michael Wagner, CEO of Maag Flock, at the 26th International Flock Symposium of the Flock Association Europe in Barcelona is about different sustainability approaches and efficient energy management in mechanical engineering and the flocking industry.

The term sustainability is on everyone's lips as a current megatrend. Many companies are developing various sustainable strategies and Corporate Social Responsibility concepts in order to respond to the sustainability requirements of their customers.

During his presentation, Michael Wagner will show various application examples and possible concepts of how this trend can be profitably introduced and implemented for customers in the flocking industry.

These include, a holistic plant concept in consideration of the factors of energy and cost efficiency across the entire value chain, process optimization, closed-loop models and the use of sustainable raw materials.

In addition to the benefits that such concepts & strategies have for sustainability, they also serve to increase productivity, reduce costs and increase the longevity of products.

Maag Flock GmbH

In summary, 6 major actors are recognized in the flocking industry:

„ INGENUITY FOR GENERATIONS“

family-owned & forward-looking

1992	MÖSSINGEN	15
founded	Headquarter	employees

Maag Flock was founded in 1992 and has developed into one of the world market leaders in the flocking industry. Today, the mechanical engineering company is managed across generations and forward-looking.

Innovation out of passion: Our work is our passion. We work with dedication for what we do and strive every day to inspire our customers.

Longevity and technological progress are our focus. Our corporate philosophy „Ingenuity for generations“, embodies this. We can always be better and always optimize ourselves. With this mindset, we focus on the intervention of solutions and find the optimal solution for each industry with competence and passion.

Portfolio

Sustainability

Term is associated, among other things, with longevity and environmental protection.

Important building blocks according to BmWi:

- Circular economy
- Climate protection
- Energy transition
- Trade
- Innovation
- Digitalization
- Sustainable finance strategy

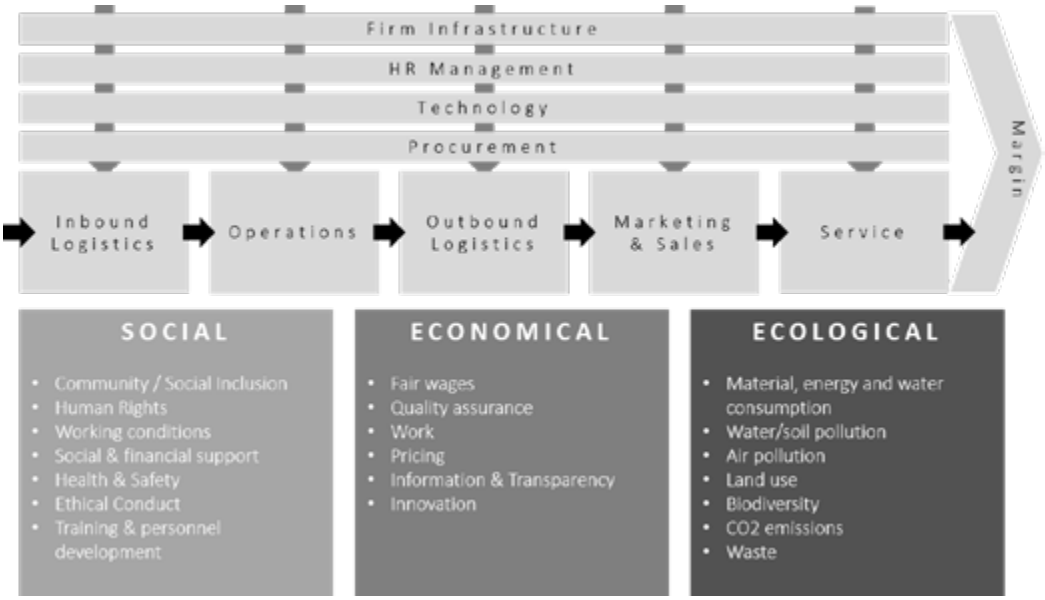
Agenda 2030 for sustainable development with the goal of initiating various measures within 15 years to improve living conditions on the entire planet. At the same time, to ensure protection of the earth for future generations.

Standards

- Basic standard: DIN EN ISO 14001
- Energy management: ISO 50001
- Emissions: EU ETS
- Climate neutrality: PAS 2060
- Social responsibility: SA8000
- Sustainability line: ISO 26000

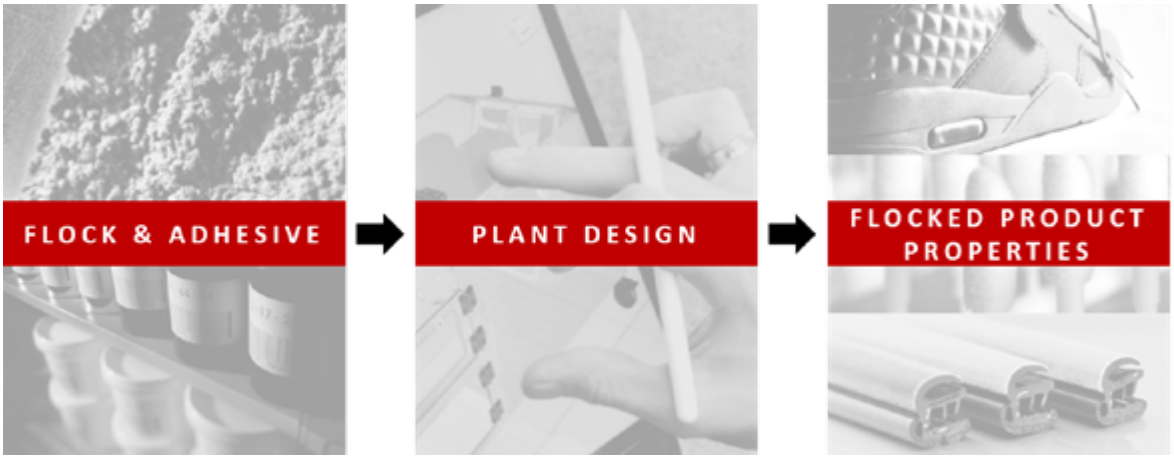
Sustainable Value Chains

Value chain sustainability forms the link between value chain and sustainability management with the aim of managing and adding value to environmental, social and economic impacts as well as promoting good governance throughout the life cycle of products and services.



Instruments for integrating sustainability into the value chain are standards, certifications and a code of conduct.
In addition to the sustainability aspect, the integration of sustainability into a company's own value chain offers competitive advantages in the form of improved performance, a higher ROI and measurable brand enhancement.

Sustainability in the Flocking Industry



Flock & Adhesive

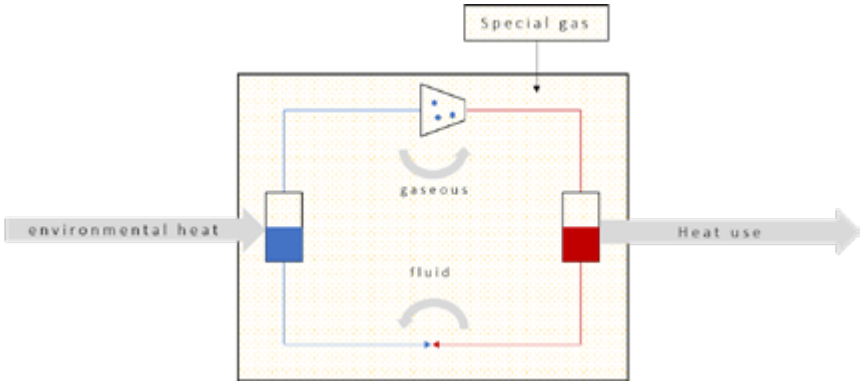
Sustainable raw materials and processes for the production of flock fibers:
- Production possible with biopolymers from renewable raw materials
- Natural fibers, organically grown, recyclable, low CO2 production
- Recycled polyester (Reduction of waste & saving of raw materials)
- Viscose (recycled cellulose) using N-methylmorpholine-N-oxide (less harmful to the environment than pure plastic fibers)

Sustainable adhesives:
- Solvent-free, water-based and therefore harmless to humans and nature (15% better life cycle assessment than solvent-based adhesives)
- Positive impact on health & safety in the workplace
- More cost-effective

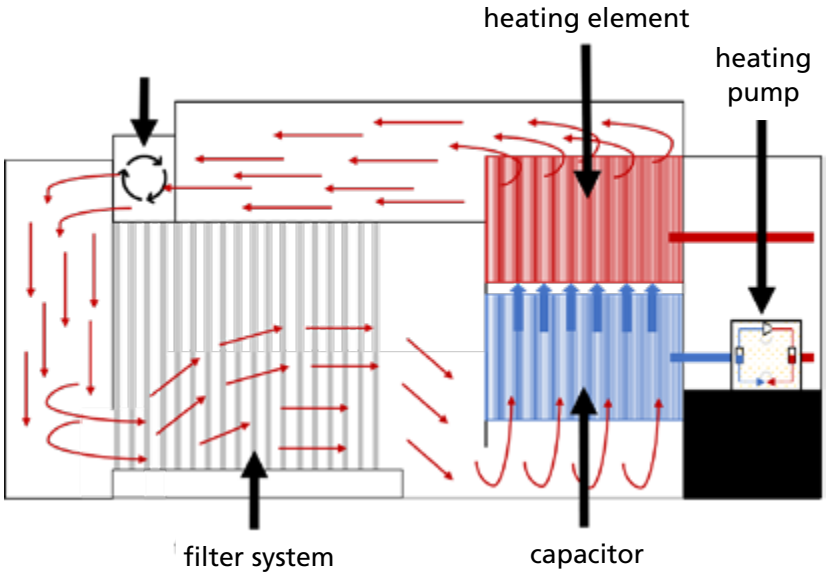
Plant design

For example, as modular systems or light construction
- ensures longevity and thus resource conservation
- design of an efficient flock process with the help of sensors that check all parameters
- Maintenance & servicing offer serves to extend the life of a plant
- Flock cycle and recirculation
- variable flock dosing
- Process data monitoring
- Engines with less energy use

Energy management



Heating pump:
A heat pump uses energy from the environment and converts it into heat. To do this, the existing heat contained in water, soil, air or exhaust air is first fed to the refrigerant using a heat exchanger (evaporator).



Energy recovery dryer:
The Energy recovery dryer works with the help of a heat pump. This saves up to 80% energy compared to conventional dryers.

Sustainable Flock Properties

Abrasion resistance

The high abrasion resistance of a flocked surface, serves the longevity of a product. The fibers straighten again and again.

Transport rollers, case shells

Tolerance compensation

The flock fibers act as gap fillers. This allows gaps to be filled without the need for additional components.

Glove compartments, furniture, slide rails

gliding property

The smaller the flock fiber, the smaller the distance between the fibers, the more optimized the surface finish of the substrate.

Boats, aircraft, window profiles

Insulation

A flocked surface has an insulating effect. This reduces heat loss and saves energy

Building materials, ovens

Enlarged surface

Flocking of paint rollers is used to increase the surface area. In addition, a filter effect is achieved, due to the small spacing of the fibers, which leads to savings in paint consumption.

Painter rollers

Surface protection

The flock fibers and the adhesive, form a protective layer, protecting the substrate from environmental influences.

Furniture, boats, porcelain

Our contribution

- Regional sourcing of raw materials
- Regional suppliers
- Sustainable partnerships
- Selection of suppliers based on various criteria (for example energy management)
- consulting our customers on the use of dispersion adhesives and flock fibers made from sustainable materials such as viscose
- Maag Flock training to reduce the scrap
- we advise according to Holistic Circular Economy
- we support the creation of new fibers from recycled materials such as jeans, leather scraps or wood

Our Promise

- Maag Flock GmbH stands for know-how, durability and technological progress. The products and systems developed by us enable our customers to position themselves sustainably on the market and to ensure their success.
- Together with our partners, our company will continue to create future-oriented products, open up new markets and develop groundbreaking processes from ideas, in line with our mission statement „Ingenuity for generations“.
- With innovative strength, quality, passion and commitment, we confidently face the challenges of the future.

NOTES

Flock Association
of Europe

5. Flock. Our Future has a history.

David Capdevila
General Manager Velutex Flock

David Capdevila, born in 1971 in Barcelona, studied Industrial Engineering in The Polytechnic University of Catalonia, where he achieved his specialization in Business Organization. Afterwards he continued his training with several postgraduate degrees in Quality Management (FUPC) and integrated management of quality, environment and safety (ICT). In 2009 he pursued an MBA executive program in IESE.

He is currently the CEO and shareholder of Velutex Flock, leading company in Flock Manufacturing. He has developed his entire career in Velutex, starting in 1994 implementing a Quality Management System according to ISO 9001 standards. He has developed different roles within the company where he has been Safety, Environment & Quality Responsible, Facility Manager, Plant Manager, Technical Manager and finally CEO.

Introduction

The reading that we are going to present to you is not intended to be a complete history of the Flock in Europe, but rather a short narration of the origins and development of the Flock technology, with the contribution of data, photographs and certain considerations. Our goal is to help new generations to know a little better the origins of the activity in which we all work and try to foresee the future together.

In this sense, the title of this reading OUR FUTURE HAS A HISTORY illustrates our intention.

This year's celebration of Velutex Flock 75th anniversary gives us a certain authority to be able to make an incomplete, but honest, summary that helps to have an optimistic hope about the future of the Flock.

The original idea

We must place ourselves in the middle of the last century to witness the beginning of the development of an industrial idea that led to the origin of a textile product, which was soon known by the name of FLOCK.

We allow ourselves to speak first about the beginning of the new concept in Spain.

My grandfather Mr. Francisco Capdevila owned in the 1940's a mechanical workshop dedicated to the construction of machines for the wool & sheep leather industry (Talleres Capdevila).

Mr Capdevila & his wife Ms. Pallarés, founders of Velutex Flock and photograph of its first location.

During the manufacturing process of these sheepskins, there is a shearing phase that involves trimming the length of the wool to a certain extent, with rotary rolling machines, which produces a vast waste of wool fiber to be discarded.

Wool skin photograph (Wikipedia)

In times of great scarcity of everything, it was not logical to through away short wool fibres and Mr. Capdevila started seeking for a second life to this material. What we now all call as Closing the Loop.

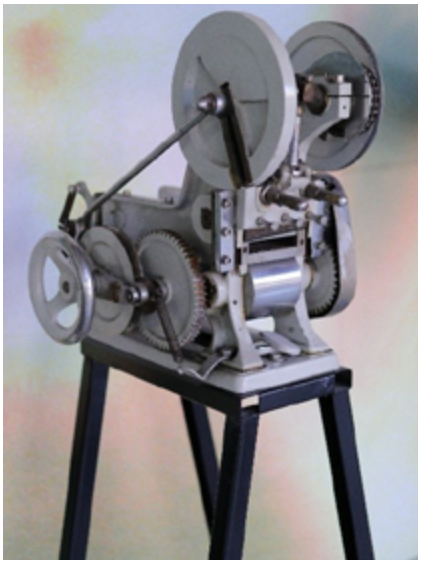
These wool residues turned into textile powder, to be able to use it as a coating and ennoblement of paper. A new textile product had been born. It was the origin of the flock of wool and velvety paper.

It was 1947 when Mr Capdevila and his wife Ms. Pallarés have founded the company: Industrias Pallarés.

Velutex Flock- Industrias Pallarés first logo and colourcard

In a historical era of great difficulties, it is quite true that necessity makes ideas and imagination flow.





We illustrate with the photographs the shearing machine used at that time and which is part of the small museum of Velutex. Also the first mill used to pulverize the fibers and the the first cut machine Willigens (Germany)

In the same period in France, the company Michel & Marchal began to do trials with cotton waste, thus achieving what would become the cotton flock.

Soon, both Industrias Pallarés in Spain and Michel et Marchal in France, carried out positive tests to obtain Viscose Rayon Flock, using residues and different available presentations of this fiber.

The development of the flock industry in England started manufacturing flock by grinding waste textiles for fillers. John Peel & Son used tobacco cutting machines which they were guillotine machines and cut onto a wooden circular roller. They started cutting waste denim for fillers and viscose rayon tow for flock.

A following step was sieving the fibers using agricultural machines normally used to separate grain from stalks etc. Later the flock companies introduced dyeing, and other specific technologies.

Subsequently, several companies producing Flock of these fibres appeared in Switzerland and later in Italy.

We are in the 50's and the Flock and Flocking Industry is developing with Cotton Flock and Rayon Viscose, being used to flock paper, fabrics, some plastics and handicrafts. Many investments were done to develop the product


Le Flockage (France) 1970 – Cutting and grinding Areas

During that period the flocking was obtained by vibration and fulling/batage, on surfaces previously glued with very primary adhesives.

The tests carried out to obtain electrostatic generators, which could create an electric field during the fall of the flock, was really a great step in the development of flocking. On the late 60's the companies began to study the possibility of making a generator, but the high voltage components were practically non-existent.

Mr. Riccardo Levi (AIGLE) explained to us the difficulties to find solutions during that period:

"I address myself to high voltage transformers on which to build multi-stage multipliers: rectifiers and capacitors were needed. The only rectifier available was the 1B3 thermionic valve used in the of the cathode ray tubes of primordial black and white televisions. After many tests, I solved the problem by making the coils with insulated cables, further insulated in polyethylene pipes, putting the high voltage apparatus in a Bakelite box and drowning everything in melted paraffin. The new electrostatic generator TE1 was sold to Mr. Contu we are on 1970, a craftsman who produced air filters for cars with flocked and pleated metal mesh."

An Electrostatic Generator Mod. TE1 (Still working, owned by M/S Qualplast)

Other companies also started developing technology for the flock machines application (Eloflock, Arno H. Wirt, Maag Flock, Schnier, etc.). The greatest spread occurred when appearing the roll-to-roll systems as well as the developments of control testing apparatus designed by Mr. U. Maag, which were essential for the normalization, and parametrization of flock characteristics.

With these technical developments, electrostatic flocking was already defined and it started to be well known worldwide. In Europe, the flock industry spread rapidly throughout France, Spain, Switzerland, Italy, Germany, the UK, Netherlands and the rest of the countries.

Chronologically, the 1960s saw the beginning of the Polyamide Flock and in the mid-1970s the Polyester Flock started to be produced.

Photo Mr. Maag

The development of the Flocking Industry

In summary, 6 major actors are recognized in the flocking industry:

- Fiber Producers
- Flock Manufacturers
- Adhesive manufacturers
- Flocking Plant Builders
- Manufacturer of flocked products and articles
- Flocked products users

It is curious how textile fashion trends have exponentially advanced the use of flocking technology. For example, the trend in 1980's to make stockings with flocked designs (butterflies, fish, polka dots, puppets, etc) which made many companies start flocking and buy relevant quantity of flocking machines.

In the USA the general use of flocked blankets also in the 80's originated the creation of a new type of companies and experts in the flocking field.

Example of some 80's & 90's Flock applications

Later, flock was introduced in more technical applications such as profiles and glove boxes for the automotive industry and since then a large number of flocking of very specific products, which are well known today.

The extraordinary development of adhesives, based on the various types of resins and compositions, where important chemical companies as Kiwo and CHT among others invested in Flock adhesive technology, as well as the very important progress in flocking facilities, have made possible the progressive increase of the quality level of flocked products.

The awareness & promotion

In the 1970s, in view of the development of the activity in the world of Flock, the meetings of the different protagonists and experts began in Germany, which led to:

- Symposiums about Flock
- The creation of the Verband Flock Industry Europe.
- Workshops, Flock School, magazines, Exhibitions, etc.

The Rosenheim Symposium in 1975 with great international attendance was a before and after in the world of Flock. Organized by Joachim Müller, Alma mater, and his team of the early Flock activity, it was a success of participants and presentations.

Photographs from Flock symposium's and Exhibitions
(1. JP Lion, E. Capdevila, 2. T. Levi, Y. Taupin, 3. J. Müller with Frank & David Capdevila)

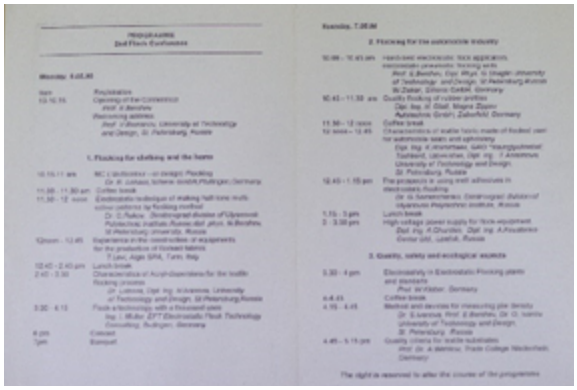
From then until today, the succession of Symposiums, Workshops, meetings, etc. have greatly advanced the world of Flock, which today is a consolidated and recognized technique in multitudes of industrial activities.

Flock magazines and about Technical Fibres were extremely interesting for the cohesion of the world of the Flock.

Examples of several magazines and documents related with Flock Technical information

We must remember that all the Flock Symposiums have been held in Germany except three:
Saint Petersburg (Russia) – year 1996
In Como (Italy) – year 2013
and the current Symposium 2022 in Barcelona.

Saint Petersburg



Lectures in 2nd International Flock conference in Saint Petersburg

In America, the AFA association performs a role similar than the FAoE, but perhaps they have another approach more dynamic and personalized, orientated to the cooperation between companies more than a technical debate. On the other hand, it is rather restrictive in terms of links and approaches with other countries. As a suggestion, we believe it could be and interesting option to start developing FAoE –AFA synergies together.

Current situation in Europe

Many different key actors have passed during the 75 years of history of the Flock industry in Europe. Manufacturers of fibers, producers of Flock, adhesives, flocked products, etc.

Some of these companies as for example Hug Flock (Switzerland), Dr. Platte (Germany), CEFSA (Spain), Insodec (France), AlphaFlock (UK), Reo Flock (Germany), Le Flockage (France), Tinto Flock (Italy), Flock and Fasern (Germany); and others have been left behind. We want to point out that each one had relevant contributions in the world of Flock.

Small representation of flock-related companies that no longer exist today

Other companies have overcome all the challenges and they have adapted to the different needs of the market. Indeed, they are currently the main references in the flocking sector. We must thank all of them their efforts and their hard work to launch this sector and help to lead our current state of the art.

Currently, despite the Covid-19 worldwide crisis, the world of flocking is very active in many areas. We can realize a continuous emergence of new applications and technologies, while more classical applications are disappearing.

Flocking continuous being a very active and creative technology, which provides solutions to multiple technical aspects.

The main difficulty we are facing is the lack of awareness about this technology by the young decision-makers (plastic engineers in automotive industry, packaging & textile designers, product developers in industry, etc).

An adverse publicity, where some industrial fields see the flocked product as old-fashion and flocking process as difficult, dirty or unsustainable technology, can lead to a loss of business in the flocking sector in the coming years if we do not manage to change this view and approach about flocking products together. Those of us present at this symposium have the responsibility to unify efforts in this area.

Examples of different Flock applications by Velutex

Nowadays, flock application is a relevant technology used in the automotive, technical textiles, paper, cosmetics, packaging, decoration, upholstery & medical sectors, but new ideas are appearing every day.

The introduction of sustainability as a present and future feature enhances the value of recycled polyester, Rayon viscose and cotton fibres, better positioned than conventional polyamide fibres for this approach. Polyamide fibres that respond to ecological demands will be also broadly available in the market in a short time, together with other new options of materials already under trials.

We must insist on achieving sustainability as a norm that it is an imperative of our time.

It is curious and surprising that the flock had its origin in the use of textile waste, with the objective of not throwing away any material due to an economic need, and now, 75 years later, we are in practically the same situation. Now our planet does not admit more waste.

We have gone from an economic need to an ecological need.

The price issue has also a determining role. Flock powder has become a commodity for most of its standard uses; therefore, its price must be much adjusted to the products and demands. We are convinced that we are witnessing a notable change regarding the different fibres to manufacture flock in order to make the product more competitive for some applications.

Nevertheless, we also want to highlight the importance of maintaining a balance in the economic margins of all the actors in the Flock world.

In this sense, globalization is an opportunity but also a threat. Europe has been from the beginning the magnificent engine and the origin of the innovation in the flock industry. It does not make sense to change now our objective to compete with some markets that look only for the cheapest price, without properly considering quality and service. In our opinion, it is not the way to continue and plan the near future. Otherwise, it would be the process towards self-destruction of our European industry.

2030's Flock Future Perspective

As explained in the previous pages, lately we have experienced a change in the type of queries related to the flock and also in the kind of professionals seeking opportunities in this sector.

From our perspective of flock manufacturer, we can see a continuous emergence of new applications and technologies while applications that are more classical are reducing their consumption due to different reasons, some of them explained by other attendants during this symposium.

We would like to share with you some of the new trends detected in the market in order to work together in the 2030's Perspectives for Flock.

It is a matter of fact, that companies working on SOUNDPROOFING and NOISE REDUCTION are looking for flocked solutions as an efficient and light weight alternative. Panelling of buildings, electric car interiors & aeronautics are an example about that.

Examples for sounproofing different applications

SURFACE protection & haptics have been very well recognized properties of a flocked piece since many years ago. Nowadays, with the exponential incorporation of 3D pieces in different sectors (railway and naval interior design, for example), it is necessary to find a solution to the dull and unpleasant surface of a 3D piece in contact with the final user skin. Flocked pieces are the best solution to that handicap and some builders have already realized this fact. This can be a huge market for flocking companies that can adapt their technology and products.

COVID-19 brought also opportunities to the Medical Flock manufacturers. Flock swabs have been used for forensic uses and sample collection for many years. However, the recent need to take millions of testing samples for COVID-19 detections, has given the opportunity to a wide public (scientists, doctors, pharmacists, etc.) to know that swabs made with polyamide flock lead to an innocuous media that experience better extractions/

sampling than other materials (ex. cotton swabs). That will bring new opportunities in medical & dental parts and equipment for the coming years.
New characteristics in the new generation of fibres and the resulting flock material with properties such as bacteriostatic, anti-virus, photocatalytic, etc can help in all type of uses where such a property is needed. It is an example the flocked panels in shops, where the flock has an Air-cleaning effect helping on the removal of bacteria/virus within the air of the shop. There are already trials made by an automotive brand in the USA, with such technology in areas with skin contact.

New projects related with shock-impact reduction, sealing force at extreme temperature, vibration dampening, etc are sourced and tried at daily bases and surely new types of products will come to light in the coming years. Nevertheless, if there is a common thread for all new items are the tags: SUSTAINABILITY, NEW POLYMERS, TECHNICAL TEXTILES.

We do invite the flock-related industry to have solutions for the 2030's Flocking needs by using recycled and recyclable materials, having biodegradable adhesives and fibres, and launching closing the loop programs in our manufacturing facilities.

Conclusion

We must recognize that the years 2020 and 2021, with the Covid-19 pandemic economical and social situation, have been very difficult period for the European industry and in particular for the Flock Industry. Despite the complexity to manage the shortage of raw materials, energy, transport difficulties, etc, we are all getting ahead with new projects and new challenges. In any case, we must remember a famous phrase:

„A calm sea has never made good sailors."

We firmly believe that this year 2022 the situation will normalize. Velutex Flock therefore want to send a message of optimism and hope for our future. We all, as current major players in the European & Worldwide Flock industry would need to learn from our History and try to work closely to develop new products, promote the especial characteristics of the flock and apply flock to the new uses and applications. The European Flock Association and its Associates have been always very important to impulse, promote and give awareness about this niche product and we expect this will continue happening.

Thank you very much.

With this we end this reading. Now as planned in the Symposium program, we are pleased to offer all attendees a dinner to celebrate the 75th anniversary of the founding of our company, Velutex Flock.

Abstract

Flock. Our Future has a History.

We will analyse the recent and possibly future applications in the flock industry from a historical perspective. Since the development of an strong flock industry in Europe, starting during the 40's last century, different major players in France, Spain, Germany, Switzerland, Italy, UK, etc have strongly impulsed the awareness of technical solutions in sectors such as Automotive, Packaging, Textiles and many new applications in Industry. Research and Development of machinery, fibres, adhesives and also a close cooperation with technological centres and certifying agencies lead to a Golden Age of the Flocking Business at the end of XX Century. During the presentation, we will share some treasured documents from that period.

The European Flock Association and its Associates have been always very important to impulse, promote and give awareness about this niche product. Now, after a Global Pandemic situation that we are still living, new challenges and opportunities in Flocking Business are appearing. We would like to bring an optimistic and futuristic perspective to the attendants to this symposium in order to work together in the 2030's Future for Flock.

NOTES

Flock Association
of Europe

6. Friction behaviour of flocked seals

Dr.-Ing. Martin Strangfeld

- born on 08.08.1981 in Dresden
- 2006 Diploma in Applied Mathematics at the University of Applied Sciences Mittweida.
- since 2006 Project Leader FILK Freiberg Institute

• Since 2013 Doctor of Materials Science
Title: „Dynamic Material and Squeak Behavior of Elastomeric Vehicle Seals“

• Research focus:
Friction and wear of elastic polymers and leather, especially stick-slip phenomena with the aim of developing and evaluating test methods and analyzing the relevant influencing variables.

Abstract

The flocking of sealings to minimize the frictional forces in the contact is a common method in sealing technology. Flocked seals are commonly used in automotive, for doors, glove boxes, hat racks, and storage compartments. They have a great influence on the perception of the quality of the vehicles by the vehicle passengers. Today's customers demand that, for example, moving door windows slide almost frictionless and noiseless. Despite the optimizations made in this area, under certain mechanical and climatic conditions, unwanted friction-induced noise phenomena repeatedly occur in the contact of the seals. The lecture should address this scientifically and economically significant problem and provide results through systematic, friction-based analyses, which characterize the flocked seal as a source of noise. So far, it is unknown what effects the characteristic of the flock and the properties of the friction partner have on the friction behaviour.

In recent years, noise in vehicle interiors has become a considerable economic problem. Since unpleasant noises such as squeaking or creaking have a major impact on the perception of vehicle quality and comfort, as well as representing a safety risk, automotive manufacturers attach great importance to noise prevention. Noise interference occurs when contacting materials with unfavourable friction behaviour are set in relative motion, e.g. by the jerking motion when driving or a functional motion such as when opening a window. In the case of seals, friction behaviour can be improved for noise prevention, for example, with the aid of flock, which has the advantage over a bonded coating of higher impact and noise absorption. Flocked seals are frequently used in vehicles, for example in the door and window area, for glove boxes, parcel shelves and storage compartments.

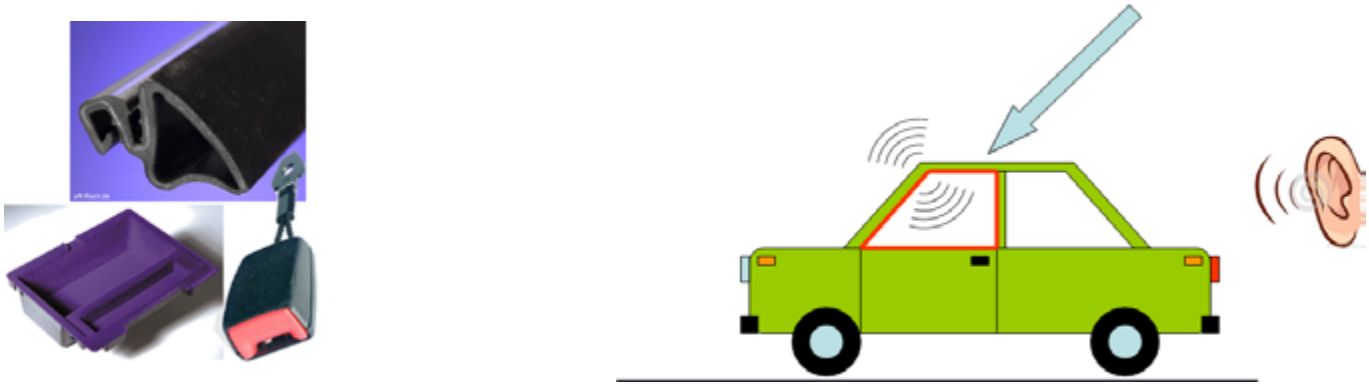


Figure 1: examples of application (left) and main source of flocked seal noise (right)

Despite the optimizations made in this area, unintentional friction-induced noise phenomena repeatedly occur with flocked seals, depending on the installation situation as well as the mechanical loads and climatic conditions. To solve these problems in the short term, a bonded coating, in special an anti friction coating, is currently applied to the flocked seal. Although this can reduce the disturbing noise, other positive properties of the fibrous structure are masked and manufacturing costs are increased.

It would make more economic and ecological sense if the seal could be designed from the outset in such a way that it does not generate interference noise under any of the loads and conditions typical in a vehicle. At present, however, there are no well-founded studies that could be used for targeted material optimization. For example, the interrelationships between the adjustable parameters of flocking (e.g. with regard to base materials, manufacturing conditions and possible post-treatments) and the friction behaviour of the seal achieved with them are as yet unknown. The influencing factors are very diverse and, moreover, not independent of each other. The aim of the research is to address this scientifically and economically important problem and to describe and evaluate the factors influencing noise generation during the manufacture and application of flocked seals. The aim of the project is to analyse and describe the frictional behaviour of flocked automotive seals and to develop ways of influencing it in a targeted manner.

Economic significance

The use of flock fibres, especially in the automotive industry, is steadily increasing. A distinction is made here between flocking for optical enhancement (design) and technical flocking, which is mainly used for noise insulation (noise). Further economically relevant areas of application are sealing, tolerance compensation, avoidance of vibration noise, easy sliding, avoidance of condensation, protection against contact at high temperatures, high absorbency and slip resistance. Warranty costs due to noise are estimated to be 10% of total warranty costs (worldwide > 10 billion € per year). Therefore, the optimization of materials with respect to perceptible noise during relative motion is considered an important component of successful vehicle development. Currently, there are no generally applicable standards that cover the friction behaviour of flocked seals. The project results provide the basis for this and thus enable material optimization based on an objective test procedure. Knowledge of the fundamental relationships between flock characteristics and the resulting surface properties enable a targeted and thus effective approach to product development. The investigations and developments in the field of flock post-treatment open up additional possibilities and areas of application on the technical side.

Assuming the tribological system as it is mentioned in the following figure the samples we have to consider the sample structure, which consists of substrate, bonding agent and the flock fibres as well as the mating material and certain particles. In addition to the properties of the flock fibres themselves, the structure and characteristics of the flock (e.g. fibre density, fibre orientation, regularity, etc.) can also have a major effect on the frictional behaviour.

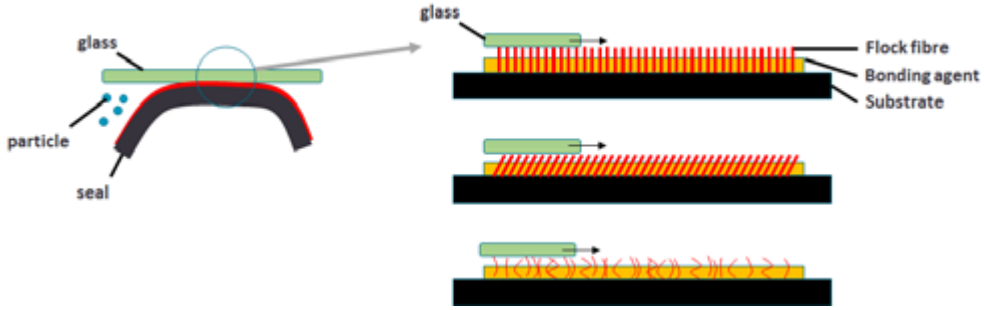


Figure 2: tribological system (left) and different flock properties (right)

However, the properties of the flocked surface influence not only friction, but also other functions of the material. For example, a seal should primarily serve to separate two spaces and prevent foreign substances such as dust, water, air or similar from being exchanged between the spaces. The sealing effect as well as the friction behaviour, is influenced by the characteristics of the flocked surface (in particular fibre type, density, length and orientation), so that, depending on the characteristics, foreign substances can enter the friction gap in the worst case (figure 2, left). This must be prevented and therefore always taken into account when optimizing the seal in terms of friction behaviour.

We want to address the following questions:

1. What is the relationship between the material properties of flocked seals and the friction properties?
2. How can the friction and noise behaviour of flocked materials be specifically influenced?
3. Can processes for the subsequent modification of flock be profitably used to improve the frictional properties of flocked seals?

So first we have to find out how we can characterize the flocked seals. Of course the main parameters are the length, the diameter (dtex) and the material type of the fibres. A special parameter regarding the process is the density of the fibres. Therefore the amount of fibres in an area of a square millimetre is calculated or counted. During the project we have analysed the surfaces and have counted the amount by using computer aided picture analytics.

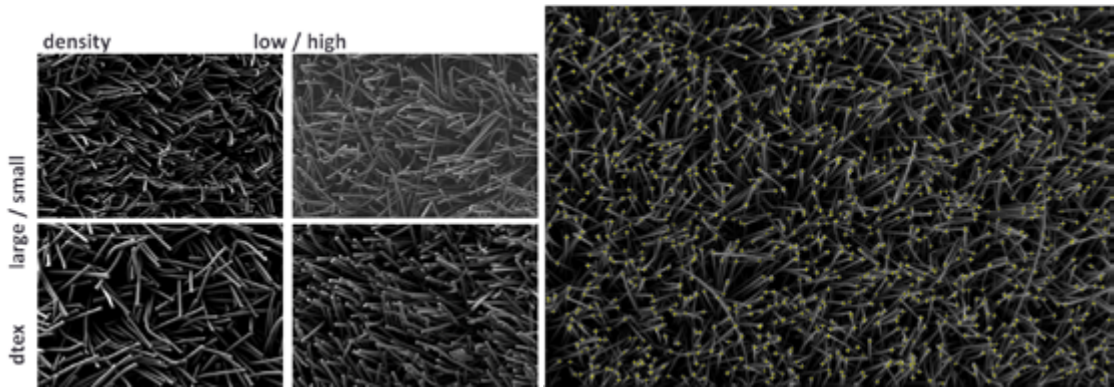


Figure 3: representation of different fibre density and diameter (left) and counting fibres by picture analytics (right)

Another interesting fact which is related to frictional behaviour is the effect of adhesion. It is important how the fibres interact with the mating material. The interaction is often discussed with the surface energy and its polar and dispersive parts. Surface energies can be calculated using a drop shape analysis with different liquids. Comparing the ratio between the dispersive and the polar part of the surface energy/tension for two phases allows for a prediction of the adhesion between these two phases. The closer the ratios match the more interactions are possible between the phases and the higher the adhesion which is to be expected.

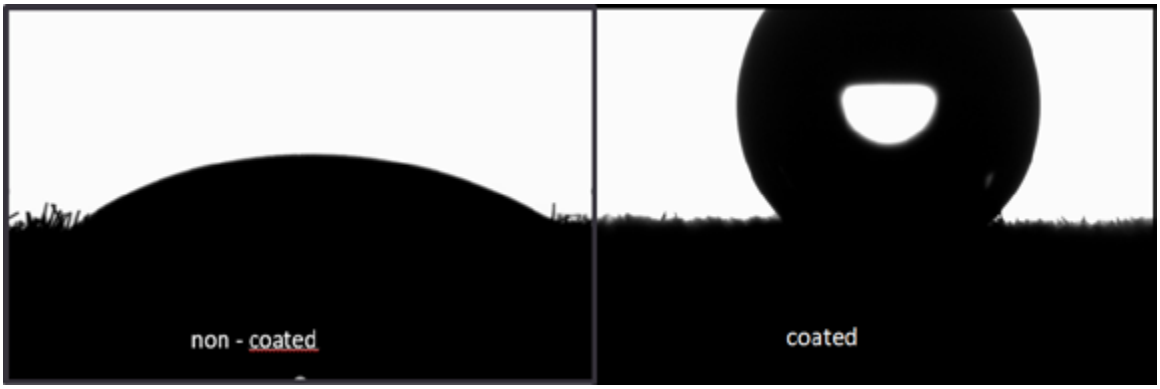


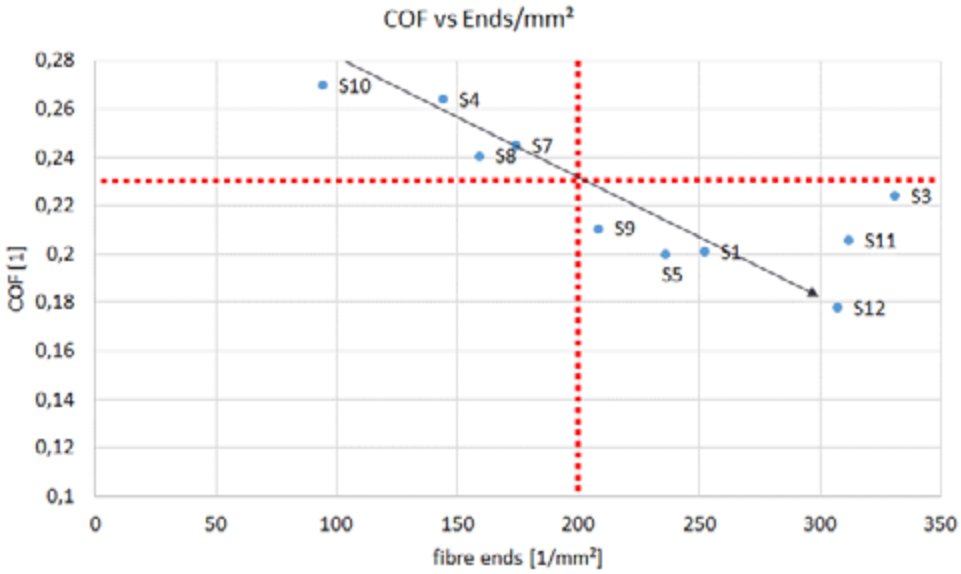
Figure 5: Drop shape analysis of coated or uncoated flock surfaces

In case of uncoated surfaces the drop, in this case a water droplet, moves directly into the surface. Coated surfaces are mostly hydrophobic and the droplet remains on the surface. Now it depends on the properties of the mating surface whether the adhesion is high which will result in higher friction or vice versa.

Additionally the deformation behaviour or hardness of the samples as well as the properties of the bonding agent and substrate were measured and taken into account.

To find a first answer for the question related the correlation between friction and fibre properties we plot the calculated fibre density vs the coefficient of friction (COF).

Correlation of fibre ends to friction



There is a strong correlation of the coefficient of friction to the amount of fibres/mm². This is related to the resulting contact area. A high amount of fibres is related to a small gap between them. Therefore, these fibres interfere with each other when bending and tend to stay upright. Therefore, the fibre ends are more likely to come into contact with the mating surface. This leads to a smaller contact surface and thus to less friction.

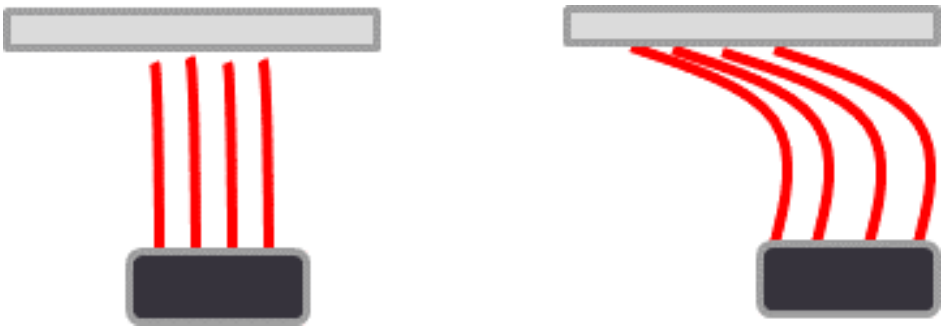


Figure 6: fibres and its contact surface

This leads to some short conclusions.

A smaller diameter (dtex) should lead to more flattening. This flattening is related to a bigger contact area and results in higher friction. The same should be present if we increase the normal force or the pressure. Higher pressure is related to a higher flattening. Also if we extend the fibre length it is easier to bend them. This will lead to more deformation and so to higher friction.

Coating of fibres enhances the hydrophobicity. This is good to reduce friction, but always dependent on the mating surfaces (delta surface energy).

But what about alternatives to coating?

In the research project three different approaches were tested (see figure 7).

Using the atmospheric pressure plasma process, very thin polymer layers should be deposited on the flocked surfaces. This is already used in different applications to reduce friction.

A process that is still little used is the subsequent structuring of the flocked surface by means of laser technology. In this way, defined structures can be introduced into the flocked surface. Since the surface structure generally has a demonstrable influence on the friction behaviour, this variant is tested for its effectiveness/ applicability with flocked seals. In terms of optimisation with regard to friction and stick-slip, the focus will be on reducing the contact area.

And third, the application of textile finishing agents was tested to find an alternative to coat the surfaces.

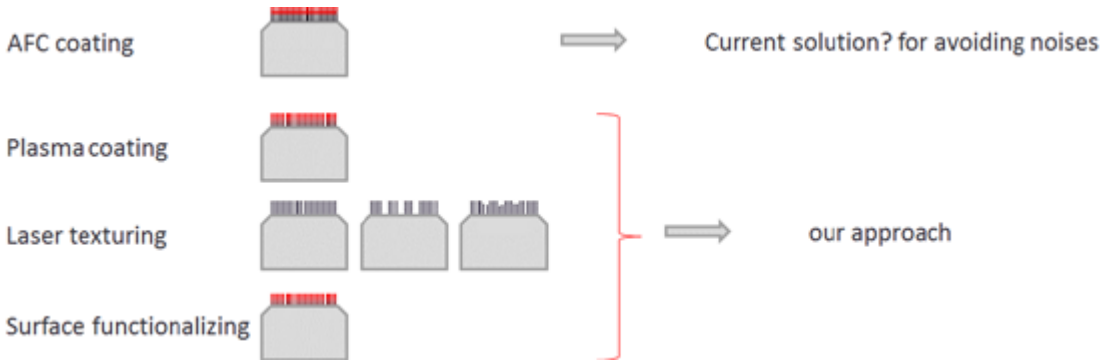


Figure 7: approach for alternatives to improve friction behaviour.

Post-treatment of the materials via plasma polymer coating

In order to save and optimise the current coating process, alternatives are to be examined within the project in order to save money and influence the friction properties. The first is coating by means of a plasma polymerisation process. For this purpose, a SiOx layer was deposited on the fibres via a plasma nozzle (Figure 8, left).

Figure 8: Plasma nozzle process schematic (left), comparison of the uncoated and coated flock fibres (right).

The deposited layers are still too thick at this stage (figure 8, right). A rougher structure can also be seen on the coated fibre surface. This could have a positive effect on the friction properties. Further experiments are being carried out here on varying the process parameters (e.g. lower precursor flow, faster treatment speed). The thickness results in a very low deformation behaviour which has a negative effect on friction up to now.

Second the laser treatment was taken into account. Defined structures were developed and applied to the samples using a laser system. Depending on the laser intensity, the fibres can be ablated completely or only partially. The fibres are melted by the heat input and thus can exhibit different properties.

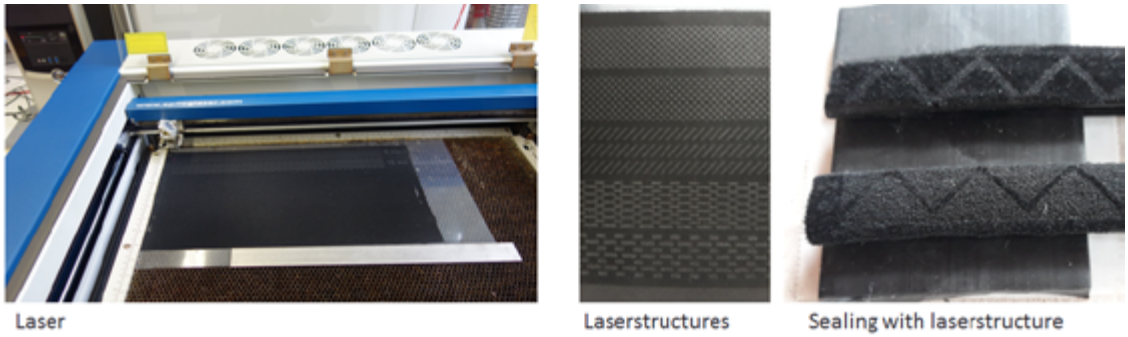


Figure 9: Laser treatment and modified samples

The samples were then subjected to a friction analysis. Different forces and speeds were taken into account. As an example, the coefficient of friction for a selection of fibre surfaces is shown in the following diagram.

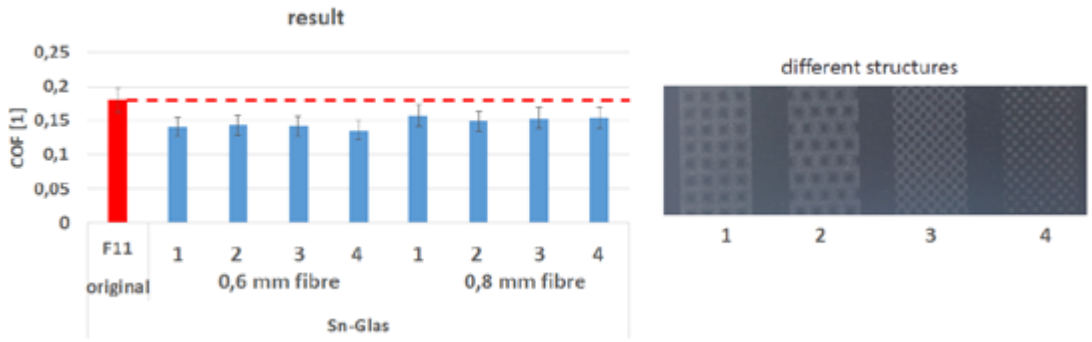


Figure 10: Coefficient of friction in dependence of laser treatment and fibre length

The structures shown here have a significantly lower coefficient of friction than the original shown in red. This proves that laser structuring can lead to an improvement in the friction properties. It can also be seen that longer fibres (0.8 mm) cause somewhat higher friction values. This can be explained by the above-mentioned approach of bending longer fibres and the associated higher contact area.

Thirdly, textile finishing processes were tested. Various finishing materials were distributed on the flock surfaces. The substances can be divided into four groups: oil and water repellent finish, fluorocarbon-free hydrophobing agent, softeners and silicone-free softeners.

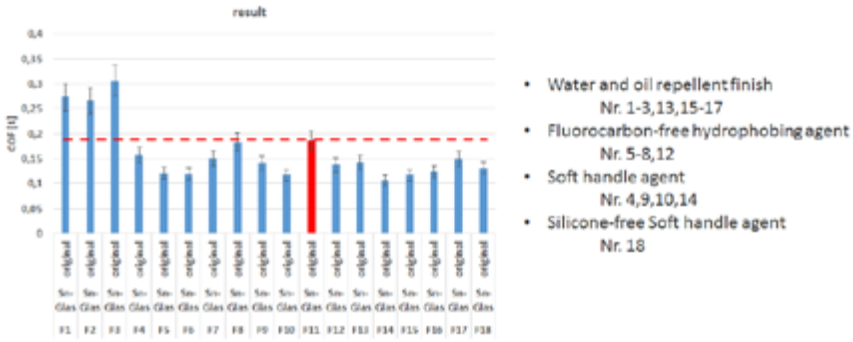


Figure 11: Coefficient of friction of different flock surfaces with textile finishing

The individual equipped materials were also subjected to the friction test. The diagram (figure 11) shows the determined friction coefficients compared to the untreated sample (red). It can be shown that textile finishes can be successfully used to optimise the friction properties.

To investigate the behaviour of flocked seals in practical application, a test rig is to be set up that reflects the sealing, sliding and cleaning properties. Up to now, the practice of car manufacturers is only a static leak test of the windows under simulated rain conditions at the end of production. So far, no cycles with opening and closing of the side windows have been carried out. This can now be done with this new test rig.

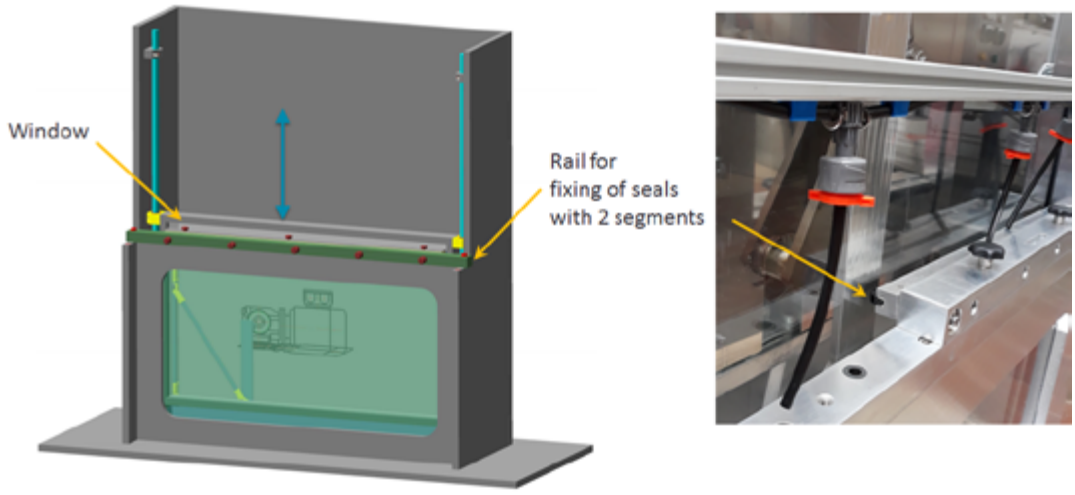


Figure 12: new test rig for wear and leakage und der rain conditions

Summary

1. Influence of the substrate material: This influence essentially relates to the formation of the deformation properties of the flocked complete geometry. Depending on the viscoelasticity, a contact area of varying size is formed. The higher the contact area, the higher the friction.

2. Influence of the adhesive: The choice of adhesive influences the strength of the bond. The adhesive must both adhere to the substrate and absorb the flock fibre. Depending on the viscosity of the adhesive, the penetration of the fibre is thus influenced and indirectly, via the layer thickness and elasticity/stiffness, the sliding strength of the flock fibres. This strength influences the sliding of the fibres against elevations of the counter material and is thus connected with the frictional force.

3. Influence of the fibre characteristic: The fibre characteristic is described by the parameters fibre stiffness, fibre length, fibre diameter and fibre density. Depending on the variation, this influences the deformation properties and the resulting contact area. The friction force is essentially determined by the fibre density.

4. Influence of post-treatment: There are two successful possibilities for post-treatment. The contact surface to the mating material can be influenced by subsequent structuring. By coating or functional finishing of the fibres, the adhesion tendency of the fibres to the counter material can also be controlled. The reduction of the adhesion leads to a reduction of the susceptibility to stick-slip.

5. Influence of the counter material: The counter material or the friction partner has a high influence on the friction behaviour. A flocking should therefore work for several different friction partners. Therefore, the compatibility consideration regarding the chemical component, which is related to the adhesion properties, and the surface structure component, which describes the contact area, is essential for an optimisation of the materials.

6. Influence of loads: The different types of loads (mechanical and thermal) influence the material properties both on the surface (adhesion) and in the material itself (stiffness/damping/deformation). This thus has an impact on the cleaning (tightness) as well as the friction behaviour. Here, both contact surfaces and adhesion properties change.

The aforementioned effects on the contact surface, stiffness, damping, adhesion properties and deformation not only influence the strength of the friction, but also have an influence on the stick-slip behaviour.

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This was a joint research project “Friction behaviour of flocked seals” between the FILK Freiberg Institute and the Institute for Textile and Leather Technology of the University of Applied Sciences in Zwickau/Reichenbach. This Project was funded by the Federal Ministry of Economy and Climate Protection on the orders of the Deutscher Bundestag.

NOTES

7. Flock and the microplastic issue: ECHA's proposal for the restriction of „microplastics"

Michael Stark

Abstract

The prevention of the environment from litter of resistant plastic has become an objective for society and politics in the last few years. The European Commission asked in that perspective the European Chemical Agency ECHA to prepare within REACH a restriction dossier for microplastic added to consumer products.

ECHA's proposal for a restriction was already published in January 2019 and revised in December 2020 after public consultations and discussions within competent bodies, however the final draft for a regarding regulation by the Commission is still pending.

The very broad definition in ECHA's proposal indeed includes flock, however the manufacture of flock and its use for flocking – both as articles – are not included in the scope of the restriction and are without any duties. However, a different use of flock as short fibre in any preparation/mixture might be under the scope and would be restricted or would have reporting obligations in the current proposal.

The presentation introduces the aspect of textile fibres within the microplastic issue, estimates their emission into the environment, discusses their possible harm, presents the common definition of microplastic and ECHA's proposal under the aspects of the relevance for flock and finally the affectedness of flock from the intended restriction.

1. Introduction – Microplastic and Fibre Lint

Plastic has achieved in media and in politics for the moment an image as a relevant and huge polluter of the environment with harmful risks for fauna and flora. The increasing amounts of materials from synthetic polymers for packaging or single-use materials and their in-proper disposal result in a visible accumulation of rubbish at roadsides, on beaches as well as on marine surfaces.

Less visible are the tiny pieces of plastic, "microplastic" from various origins which can be found everywhere in marine environment or in remote areas, distributed by floating on the oceans or via ambient air. The analyses of these particles (ranging from lower µm up to few mm) and their identification from synthetic polymeric origin are very challenging. The detection of textile fibre lint[1] particularly from coloured textile products is easier, comprised only by the difficulties for the differentiation of synthetic from natural polymers – as cotton or viscose - and for the avoidance of contamination with fibre fly from ambient air.

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1 Fibre lint: as fragments from fibres (fibre fly in case of airborne; visible to the naked eyes)

Accordingly, fibre lint was only counted in several initial studies about microplastic in the aquatic environment, as the often-cited Australian study by Browne et al., 2011[2]: Fibres consisting of PES, PAN and PA were reported to be found on various marine beaches and in the effluent of sewage treatment plants (even at doubtfully high concentrations of 1 fibre per litre). One result of this study is often cited: the loss of >1900 fibres in the wash water of one "fleece" garment. This amount would be indeed less frightening as it represents a loss in the lower ppm range (about 1 mg per ½ kg garment – calculated with <0.6 µg per fibre for <2 mm and <3 dtex PES fibres). However, this value was used for extrapolations of emissions into the environment of Norway, EU and even the whole world with conversion factors (for number into mass concentrations) which were exaggerated about 300 fold. Not to at least because of these biased reports, the washing of synthetics was assessed to be the major source for the abundance of synthetic fibres in the aquatic environment and to have a high share of any microplastic, as the often cited 35% reported by IUCN for the oceans. [4] [5]

Any estimate of fibre emissions from washing should be based on results from sewage and from sewage treatment plants, as the complexity of textiles and garments does not allow any extrapolation from results of washing of individual textile products.

Fibre lint in the sewage will be very effectively (at least 99%) retained in conventional (with activated sludge) and well operated waste water treatment plants. An emission of these fibres into the aquatic environment is therefore negligible for at least areas with developed infrastructure. The agricultural use of the sewage sludge which retain a proportion of particles from the sewage distributes however the retained fibres.

However, the abundance of fibres in the environment should derive more from depositions and distribution of airborne fibres via airway. These fibres originate from different outdoor uses of textiles and their degradation. Tinier fibrous particles are suitable for any long range transport, can be found therefore also in the arctic snow.

2. Harm of synthetic fibres

The low rate of biodegradation of microplastic from most synthetic polymers raises the concern of their accumulation in aquatic or terrestrial environment and of an increased up-take by vertebrates or invertebrates associated with harmful effects. But is has to be taken into account that in this discussion often bioavailable nano- and larger micro sized particles were not distinguished.

Some feeding studies in aquatic invertebrates were performed also with fibre lint which did not result in any accumulation, but excretion of the dosed fibres (occasionally with some retardation in the intestinal tract), without Adverse effects.

The current discussion about potential harm of microplastic initiated reviews about the health impact from an exposure in ambient air and two claims which gained a renaissance were raised as evidence for health impacts and harm of fibre fly in ambient air:

- fibre lint in the lungs of tumour patients responsible for an inflammation,
- lung disease of flock workers in US in the 90ties

But both are invalid for that assertion:

- The fibres found in the respiratory part of the lung were, according to the description, too large to be respirable and would contradict otherwise the more than 50 yearlong scientific knowledge about respirability (the reviews reproduced uncritically the assertion in the publication, whereas hints are evident of bias and of an incorporation of these fibres from biopsy).

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2 Browne et al.: "Accumulation of microplastic on shorelines worldwide: sources and sinks", Environ. Sci. Technol. 45, 9175-9179 (2011)

3 See in the review: M. Stark, „Microplastics and textile fibers: a critical review", Melliand Int 23 , 135-139 (2017)

4 J Boucher and D Friot: "Primary microplastics in the oceans: a global evaluation of sources", IUCN, Gland, CH, February 2017; https://portals.iucn.org/library/node/46622

5 IUCN reported an emission of 0.52 million tons synthetic fibres into the oceans, a volume which would represent more than 1 % of the world production of synthetic fibres used for textiles for garments.

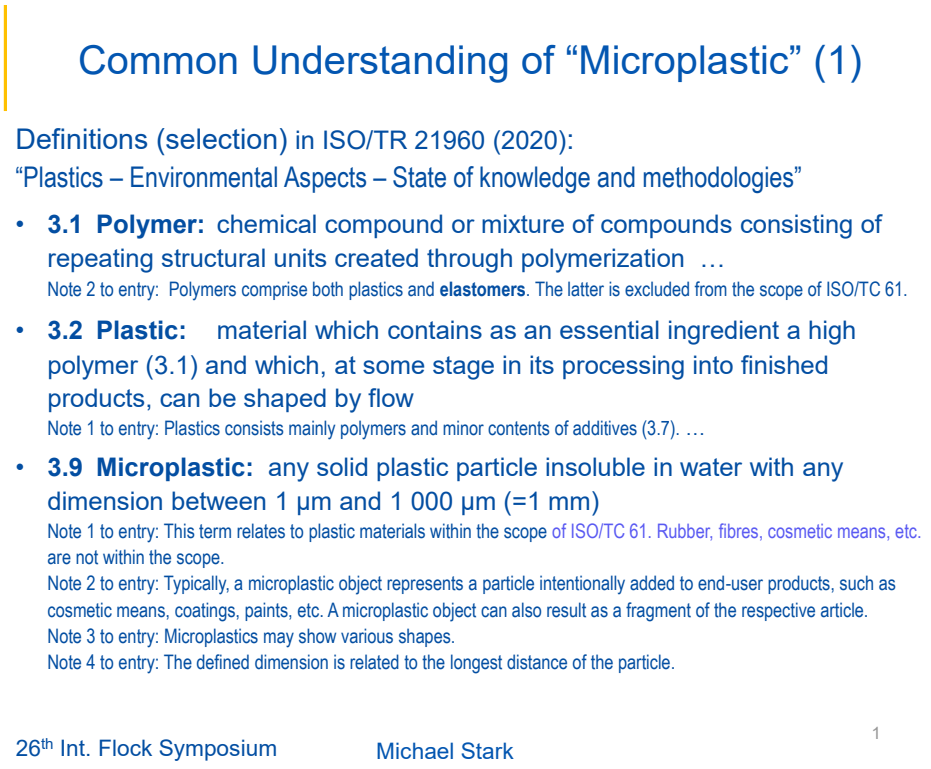
- "Flock Workers Lung"[6] describes a respiratory disease, diagnosed also as "interstitial lung disease", in workers from three flock plants in USA and Canada from one company. The etiological agent for this illness was not identified, despite a medical and hygienic survey by NIOSH at the US plants. NIOSH's conclusion of coarse PA dust generated by the rotating cutter as cause is less conclusive (the mentioned supporting prove by an intratracheal installation of these "shreds" was disproved by a more sound inhalation study, and further arguments).

Therefore, there is no evidence of harmful effects of (non-respirable) fibre lint itself neither from synthetic nor regenerated man-made origin, and neither for the biota nor for human health.

Therefore, the presence of fibre lint or fly in the environment should not be denominated as pollution (with harmful effects) but instead as contamination (and as an avoidable which should be minimised for various reasons).

3. Common understanding of "microplastic"

"Microplastic" was initially and is still used in various meanings, particularly with regard to the dimensions, ignoring the essential meaning of "micro", but including nano-sized particles and extending up to 5 mm (intended to cover also polyolefin pellets lost from shipping containers and found on beaches at marine litter monitoring programs). Sometimes man-made materials even from not-modified natural polymers are included.
A meaningful and important definition of microplastic (from any plastic material) was issued in 2020 in the ISO Technical Report ISO/TR 21960 which was developed from a working group headed by Claus-Gerhard Bannick from the German Umweltbundesamt, see the slides below.



6 Also called "Nylon Flock Disease" and became popular not at least because a conflict between scientific freedom and secrecy agreement/data ownership got many public attentions.

Common Understanding of "Microplastic" (2)

Definitions (selection) in ISO/TR 21960 (2020):
"Plastics – Environmental Aspects – State of knowledge and methodologies"

- **3.10 Large Microplastic:** any solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm
  Note 1 to entry: Microplastics (3.9) may show various shapes.
  Note 2 to entry: Typically, a large microplastic object represents an article consisting of plastic or a part of an end-user product or a fragment of the respective article.
  Note 3 to entry: Microplastics in this size range are, for example, plastic pellets as intermediates for further down-stream processing such as moulding, extrusion, etc. resulting to semi-finished products which are not final end-user products.
- **3.11 Microparticle:** solid particle insoluble in water in the dimension between 1 µm and 1 000 µm (=1 mm)
  Note 1 to entry: There is currently no specific distinction between nano- and microparticles
- **3.13 Nanoplastic:** plastic particles smaller than 1 µm
  Note 1 to entry: According to OECD nanoparticles are up to 100 nm.

Common scope: Includes particles from polymers with structural properties:
– elastomers (rubber)
– fibres

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The common understanding of microplastics covers not only those from any plastic material but also all materials from synthetic polymers, including elastomers (rubber like material) and fibres.

The fibre and textile industry missed the occasion to prepare parallelly a similar report with relevant terms and definitions for a consistent use, as well as with requirements for analyses of fibres in the environment. Some relevant terms and meanings are summarised in the slides below.

Common Understanding of "Microplastic" Fibre terminology (1)

By BISFA ("Terminology of man-made fibres", 2017 Edition; www.bisfa.org)

- **fibre:** "a morphological term for substances characterized by their flexibility, fineness, and high ratio of length to cross sectional area."
- **staple fibre:** "a textile fibre of limited but spinnable length …."
- **flock:** "very short fibres intentionally produced for other purposes than spinning (e.g.: flocking)."
- **fibre fly:** "airborne fibres or parts of fibres (light enough to fly), visible as fibres to the human eye."
- **fibril:** "a subdivision of a fibre. .. "
- **particulates from fibres:** "airborne particles, not visible as fibres to the naked eye. …." (also without fibre shape)
- **respirable fibre-shaped particulates (RFP)**:
  "airborne particulates fulfilling the following dimensional conditions: length > 5 µm, diameter < 3 µm and length/diameter ratio of > 3:1"

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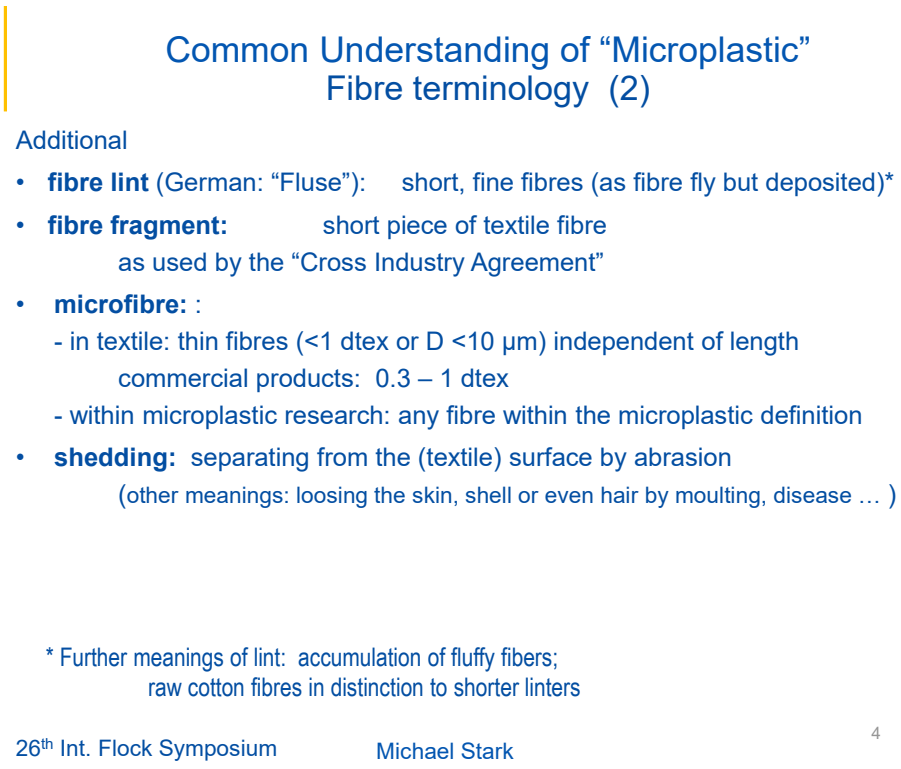

4. ECHA's Proposal for Restriction

The EU Commission asked in November 2017 the European Chemical Agency (ECHA) to prepare a Dossier for the Restriction of "microplastic",

- as synthetic, water-insoluble polymer of 5mm or less in any dimension (i.e. microplastic particles),
- intentionally added to consumer or professional use products of any kind.
- Additional criteria in the definition (e.g. biodegradability, solid state) should be assessed.

Restriction is intended in the European Chemical Legislation REACH for certain substances which would pose an unacceptable risk to human health or the environment by limiting or banning their manufacture (including imports) or use, or by imposing relevant conditions.

> *Art 67, Nr.1: „A substance on its own, in a mixture, in an article, for which Annex XVII contains a restriction shall not be manufactured, placed on the market or used unless it complies with the conditions of that restriction. … "*
> *(derogated from any restriction are intermediates, use for research or cosmetic products)*

> *Article 68, Nr. 1: „When there is an unacceptable risk to human health or the environment, arising from the manufacture, use or placing on the market of substances, …. "a restriction shall be adopted „for the manufacture, use or placing on the market of substances on their own, in mixtures or in articles, …. Any such decision shall take into account the socio-economic impact of the restriction, including the availability of alternatives."*

The process for the issuing a restriction should last not more than 27 months from the initiation until the publication of the draft of the regulation. But this task for microplastic is much delayed: ECHA's initial Dossier as Restriction Proposal was published in January 2020 which was eligible for public comments. Thereafter ECHA's Committees for Risk Assessment (RAC) and for Socio-economic Analyses discussed the proposal and the comments, accepted basically the proposal with some modification in the definition and derogation: The revised Dossier titled "Background Document" was finally published with date of December 2020. (The whole documentation is available on ECHA's website: https://echa.europa.eu/de/registry-of-restriction-intentions/-/dislist/details/0b0236e18244cd73).

EU's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) is now in charge for the preparation of the draft for the restriction legislation. This is also delayed and now expected to be released in March 2022. The outcome might be presented at the Symposium.

Therefore, ECHA's proposal for the restriction will be discussed below particularly with aspects relevant for fibres. We do, however, have to take into account that it is most likely that the Commission will again confine the scope, as ECHA's proposal goes in their definition far above the initial mandate.

Intention

ECHA identified the use of polymeric particles in various sectors – which are listed in the slide below -, estimated the volume of their use in Europe and their emissions into the environment, searched for possible substitutions with associated additional costs.

ECHA's Proposal for Restriction of Microplastic (3) Considered scope

Sectors in ECHA's focus

Estimated amounts [kt/a] in EU of "microplastic" intentionally added in descending order (with ratio of emission from the volume used)

Sector	Mean estimate	Range	Ratio
Turf infill material	16	2 – 52	16 %
Agri– & horticulture	10	3.5 – 18	100 %
Detergents	8.5	5.6 – 11.6	50 %
Cosmetic	3.8	1.8 – 5.9	50 %
Paints & coatings	2.7	0 – 5.2	50 %
Medical products	1.1	0.4 – 1.8	50 %
Oil & gas	0.27	~ – 0.55	27 %
Construction prod.	Not known		?
Total	42.4	13.2 – 95	

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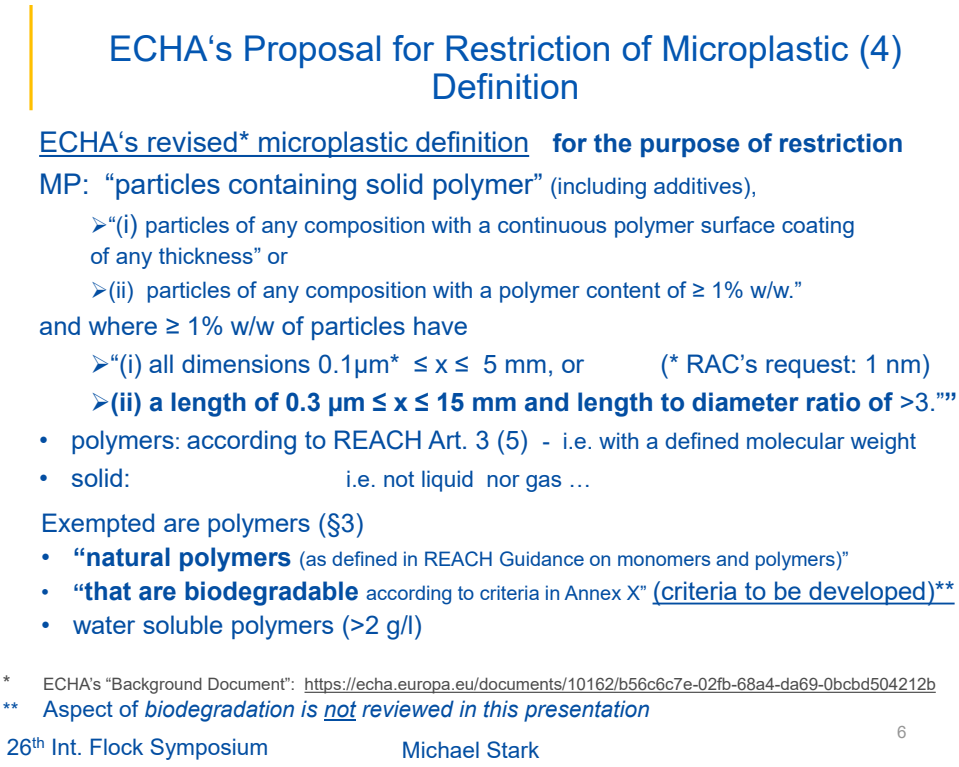
The estimated emissions for the sectors analysed – as mean and as range – are listed in this table. Fibrous particles appear only as reinforcement fibres in adhesives and concrete (sector: "construction products").
Despite all uncertainties of the data and their huge range: ECHA mentioned in a press release in December 2020 that this restriction process would prevent the environmental emission of 500 000 tons of microplastic within and over 20 years (or 60 % of the estimate of annual emissions) – for an estimated additional cost of 11 to 19 billion Euro.

Definitions

ECHA's proposal for the definition of microplastic "for the purpose" of the restriction exceeds the scope expressed by the Commission and differs from common definitions of microplastic (therefore, SEAC proposes not to use the term "microplastic" in the upcoming regulation). Relevant parts of the definition are compiled in the slide below. Any particle – from inorganic or natural origin – coated with a synthetic, less water soluble polymer (as for dispersing properties) would be covered by the definition. And the dimension with maximal lengths of 15 mm for any particles with an aspect ratio of >3:1 is also exceeding all other definitions (a particle with aspect ratio of only 3:1 can hardly be named as fibre).



The different dimension for fibrous particles of 15 mm as upper length in the proposal for the restriction is arbitrary and its deviation is not conclusive. The authors of ECHA's proposal assumed obviously that particles used for the reinforcement of adhesives and concrete would be relevant to the microplastic concern, due to a potential release from any accidental spill during production or at construction sites and should be captured by the restriction. And those polymeric fibres might have length above 5 mm.

However, the lengths of the polymeric fibres as substitute of steel nails which are mentioned in papers cited in the restriction proposal have lengths even exceeding 15 mm [7]. And the suspicion of any spills is exaggerated – the alkaline cement would be worse if spilled.

Exemptions and Derogations

Exempted from the restriction are:

- "natural polymers (as defined in REACH Guidance on monomers and polymers) that have not been chemically modified (as defined in REACH Article 3(40))"' [8]
- biodegradable (with a pending and highly disputed requirements for the degradability)
- and soluble polymers (>2 g/l) (as derogation)

Derogated are (§4)

- "substances or mixtures containing microplastics for use at industrial sites", i.e. pellets;
- medical products, in vitro diagnostic devices, fertilising products, food and feed, food additives, sewage sludge;
- but also: granular infill (maximum annual losses by technical means) (RAC disagrees)

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7 The misunderstanding of ECHA's authors about the use of fibres in concrete are commented in my submission to ECHA's SEAC: # 546; https://echa.europa.eu/documents/10162/71b5eb22-5dc1-77d9-8472-4305b21bfca3

8 "Natural polymers are understood as polymers which are the result of a polymerisation process that has taken place in nature, independently of the extraction process with which they have been extracted."; ECHA: "Guidance for monomers and polymers", Version 2.0, 2012, p.20; https://echa.europa.eu/documents/10162/23036412/polymers_en.pdf/9a74545f-05be-4e10-8555-4d7cf051bbed:

Further derogations (§5) for "**substances or mixtures** containing microplastic in case the microplastic
- "is **contained by technical means** to prevent releases to the environment during end use"
- "**permanently incorporated into a solid matrix**"

Duties
- Downstream users of microplastic derogated because of its use at an industrial site, need to report annually
  - the description of the use,
  - generic information on the polymer identity and
  - estimated quantity of an environmental release for each use.
- Similar information is requested for the first supplier of derogated microplastic for professional or consumer end use.
- Supplier of substances / mixtures containing microplastic for derogated use need to prepare label / safety data sheets / instruction of use … .

5. EU Commission

The draft for the restriction by the EU Commission is expected now for March 2022.

Within the ambitious and broad Green Deal Program of the Commission many actions for the reduction of plastic and microplastic in the environment are covered. Whereas, microplastic is handled with the precautionary principle due to growing concern for the environment and for human health, despite lack of any scientific evidence.

- Circular Economy Action Plan (Mobilising industry for a clean and circular economy)
  ➔ restrict intentionally added microplastic
- Zero Pollution Action Plan for air water & soil (ambition for a toxic free environment)
  ➔ reduction by 50% plastic litter at sea and
  ➔ reduction by 30% microplastic released into the environment by 2030
- Plastic strategy (reduce littering - as the Single Use Plastic Directive, increase recycling)
  ➔ unintentionally release of microplastic: regulation intended for textiles, tyres and pellets (not intended for the more relevant contaminants paints / coatings)
  - with harmonised / standardised methods for measuring (tyres, textiles)
  - with labelling and certification
- Farm to fork (a fair, healthy and environmentally friendly food system)
  ➔ contaminants in food and drinking water: close gaps in scientific knowledge related to the risk and presence of microplastics Measuring of microplastic intended or considered
- in the next Urban Waste Water Treatment Directive (UWWTD) – draft for revision expected by mid-2022
- in the next Sewage Sludge Directive (SSD) – draft expected by end 2022,
- in the future Environmental Quality Standards Directive (ESQD) about surface water and groundwater quality standards
- in the recast Drinking Water Directive (DWD): by January 2024

6. Restriction Proposal and Flock

The affectedness of flock manufacturer and user from the intended restrictions is discussed below, still with ECHA's proposal, but might be updated in the presentation according to the expected publication of the announced Commission's draft.

Flock itself is regarded in Chemical Regulations as an "article", manufactured from the article tow and processed in another article as flocked material. Article is defined in REACH as "an object which during production is given a special shape, surface or design which determines its function to a greater degree than does

its chemical composition" (Art. 3(3)). This contrasts with substance which "means a chemical element and its compounds…" (As the polymer in pellets) and to mixture (former term: "preparation"; as the finish used for the flocking).

Articles are not in the scope of REACH (besides specific substances in articles), and the restriction on REACH is provided by substances on its own, in a mixture or in an article. [9]

Flock as man-made fibre itself has no indication of a hazard to human health or environment which would result in an unacceptable risk, required in the REACH regulation for the restriction (valid also for other microplastic particles, or in other words: REACH is a doubtful approach for limiting the contamination of the environment with durable man-made litter).

Otherwise, short fibres are within the scope of ECHA's definition of "microplastic" which means "particles containing solid polymers".

- Regarding the wording, the whole restriction including the derogations applies only to substances or mixtures, therefore the manufacturing of the article flock and their use for flocking are not in the scope of the proposal at all.
- Also from the intention of this restriction: the manufacturing and processing of flock at industrial sites, their permanent incorporation into a solid matrix or containment by technical means would qualify for the derogation (the use of this derogation would require reporting obligations).

However, if flock does not end up in another article but is used in a mixture / preparation (as in paints or adhesives) the aspect of mixture containing particles of polymers (even though they are articles) must be considered:
The use would not be banned if the flock in the final product is permanently incorporated in a solid matrix or contained by technical means. But required are.

- labels / SDS / instruction of use / package leaflets for the proper handling of flock containing mixtures ;
- and an annual reporting by the flock manufacturer/importer (as the primary / initial supplier) about the use, polymer identity and estimated environmental emission.

Similar reporting requirements are proposed for the industrial user of any polymer pellets, to be used for the production of plastic articles, films, tow or fibres.

However, we can still hope that the final draft from the Commission will not follow ECHA's proposal and will lessen the proposed excessive bureaucracy.

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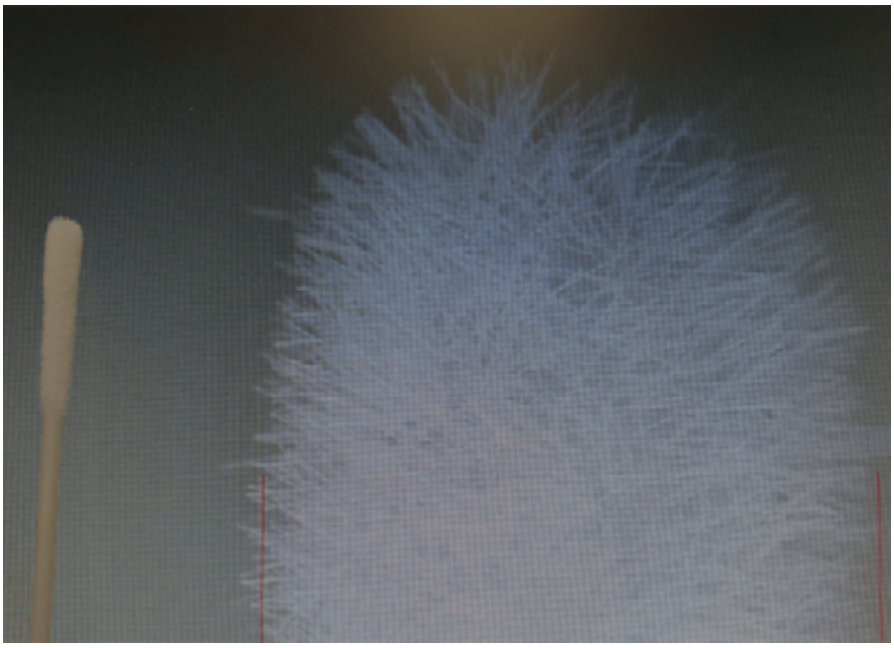
9 However, the authors of the ECHA's proposal intend to integrate fibres into the scope of the intended restriction. They argue that microplastic particles in general cannot be an article! And in case that this position would not be confirmed the wording in the proposed restriction should be modified to include also "polymers in articles" in the scope for this restriction for intentionally added microplastic, with particular emphasis to fibre-like particles:
"Specifically, this relates to the status of fibres, which are currently considered in the ECHA Guidance to be articles in their own right, irrespective of the type of object that they are subsequently incorporated into (e.g. clothing). The Dossier Submitter considers that fibre-like particles (within the relevant size dimensions identified in the proposal) are intentionally-added microplastics that should be within the scope of the restriction." ECHA, Background Document, December 2020, p.88f

NOTES

8. Round table discussion – „Flock supports the fight against Covid-19“

Thomas Starsetzki
Kissel + Wolf GmbH



Abstract

- What are your experiences with
  - flocking swabs
  - substrates
  - flock
  - application?
- Which influence does a medical approval have?
- What are the requirements you were faced e.g. durability, resistance or haptical values?
- What are your experiences with FDA or EU regulations?

Please share your experience with us.

IMPRINT

26TH INT. FLOCK SYMPOSIUM

Organizer
Flock Association of Europe (FAoE) e.V.
Ohmstr. 11
96175 Pettstadt, Germany
www.faoe.eu

Event Chairman
Stephanie Wegner, CEO FAoE

MANUAL OF LECTURES

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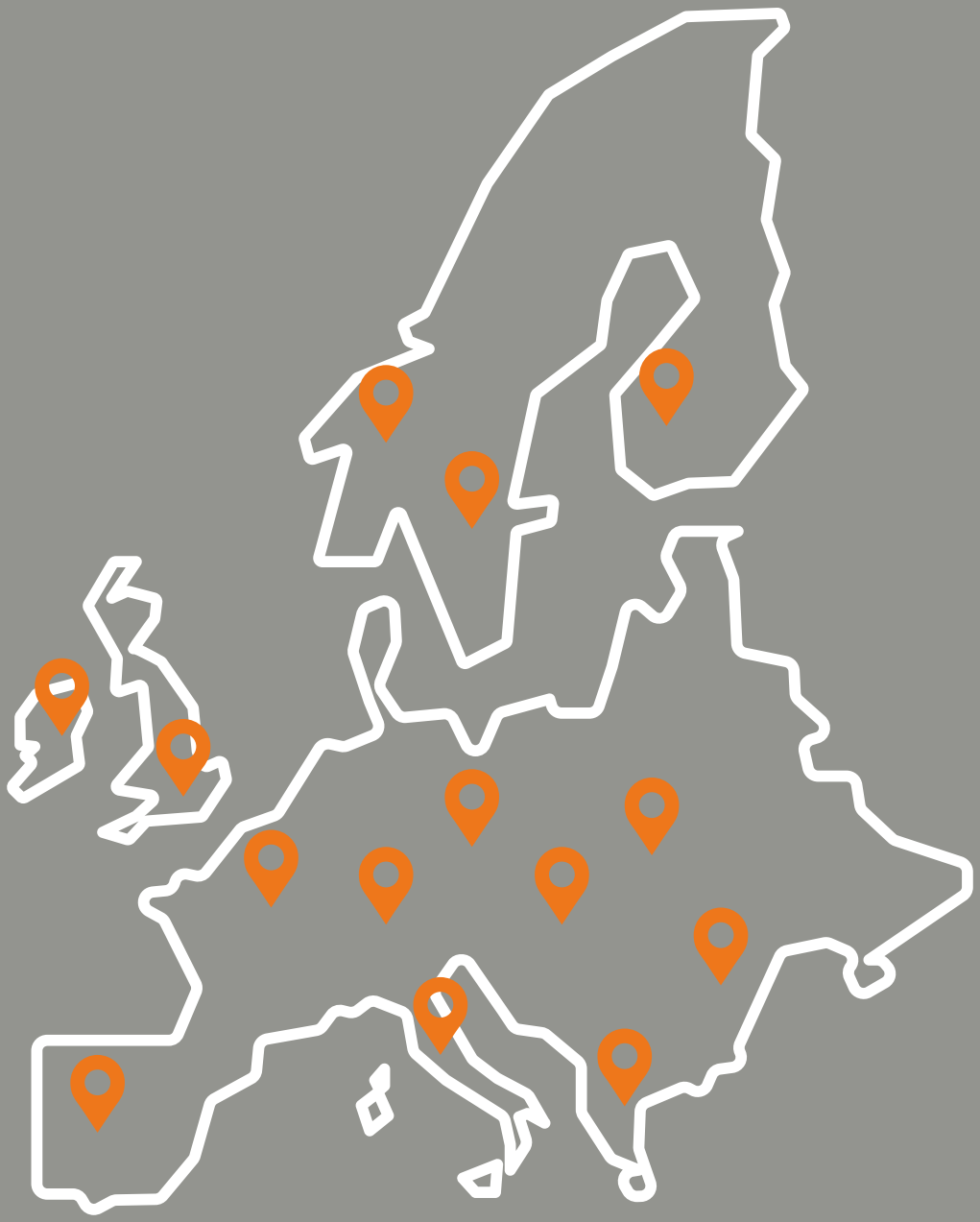

ALL ABOUT FLOCK

THANKS FOR YOUR ATTENTION.