PFAS Application in Textile Services, PPE, Medical Devices, Textiles, and Machinery

The ETSA Perspective

ETSA

EUROPEAN TEXTILE SERVICES ASSOCIATION

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ETSA: A Key Player in Textile Services

The European Textile Services Association (ETSA)[i] has deemed it an imperative to answer the following ECHA consultation on the REACH restriction, in the interest of not only its industry and members, but also in the interest of individual safety and concerns over the preservation of human life. Established in 1994, ETSA operates as a not-for-profit organization, representing textile rental firms, suppliers of detergents, machinery, fabrics, and garments, and a research institute along with national associations in the textile services sector. ETSA has repeatedly served as a platform of dialogue and exchange between European policymaking institutions and the textile service sector.

Textile services, the core domain of ETSA, encompass the washing, supply, rental, and maintenance of various textiles. This represents a diverse range of products, from workwear and hotel linens to surgical textiles and industrial cleaning materials. These textiles play pivotal roles in ensuring hygiene, safety, and comfort across multiple sectors.

In the world of industry and technology, Per- and Polyfluoroalkyl Substances (PFAS) have quietly but ubiquitously made their presence felt. These compounds have found their way into a vast array of applications across various sectors, demonstrating their indispensable role in enhancing human safety, performance, durability, and functionality, in the domain of textile services. Nevertheless, ETSA as a European Commission Climate Pact Ambassador, underscores and emphasizes that PFAS should not be found in the environment. As such, ETSA and its members agree with the necessity to eliminate the large quantities that enter the collective ecosystem. Textile Service companies are working to find substitutes for all these chemicals, constantly researching and innovating.

However, as will become evident during the course of this paper, ETSA strongly advises specific derogations for the essential uses of PFAS wherein there are no viable existing alternatives at this time. For certain critical industries (including those necessary to fulfill European Climate and Green Deal Objectives and safeguard Europe's health and safety) some PFAS compounds without alternatives remain a necessity in the fulfillment of these goals.

As we delve deeper into the multifaceted world of PFAS applications in the context of this answer to the ECHA consultation, it will become evident that where adequate alternatives are not available these substances are integral to industries spanning textiles, personal protective equipment (PPE), medical devices, and machinery and are necessary for the protection of human health and safety in conforming to existing European health and safety standards. **Thus, ETSA, representing the textile service industry, highlights the importance of permitting the use of PFAS for personal protective equipment (PPE) and medical devices, namely through the use of derogations when no alternatives are available. An undue restriction on these compounds would heavily undermine the health and safety of European workers and citizens alike. With respect to medical devices, a ban would pose a threat to the continued provisions of state-of-the-art medical care that Europeans currently enjoy**. This is also particularly relevant for category III PPE as specified, for example in the EN 13034 (Protective clothing against liquid chemicals. Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (Type 6 and Type PB [6] equipment)) and EN 469 (Protective clothing for firefighters - Performance requirements for protective clothing for firefighting activities) and also holds true for some

categories I and II products, especially in conjunction with the C6 formulation. This reality will become evident throughout the response here.

A Historical Perspective on PFAS Regulation

The journey into understanding PFAS's extensive applications must begin with a historical context. In May 2020, several European nations, including Germany, the Netherlands, Sweden, Denmark, and Norway, collectively voiced their intention to propose regulations restricting PFAS to the European Chemicals Agency (ECHA). This regulatory move set the stage for comprehensive evaluations of PFAS applications, with particular focus on PPE and its reimpregnation process. Moreover, in late 2023, following a meeting with the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW), ETSA lobbied its national associations to support the European Commission's proposed measures which were initially submitted by to the Commission by Germany. These proposals include a derogation for Personal Protective Clothing (PPE) based on socio-economic impacts and the lack of availability of alternatives.

The objective of ETSA's action on these topics was to ensure that information about PFAS and potential alternatives is accurate and reflective of the market situation when debated by policymakers. These knowledge-based approaches would serve as the foundation for forthcoming restriction proposals and have been reviewed and re-evaluated in the context of this answer.

Protective Clothing and PPE: The Critical Role of PFAS

In the realm of protective clothing and PPE, the significance of PFAS application takes centre-stage. This is a domain where safety and functionality converge, making PFAS-infused textiles indispensable. PFAS formulations are diverse and versatile, contributing to the creation of essential equipment like surgical drapes, gowns, and protective covers. These products are distinguished by their ability to act as robust barriers against liquids, microbes, and chemicals, meeting stringent industry standards and upholding safety and hygiene. Currently there are no practical alternatives that can provide the same level of repellent and protective properties while ensuring the safety and well-being of frontline workers.

The absence of PFAS-treated PPE could have profound societal repercussions. Firefighters, for instance, rely heavily on specialized gear that incorporates PFAS to protect themselves during perilous firefighting operations. Without PFAS in PPE, these professionals would face heightened risks and challenges, touching on several critical aspects as it is technically not feasible to offer resistance to penetration by liquid chemicals according to EN 469: 2020 (Protective Clothing for Fire Fighters).The main limitation for PFAS free solutions is offering the right level of protection against - Oil based chemical splashes (o-Xylene) Group.

For a more comprehensive list of some professions which would be impacted by an impractical restriction on PFAS, see document, "Professional Usage Examples."

A) **Impact on Emergency Response and increased risk for human safety:** Firefighters are front-line responders to a range of emergencies, including fires, hazardous material spills, and natural disasters. The inadequacy of PPE could hamper their effectiveness in these situations,

potentially leading to longer response times, increased property damage, or harm to those needing rescue.

C) **Public Safety Concerns:** Firefighters often work to safeguard both their well-being and the safety of the public. A shortage of adequate PPE could jeopardize public safety by impeding their ability to respond safely and efficiently to emergencies.

D) **Emergency Preparedness Challenges:** A disruption in the availability of critical firefighting equipment could raise questions about emergency preparedness at multiple levels—local, regional, and national. A dependable supply of appropriate PPE is imperative for maintaining a state of readiness to respond to unforeseen events.

E) **Risk to Vulnerable Populations:** Vulnerable segments of society, such as the elderly and individuals with mobility issues, depend on the timely and effective response of firefighters during emergencies. Any reduction in firefighters' capacity to provide assistance could disproportionately impact these groups.

In summary, the absence of PPE containing PFAS would reverberate widely through society. It would compromise firefighter safety, potentially cause delays in emergency response, create economic burdens, and trigger concerns about overall emergency preparedness. It should be noted that other professions also depend on PFAS infused PPE to protect both themselves and their communities.

As regards Industrial safety, Military & Police, all end-users in these segments need limited protective performance against liquid chemical splashes. according EN 13034 - Protective Clothing - type 6. The main limitation for PFAS free solutions is offering the right level of protection against oil based chemical splashes (o-Xylene as well as the Butanol group).

Some specific cases are discussed in detail below, however, they only represent a few of the uses of PFAS in PPE.

A) **Chemical Plant Workers**: Within chemical plant environments, employees may encounter unexpected spills or splashes of hazardous chemicals. Utilizing PFAS-treated gear offers immediate protection by preventing these chemicals from penetrating the fabric, thereby reducing the risk of direct skin contact and chemical burns. Furthermore, it diminishes the likelihood of workers carrying chemical residues on their clothing to other areas, ultimately enhancing overall safety.

B) **Workers in High-Visibility Gear:** Workers in high-visibility attire may face contamination from oil-based substances that are challenging to remove unless the fabric has been treated with PFAS. This contamination can significantly diminish the high-visibility properties of their gear, posing a grave risk to their safety. Reduced visibility impairs their ability to be seen by colleagues, machinery operators, and vehicles, thereby increasing the risk of accidents.

C) **Offshore Oil and Gas Platform Workers**: Employees in energies sectors are confronted with the persistent threat of fires and explosions, primarily stemming from the ignition of highly flammable vapours and gases. These volatile elements, including well gases, vapours, and hydrogen sulfide, can be unexpectedly released from various sources such as wells, trucks, production equipment, and surface installations like tanks and shale shakers. In this dangerous environment, it is

imperative that the protective gear worn by these workers not only shields them from potential exposure but also minimizes the risk of ignition. Fabrics that are prone to easy soiling or lack effective cleaning properties can be especially problematic. Such fabrics, if contaminated and unable to be thoroughly cleaned, can become potential ignition sources, thereby amplifying the already significant safety risks faced by workers.

D) **Military Personnel:** In military special units, the demand for fire-resistant gear is paramount. However, it is essential to recognize that in the event of contamination, these garments can become prone to ignition, thereby jeopardizing the safety of the soldier. Therefore, the ability to repel and prevent the deposition of flammable substances, consequently averting their absorption into the fabric, is of utmost importance.

E) **Police Riot Squad (Handling "Molotov Cocktails"):** Law enforcement officers tasked with managing civil unrest and riot control often require specialized protective gear treated with PFAS. PFAS play a critical role in shielding officers from the dangers posed by Molotov cocktails and other incendiary devices. A Molotov cocktail, a hand-thrown incendiary weapon, consists of a frangible container filled with highly flammable substances, typically sealed with a cloth wick as a fuse. When deployed, the lit fuse ignites upon impact, shattering the container and initiating a fiery cascade as the flammable contents inside combust. In this volatile context, protective gear treated with PFAS becomes indispensable. It forms a protective barrier against the incendiary liquids, reducing the risk of both direct exposure and the ignition of the flammable substances.

Specific PPE Products needing derogation

The significance of Personal Protective Equipment (PPE) Category III, particularly in conjunction with C6 repellence, cannot be overstated when it comes to ensuring the safety and well-being of workers in various industries. The use of C6 compounds is vital for maintaining fabric repellence to chemicals, offering a high level of defence against potential hazards. It's imperative to emphasize the necessity for a European derogation in this context, as these protective garments often fall under specific regulations that require exceptions to ensure worker safety. Moreover, it's essential to underscore that, as of now, no suitable substitutes exist for these specialized garments, making their continued use and enhancement of their safety features of paramount importance for those in high-risk professions. Thus, remaining consistent with the ETSA position on this subject which was sent to the five member states in 2021 (see above for reference), ETSA as a representative of the textile service industry underscores the importance of giving a derogation for PPE using PFAS where no alternatives are available.

Medical Devices and Hygiene: Safeguarding Health with PFAS

In the modern medical sector, the synthesis of PFAS technology and reusable medical textiles forms a critical line of defence in maintaining rigorous hygiene standards, essential in safeguarding both patients and healthcare professionals. Surgical drapes and gowns treated with PFAS, notably perfluorated C6-chains, are pivotal, offering a significant barrier against

various contaminants, including bodily fluids that contain greasy components. These materials can either be impregnated or laminated.

However, alongside the undoubted benefits come significant environmental concerns, primarily centred around the potential for PFAS compounds to enter water systems. As highlighted, these substances are notably used in high and normal risk medical PPE and devices, with variations in their necessity and frequency of reimpregnation. It is a shared responsibility between the industry and society to mitigate the environmental repercussions, also through the development of robust wastewater treatment systems or innovative recycling solutions. These strategies aim to minimize the release of these chemicals into the environment, thus balancing the pivotal role of PFAS in safeguarding health with the equally vital task of protecting our ecosystems.

Moving forward, the industry acknowledges the need for adaptation and further research, particularly in exploring PFAS-free alternatives without compromising the quality of protection. The current PFAS-free options present a challenge regarding their durability compared to PFAS-containing impregnations, necessitating frequent re-treatments and potentially increasing the associated environmental footprint. Therefore, as the sector seeks to uphold the twin pillars of safety and sustainability, a concerted effort towards research and development of more environmentally friendly alternatives, paired with optimized reprocessing methods, will be essential.

Furthermore, the currently worded restriction would automatically ban production and marketing of some devices from the EU thereby severely impacting the EU medical device manufacturing industry and EU patients currently using them.

Reimpregnation of certain critical protective clothes and medical devices

In the realm of industrial safety, certified protective clothing is of paramount importance. These garments are typically engineered to offer high levels of protection against various elements like water, oil, and chemicals. According to EN standards, such clothing requires periodic reimpregnation and heat reactivation to maintain its efficacy. This specialized process is typically carried out in an industrial laundry setting, where an intricate combination of advanced washing technology, specialized hydrophobic agents, and precise drying techniques are employed. To maximize the effectiveness of the reimpregnation, certain conditions must be met, such as maintaining a pH level between 4.5 to 5.5 and adhering to specific drying times and temperatures. A drying temperature above 80°C ensures that the garment retains its full water-repellent capabilities. The age and condition of the fabric also play a critical role in the reimpregnation process. Older textiles with roughened material are less likely to absorb the protective agents effectively, suggesting a need for replacement rather than re-treatment. This underscores the importance of regular quality inspections to ensure that protective clothing meets the stringent safety requirements.

Nowadays, existing fabrics certified EN 13034:2009 are already impregnated with PFAS compounds from fabrics suppliers. These suppliers have no alternative to propose if PFAS are banned. The fabric reimpregnation is the solution to maintain the level of performance during the lifetime of a garment, thus achieving the market needs of article durability in a circular

economy strategy. From a sustainability point of view, all product performances need to be guaranteed up to 50 cycles of washing and drying.

Various test procedures are in-place to evaluate quality. Tests range from DIN/EN 24920, which assesses resistance to surface wetting, to AATCC 118 that focuses on oil-repellence. Moreover, additional tests like N/EN 20811 evaluate waterproofness through hydrostatic pressure tests, while DIN 32763 and DIN EN ISO 6530:2005 measure chemical resistance and penetration indices respectively. By adhering to these rigorous testing standards, organizations can ensure that their protective garments remain compliant and effective, **thus ensuring the safety and well-being of the workforce.**

As requested by ECHA, two of ETSA's members companies have run a series of scientific tests and empirical data gatherings which exist as a reference for the reader to better understand the nuances of the reimpregnation process, as well as the impact this procedure has on the PPE's and medical devices in question. One of these examples can be found in the annex at the end of this master document (Annex I), with the other one being available in the confidentiality part. The focused evidence demonstrates the following:

- **each fabric referenced the aforementioned test has been tested according to the ISO 6530:2005 after 50 washing cycles.**
- **Hohenstein Report 23.1.12.0398**
- **Hohenstein Report 23.1.12.0518**
- **Hohenstein Report 23.1.12.0791**

In order to guide the evolution for future PFAS regulation, three new reimpregnation products without PFAS have been tested. This study has been carried out with the latest products developed by three different European market leaders in the field of chemical laundry products. Each reimpregnation product has been tested on two different fabrics which display different performance levels according to ISO 6530:2005 (Resistance of materials to the penetration of liquids). These fabrics have been selected since they are the most used in Elis personal protective equipment ranges and they are produced by two different European manufacturers.

To date, fluorocarbon- free chemistry available in the market, does not allow to restore oil repellency of PPE fabrics as demonstrated in the above-mentioned report available in the confidentiality part.

Ensuring Safety through Standards, certification and re-certification

Prioritizing the safety of PPE and Medical Device users is paramount, and this requires a rigorous approach to standards, certification, and re-certification. For instance, standards like EN 13034:2009 and EN/ISO 469: 2020, for PPE serve as comprehensive guidelines for the design, performance, and quality of protective clothing. The same is true for EN 13795, EN/ISO 22610, EN 20811 with respect to Medical Devices. These standards set benchmarks for resistance to a wide range of hazards, including liquid chemicals, heat, and flame, ensuring the reliability and effectiveness of such gear. Additionally, test methods like ISO 9865 assess crucial factors such as water and oil repellence, as well as resistance to impact and hydrostatic pressure. This meticulous adherence to standards and testing procedures is vital not only for

ensuring the safety and well-being of workers but also for enabling compliance with legal requirements and certifications. The certification and recertification process also extends to products that may exceed allowable PFAS limits, with potential remediation efforts considered and PFAS-free alternatives certified for use, thus enhancing safety while upholding the highest standards of protection.

For the medical devices, even if an alternative was available and medical technology companies started preparations to replace PFAS in medical devices today, this timeline would be technically and legally challenging. According to the existing Regulation 2017/745 (Medical Devices Regulation (MDR), material changes are not permitted. Changes to medical devices entail new conformity assessments under the MDR, which take several years, depending on their scope. For existing products, qualifying, and implementing an alternative material for the marketplace can take up to 12 years, provided that there are already technically and economically feasible alternatives available. However, this is not the case for much of medical technology, and alternatives are not foreseeable today.

In the event of a ban or restriction, these existing standards, among others will need to be re-certified, and risk being obsoleted, thereby imposing an undue burden on European industry, putting it at a disadvantage to industry from other states where international standards on safety and sustainability are ignored.

Challenges and Importance of PFAS in PPE and medical devices

To conclude, responsible PFAS usage, where no equivalent substitutes are available for essential products like PPE and medical devices, is of paramount importance.

Neglecting this could disrupt the EU market for PPE, creating a gap in health and safety product availability across the EU single market and beyond. Regulation (EU) 2016/425 of the European Parliament and of the Council of 9 March 2016 on personal protective equipment and repealing Council Directive 89/686/EEC provides essential guidelines for the revision process, emphasizing the crucial role of PPE in today's Europe.

As well, medical technologies are strictly regulated under sectorial legislation and where changes in the chemical or material composition occur, long validation processes are triggered. It is estimated that development, validation, clinical studies, and regulatory approval of material substitution in implantable medical devices would take approximately 20 years for a single device. Currently, there are no alternatives that meet all these properties and/or have successful clinical history like fluoropolymers.

The Environmental Impact of PFAS

The persistence of PFAS compounds presents a complex challenge when it comes to environmental impact. A long-term strategy from the European Union would help traditional recycling processes that are ill-suited to PFAS, necessitating specialized methods to manage PFAS-containing waste streams. Developing efficient disposal technologies for PFAS materials is crucial to curbing their environmental impact. Research and innovation in this domain should encourage and invest in effective PFAS management, minimizing waste and

reducing PFAS release into the environment. ECHA should reflect on the best ways to support research institutes in designing PFAS testing methodologies and measurements, considering at present these processes are lacking and industries do not have precise responses.

Incineration of PFAS-containing materials carries the risk of releasing these substances into the environment posing potential health hazards. Effective waste management strategies are indispensable in mitigating such emissions. Additionally, the discharge of PFAS into water bodies requires the oversight of municipal and local authorities to prevent contamination and protect aquatic ecosystems. Employing effective treatment methods and robust oversight on the part of Member States and European Regions is vital in addressing these concerns.

Market Surveillance and Enforcement

Implementing derogations requires meticulous consideration of logistical aspects, particularly if production needs to occur within the EU for derogated products. Ensuring fair competition and preventing potential unfair advantages is imperative. Addressing the potential presence of PFAS in products originating from regions outside Europe calls for rigorous import regulations and robust monitoring mechanisms to maintain consistent PFAS standards.

The effectiveness of PFAS bans derogations or restrictions hinges on robust market surveillance. Regulatory bodies must establish rigorous monitoring systems to verify compliance. This includes inspections, testing, and penalties for non-compliance. A transparent and accountable enforcement process is indispensable to preserve the integrity of PFAS regulations. It's crucial to establish provisions for the legal import, manufacture, and impregnation of PFAS-laden PPE in the event of a derogation, from within Europe, in order to preserve European industry, commerce and jobs.

Information Challenges and Regulatory Landscape: Navigating Complex Supply Chains

The complex nature of global supply chains presents a formidable challenge in obtaining comprehensive PFAS content information. As industries source components from diverse suppliers, tracking the presence and quantity of PFAS compounds becomes a complex task. Evolving regulations, including REACH and RohS, intersect with varying supplier practices, adding layers of complexity. To surmount this challenge, transparent information sharing, and standardized reporting mechanisms are essential. Funding for research and development, coupled with the establishment of industry standards, plays a pivotal role in addressing these complexities.

Distinguishing Consumer and Professional Use

Drawing a distinction between consumer and professional use of PFAS can be necessary for a tailored regulatory approach. However, professionals are typically more informed about contamination risks, making them more aware of how to protect themselves. But both consumer and professional users must be able to prioritize safety, and any European legislation on the matter PFAS should recognize the use of PPE by individuals and SMEs in addition to large firms. Certifying PFAS products for both categories should align with EU regulations

and environmental goals, ensuring fair competition, protection of localized European industry and adherence to safety standards.

Accordingly, As regards legal clarity on "general public" and PFHxA for example, while ETSA is supportive of phasing out PFAS substances in everyday consumer garments, this type of chemistry is still needed due to its special properties, where a combination of water, oil, dirt, and chemical repellence and resistance to viruses and bacteria is needed. Although we understand and agree with the Commission's meaning of this restriction – to restrict using PFAS in textile articles which are for general consumer use – more legal clarity is needed in the restriction's text. A clarification, for example in the form of a recital, would ensure that the rules around this restriction to manufacturers, brands, enforcement authorities and consumers are clear. Here we would aim to avoid situations where a specific product is produced for safety reasons but could technically be purchased by a consumer. A case for this could be very specific safety clothing, which need to comply with the highest degree of safety and performance standards. An example is PFAS treated protective legwear, which are used when managing a hand-held chainsaw, where hot oil can drip on the legs and thus burn through a fabric if it is not treated with PFAS, which stops the oil coming through and therefore protecting the user. While this type of safety-wear is needed for logging workers, theoretically they would also be sold in specialised stores for consumers who need protective wear when they manage this specific machinery.

PFAS in the Textile and Apparel Industry

The textile and apparel sector emerges as a pivotal sector and a user of PFAS in specific cases. These chemicals, especially the noted C6 formulation, have ascended to prominence by bestowing upon fabrics exceptional qualities such as water and oil resistance, as well as stain repellence, augmenting their hygienic attributes. These traits enable the textiles to surpass stringent benchmarks, culminating in resilient, enduring, and adaptable products that are adept for a wide spectrum of applications.

Similarly, polymers formulated with 3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluoroctylmethacrylate (2144-53-8) hold a significant role in sectors vital to the European economy, alongside safeguarding public health and safety. Their applications span across industrial laundry sectors, inclusive of reimpregnation PSA Kat II, and extend to a plethora of textile merchandise encompassing home textiles, military equipment, automotive upkeep, apparel, and beyond. These widespread applications necessitate careful consideration in the event of contemplating restrictions on the employment of PFAS.

Industrial Machinery and Applications: Enhancing Efficiency

In addition to the diverse applications of PFAS in protective clothing, these compounds also play vital roles in other industrial settings. For instance, PTFE tape is used for thread sealing, serving various purposes such as foil welding, coating, facilitating sliding surfaces, acting as release sheets, and reducing static electricity. In the realm of polymer 3D printing applications, HFIP fluorinated solvent functions as a smoothing agent and activator of Au-Cl bonds through hydrogen bonding. These applications underscore the versatile utility of PFAS in enhancing industrial processes and product quality.

Moreover, textile processing machinery manufactured by European companies covers a wide range of sectors, including hotels, catering, and medical facilities such as hospitals and protective clothing. Modern industrial laundries, processing large volumes of laundry daily, require components that can withstand diverse processing technologies. This encompasses electronics, information technology, steam and gas controls, oil circulation heaters, burner technology, and the use of greases, seals, and coatings that are both chemical and temperature resistant. The specific requirements of textiles used in hospitals and protective clothing demand that these textiles meet stringent standards for hygiene and safety, ensuring that they can be used, cleaned, disinfected, and reused without posing any risk to patients. Eliminating PFAS components without suitable alternatives would jeopardize this cycle of use and potentially lead to increased reliance on single-use items.

Furthermore, generalized ban of PFAS can have a "boomerang" effect on sustainability efforts. The European Green Deal outlines a comprehensive strategy to make the EU's economy sustainable, addressing climate and environmental challenges while ensuring an inclusive transition. A lot of the needed technologies to achieve net-zero contain, including heavy machinery required for the energy transition, the uses of PFAS. These PFAS contained components in industrial machinery, part of the textiles and textile services machinery are at present necessary to reach the specific goals of the European Green Deal.

Implications of Restrictions: Balancing Functionality and Sustainability (Effects on Society)

The imposition of bans or restrictions on PFAS usage, regardless of their chemistry, poses intricate challenges that resonate throughout European industries. The absence of suitable alternatives threatens to compromise the functionality of critical products, potentially resulting in curtailed product lifecycles, heightened maintenance costs, and an upsurge in waste generation. Moreover, the potential impact on hygiene standards, particularly in medical and protective equipment, underscores the intricate balance that must be struck between environmental sustainability, functional efficacy and most of all health and safety of workers. Addressing these challenges requires a careful examination of regulatory landscape changes and their effects on society.

A Collaborative Path Forward: Shaping a Sustainable Future

ETSA believes that the path toward a sustainable future rests on robust collaboration among industries, regulatory bodies, and research entities. Meaningful progress in transitioning away from PFAS depends on the collective effort of stakeholders. Identifying safe and efficient alternatives that fulfil functional requirements while addressing ecological concerns requires a concerted approach. This collaborative endeavour underscores the commitment of all stakeholders to navigate the complex landscape of PFAS applications, regulations, and sustainability.

[i] ETSA member Ecolab did not take part in the drafting of this answer.

ANNEX 1

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The 22nd of August 2023,

TEST REPORT

OBJECT OF THE REQUEST

Due to PFAS regulations evolution, reimpregnation products must no longer contains PFAS compounds. Currently, reimpregnation products are mainly used for the garments that are certified according to the standard EN 13034 : 2009 (chemicals protection) and are considered as PPEs of category III. Elis is committed to its customers on a chemical protection level based on a risk analysis which is approved by the customers and cannot evolve during the contract length.

Nowadays, existing fabrics certified EN 13034 : 2009 are already impregnated with PFAS compounds and fabrics suppliers (i.e Carrington, Tencate, Fristads…) have no alternative to propose if PFAS are banned. The fabric reimpregnation is the solution to maintain the level of performance during the lifetime of the garment, achieving the market needs of article durability in a circular economy strategy. From sustainability point of view, all our products performances need to be guaranty up to 50 cycles of washing and drying to ensure both the durable protection of the wearer and the garment durability.

To fulfill the PFAS regulations evolution, three new reimpregnation products without PFAS have been tested. This study has been carried out with the latest products developed by three different European market leaders (i.e Christeyns, Ecolab, CHT) in the field of chemical laundry products.
Each reimpregnation product has been tested on two different fabrics which display different performance levels according to ISO 6530 : 2005 (Resistance of materials to the penetration of liquids). These fabrics have been selected since they are the most used in Elis personal protective equipment ranges and they are produced by two different European suppliers.

PROTECTION LEVELS SPECIFICATION

For confidentiality purpose, PFAS products and fabrics have been anonymized in this report.

The two tables below (Table 1,2), summarize the expected results for penetration and rejection indexes, for the two fabrics tested.
The performance levels are consistent with the standard EN 13034 : 2009 and are also contractually agreed with each customer. Elis' customers have requirements regarding PPE protection level related to the risk of their activity and their requirements can be more demanding compared to the standard; for instance, with the Fabric 2, the customer expects more than 2 chemical products with index 3 for both penetration & repellency.

The results below are obtained with the current PFAS – C6 reimpregnation products used by Elis group and the evaluation of the standard EN 13034 : 2009 is performed after 50 washing cycles.

Fabric 1		
Chemical	Penetration	Repellency
NaOH	3	3
H_2SO_4	3	3
Butan-1-ol	2	1
O-Xylen	0	0

Fabric 3		
Chemical	Penetration	Repellency
NaOH	3	3
H_2SO_4	3	3
Butan-1-ol	3	3
O-Xylen	3	3

Table 1-2 : Penetration and repellency reference indexes of the two fabrics using PFAS reimpregnation product – C6 after 50 washing cycles according to ISO 6530

TESTS WITH PFAS FREE PRODUCTS

In the approval process, each fabric has been tested according to the **ISO 6530 : 2005** after 50 washing cycles (i.e washing cycle means one wash + tunnel drying). The reimpregnation PFAS free product is applied on the material during each washing cycles (i.e 15 g/kg).
The reimpregnation product is validated, only, if the< performances above (Table 1-2) are achieved for the two fabrics ; because the reimpregnation solution has to be used globally over the group.

Sample references:

Reimpregnation Product A

Reimpregnation Product B

Reimpregnation Product C

All tests were conducted with a 15 g/kg concentration.

Norm	Tests *Tests*	Product A	Product B	Product C
EN 13034 : 2009	***ISO 6530 : 2005** : Resistance of materials to penetration by liquids* ***FABRIC 1***			
EN 13034 : 2009	***ISO 6530 : 2005** : Resistance of materials to penetration by liquids* ***FABRIC 3***			
Final approval				

GENERAL CONCLUSION

The performance of the reimpregnation products without PFAS (i.e Product A, B and C) have been evaluated on two fabrics (i.e Fabric 1 and 2) according to the ISO 6530 : 2005 after 50 washing cycles.

If we consider the norm requirements, the results after 5 washing cycles are not presented in this report but the protection level are equivalent to the results after 50 washing cycles.

Regarding the fabrics 1 and 2 results, penetration, and repellency level for Butan-1-ol (alcohol) and the O-xylene (solvent) are below the expectations after 50 washes for the three reimpregnation products.

Based on the results obtained, a second test phase has been performed using a higher concentration of PFAS free product (i.e 50 g/kg instead of 15 g/kg). The results are not improved. The products A, B and C are still not compliant with the specifications.

As a conclusion, none of those three PFAS free reimpregnation products provides a satisfactory level of protection against organic chemicals regarding the performances achieved with PFAS reimpregnation products. Thus, the products A, B and C are not compliant to maintain the chemical performances related to standard EN 13034 : 2009.

Currently, there is no alternative to replace reimpregnation products containing PFAS by PFAS free products without lowering the PPE's protection level. As ELIS is committed to achieving the level of protection required by its customers, it seems not possible to make the transition to PFAS free products today on Category III PPEs which must insure chemical protection for the workers.

DETAIL OF RESULTS

EN 13034 : 2009-08,

DIN EN 6530:2005-05

Resistance of materials to penetration by liquid chemicals

REFERENCE OF SAMPLE

Sample : Reimpregnation product A

PRE-TREATMENT

Washing program : **Anti-Acid reimpregnated (15 g/Kg)**

Number of washing cycles: **50**

Type of finishing : **Air drying tunnel 145°C °**

Reimpregnation : **Product A**

RESULTS

Fabric 1

Penetration			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**2**	**0**	**KO**
O-Xylen	**0**	0	OK

Repellency			
Chemical	**Spec**	Value	Result
NaOH	3	3	OK
H_2SO_4	3	3	OK
Butan-1-ol	1	**0**	**KO**
O-Xylen	0	0	OK

Fabric 3

Penetration			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**3**	**2**	**KO**
O-Xylen	**3**	**2**	**KO**

Repellency			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**3**	**2**	**KO**
O-Xylen	**3**	**0**	**KO**

CONCLUSION

After **50** washes cycles, the Product A is not working for the fabrics 1 and 2 (i.e penetration and repellency levels below requirements for butan-1-ol and O-xylen).

Test report : HOHENSTEIN - 23.12.0398

DETAIL OF RESULTS

EN 13034 : 2009-08,

DIN EN 6530:2005-05

Resistance of materials to penetration by liquid chemicals

REFERENCE OF SAMPLE

Sample : Reimpregnation product B

PRE-TREATMENT

Washing program : **Anti-Acid reimpregnated (15 g/Kg)**

Type of finishing : **Air drying tunnel 145°C** °

Number of washing cycles: **50**

Reimpregnation : **Product B**

RESULTS

Fabric 1

Penetration			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**2**	**1**	**KO**
O-Xylen	**0**	0	OK

Repellency			
Chemical	**Spec**	Value	Result
NaOH	3	3	OK
H_2SO_4	3	3	OK
Butan-1-ol	1	**0**	**KO**
O-Xylen	0	0	OK

Fabric 3

Penetration			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**3**	**0**	**KO**
O-Xylen	**3**	**0**	**KO**

Repellency			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**3**	**0**	**KO**
O-Xylen	**3**	**0**	**KO**

CONCLUSION

After **50** washes cycles, the Product B is not working for the fabrics 1 and 2 (i.e penetration and repellency levels below requirements for butan-1-ol and O-xylen).

Test report : Hohenstein - 23.1.12.0518

DETAIL OF RESULTS

EN 13034 : 2009-08,

DIN EN 6530:2005-05

Resistance of materials to penetration by liquid chemicals

REFERENCE OF SAMPLE

Sample : Reimpregnation product C

PRE-TREATMENT

Washing program : **Anti-Acid reimpregnated (15 g/Kg)**

Number of washing cycles: **50**

Type of finishing : **Air drying tunnel 145°C °**

Reimpregnation : **Product C**

RESULTS

Fabric 1

Penetration			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**2**	**1**	**KO**
O-Xylen	**0**	**0**	**KO**

Repellency			
Chemical	**Spec**	Value	Result
NaOH	3	3	OK
H_2SO_4	3	3	OK
Butan-1-ol	1	**0**	**KO**
O-Xylen	0	**0**	**KO**

Fabric 3

Penetration			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**3**	**0**	**KO**
O-Xylen	**3**	**0**	**KO**

Repellency			
Chemical	**Spec**	Value	Result
NaOH	**3**	3	OK
H_2SO_4	**3**	3	OK
Butan-1-ol	**3**	**0**	**KO**
O-Xylen	**3**	**0**	**KO**

CONCLUSION

After **50** washes cycles, the Product C is not working for the fabrics 1 and 3 (i.e penetration and repellency levels below requirements for butan-1-ol and O-xylen.

Test report : Hohenstein - 23.1.12.0791

Tests reports

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[redacted]@hohenstein.com

Kundennr./ *Client no.*	Zuständig für Rückfragen/ *Contact person*	Unser Zeichen / *Our ref.*	Datum / *Date*
	Franziska Maisack	FMa/aj/mau/BMI	24. März 2023

Bericht Nr. / *Report No.* 23.1.12.0398

Auftraggeber: *Client:*	Siehe Anschrift *see address*
Ansprechpartner: *Contact person:*	Wilem Boudjema +33 16988 1363 +33 16084 3568
Auftragsdatum: *Date of order:*	14.03.2023
Auftragseingang: *Receipt of order:*	17.03.2023
Eingang Prüfgegenstand: *Receipt of test samples:*	17.03.2023
Prüfgegenstand: *Test sample:*	Drei Gewebeschnitte (50-mal von ELIS mit *Three woven fabric* Muster / *Sample* 1: Muster / *Sample* 3:
Prüfzeitraum: *Period of testing:*	17.03.2023 bis / *to* 24.03.2023
Untersuchungsziel: *Aim of test/s:*	Teilprüfung nach EN 13034:2005+A1:2009 (DIN EN 13034:2009-08) - Schutzkleidung gegen flüssige Chemikalien - Leistungsanforderungen an Chemikalienschutzkleidung mit eingeschränkter Schutzleistung gegen flüssige Chemikalien (Ausrüstung Typ 6 und Typ PB [6]) - *Partial test according to EN 13034:2005+A1:2009 (DIN EN 13034:2009-08) - Protective clothing against liquid chemicals - Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (Type 6 and Type PB [6]) -*
Probenahme: *Sampling:*	Der Prüfgegenstand wurde uns vom Auftraggeber übersandt. *The test sample has been delivered to us by the client.*

Der Bericht umfasst* 4 *Seiten. */ The report comprises 4 pages.*

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HOHENSTEIN

ERGEBNIS / *RESULT*

VORBEHANDLUNG DURCH WÄSCHEN

Laut Angaben des Auftraggebers wurde das Muster bereits 50-mal mit vorbehandelt.

PRE-TREATMENT BY WASHING

According to customer state, the sample was already washed 50 times with .

FLÜSSIGKEITSABWEISUNG

LIQUID PENETRATION

DIN EN 13034:2009-08^{A}, Abschnitt 4.1		*DIN EN 13034:2009-08^{A}, part 4.1*	
DIN EN 14325:2018-08^{A}, Abschnitt 4.12 + 4.13		*DIN EN 14325:2018-08^{A}, part 4.12 + 4.13*	
Prüfung gemäß DIN EN 6530:2005-05^{A}		*Test according to DIN EN 6530:2005-05^{A}*	
Prüfungstemperatur:	(20 ± 1) °C	*Test temperature:*	*(20 ± 1) °C*
Durchflussgeschwindigkeit:	10 s	*Flow rate:*	*10 s*
Prüfmittel:		*Test agents:*	
Natronlauge	10 %	*Sodium hydroxide*	*10 %*
Schwefelsäure	30 %	*Sulphuric acid*	*30 %*
Butan-1-ol	unverdünnt	*Butan-1-ol*	*undiluted*
o-Xylol	unverdünnt	*o-Xylol*	*undiluted*
Prüfanordnung:	Die Flüssigkeiten wurden auf die rechte Warenseite aufgebracht.	*Test procedure:*	*The liquids are applied to the outer side of the fabric.*

Penetrationsindex: Höchster Wert aus 3 Einzelversuchen in Längs- und Querrichtung

Penetration index: Maximum value of 3 separate trials in lengthwise and crosswise direction.

Abstoßungsindex: Kleinster Wert aus 3 Einzelversuchen in Längs- und Querrichtung.

Rejection index: Minimum value of 3 separate trials in lengthwise and crosswise direction.

Vorbehandlung siehe Abschnitt Vorbehandlung.

Pre-treatment see section pre-treatment.

Muster / *Sample* 1	Penetrationsindex / *Penetration index* (P) in %		Abstoßungsindex / *Rejection index* (R) in %	
	Längs / *Lengthwise*	Quer / *Crosswise*	Längs / *Lengthwise*	Quer / *Crosswise*
Natronlauge / *Sodium hydroxide*	0	0	98,65	98,65
Schwefelsäure / *Sulphuric acid*	0	0	98,42	98,92
Butan-1-ol / *Butan-1-ol*	0,73	1,22	92,66	92,53
o-Xylen / *o-Xylene*	2,27	9,77	87,50	71,25

Muster / *Sample* 3	Penetrationsindex / *Penetration index* (P) in %		Abstoßungsindex / *Rejection index* (R) in %	
	Längs / *Lengthwise*	Quer / *Crosswise*	Längs / *Lengthwise*	Quer / *Crosswise*
Natronlauge / *Sodium hydroxide*	0	0	98,74	98,10
Schwefelsäure / *Sulphuric acid*	0	0	97,51	98,17
Butan-1-ol / *Butan-1-ol*	21,79	17,75	58,75	72,83
o-Xylen / *o-Xylene*	52,27	57,50	3,98	0

Klasse / *Level*	Penetrationsindex / *Penetration index*	Abstoßungsindex / *Rejection index*
3	< 1 %	> 95 %
2	< 5 %	> 90 %
1	< 10 %	> 80 %

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Anette Jentsch

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Kundennr./ *Client no.*	Zuständig für Rückfragen/ *Contact person*	Unser Zeichen / *Our ref.*	Datum / *Date*
	Franziska Maisack	FMa/aj/mau/CST3	19. April 2023

Bericht Nr. / *Report No.* 23.1.12.0518

Auftraggeber: *Client:*	Siehe Anschrift *see address*
Ansprechpartner: *Contact person:*	Wilem Boudjema +33 16988 1363 +33 16084 3568
Auftragsdatum: *Date of order:*	04.04.2023
Auftragseingang: *Receipt of order:*	06.04.2023
Eingang Prüfgegenstand: *Receipt of test samples:*	06.04.2023
Prüfgegenstand: *Test sample:*	Drei Gewebeabschnitte (50-mal vorbehandelt von ELIS *Three woven fabric cuts (pre-treated 50 times by ELIS* Muster / *Sample* 1: Muster / *Sample* 3:
Prüfzeitraum: *Period of testing:*	06.04.2023 bis / *to* 19.04.2023
Untersuchungsziel: *Aim of test/s:*	Teilprüfung nach EN 13034:2005+A1:2009 (DIN EN 13034:2009-08) - Schutzkleidung gegen flüssige Chemikalien - Leistungsanforderungen an Chemikalienschutzkleidung mit begrenzter Schutzleistung gegen flüssige Chemikalien (Typ 6 und Typ PB [6]) - *Partial test according to EN 13034:2005+A1:2009 (DIN EN 13034:2009-08) - Protective clothing against liquid chemicals - Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (Type 6 and Type PB [6]) -*
Probenahme: *Sampling:*	Der Prüfgegenstand wurde uns vom Auftraggeber übersandt. *The test sample has been delivered to us by the client.*

Der Bericht umfasst* 4 *Seiten. */ The report comprises 4 pages.*

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ERGEBNIS / *RESULT*

VORBEHANDLUNG DURCH WÄSCHEN

Laut Angaben des Auftraggebers wurde das Muster bereits 50-mal mit vo[redacted]

PRE-TREATMENT BY WASHING

According to customer state, the sample was already washed 50 times with .

[redacted]

FLÜSSIGKEITSABWEISUNG

LIQUID PENETRATION

DIN EN 13034:2009-08[A], Abschnitt 4.1		*DIN EN 13034:2009-08[A], part 4.1*	
DIN EN 14325:2018-08[A], Abschnitt 4.12 + 4.13		*DIN EN 14325:2018-08[A], part 4.12 + 4.13*	
Prüfung gemäß DIN EN 6530:2005-05[A]		*Test according to DIN EN 6530:2005-05[A]*	
Prüfungstemperatur:	(20 ± 1) °C	*Test temperature:*	*(20 ± 1) °C*
Durchflussgeschwindigkeit:	10 s	*Flow rate:*	*10 s*
Prüfmittel:		*Test agents:*	
Natronlauge	10 %	*Sodium hydroxide*	*10 %*
Schwefelsäure	30 %	*Sulphuric acid*	*30 %*
Butan-1-ol	unverdünnt	*Butan-1-ol*	*undiluted*
o-Xylol	unverdünnt	*o-Xylol*	*undiluted*
Prüfanordnung:	Die Flüssigkeiten wurden auf die rechte Warenseite aufgebracht.	*Test procedure:*	*The liquids are applied to the outer side of the fabric.*

Penetrationsindex: Höchster Wert aus 3 Einzelversuchen in Längs- und Querrichtung
Abstoßungsindex: Kleinster Wert aus 3 Einzelversuchen in Längs- und Querrichtung.

Penetration index: Maximum value of 3 separate trials in lengthwise and crosswise direction.
Rejection index: Minimum value of 3 separate trials in lengthwise and crosswise direction.

Vorbehandlung siehe Abschnitt Vorbehandlung.

Pre-treatment see section pre-treatment.

Muster / *Sample* 1	Penetrationsindex / *Penetration index* (P) in %			Abstoßungsindex / *Rejection index* (R) in %		
	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*
Natronlauge / *Sodium hydroxide*	0	0	3	98,19	99,27	3
Schwefelsäure / *Sulphuric acid*	0	0	3	98,85	98,85	3
Butan-1-ol / *Butan-1-ol*	5,31	8,02	1	82,96	67,16	–
o-Xylen / *o-Xylene*	20,34	14,89	–	68,07	71,59	–

HOHENSTEIN

Muster / *Sample* 3	Penetrationsindex / *Penetration index* (P) in %			Abstoßungsindex / *Rejection index* (R) in %		
	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*
Natronlauge / *Sodium hydroxide*	0	0	3	98,46	99,00	3
Schwefelsäure / *Sulphuric acid*	0	0	3	98,43	99,09	3
Butan-1-ol / *Butan-1-ol*	43,58	57,16	–	21,11	11,23	–
o-Xylen / *o-Xylene*	69,55	65,57	–	0	0	–

Klasse / *Level*	Penetrationsindex / *Penetration index*	Abstoßungsindex / *Rejection index*
3	< 1 %	> 95 %
2	< 5 %	> 90 %
1	< 10 %	> 80 %

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Kundennr./ *Client no.*	Zuständig für Rückfragen/ *Contact person*	Unser Zeichen / *Our ref.*	Datum / *Date*
	Franziska Maisack	FMa/aj/mau/BMI	12. Juni 2023

Bericht Nr. / *Report No.* 23.1.12.0791

Auftraggeber: *Client:*	Siehe Anschrift *see address*
Ansprechpartner: *Contact person:*	Wilem Boudjema +33 16988 1363 +33 16084 3568
Auftragsdatum: *Date of order:*	26.05.2023
Auftragseingang: *Receipt of order:*	26.05.2023
Eingang Prüfgegenstand: *Receipt of test samples:*	26.05.2023
Prüfgegenstand: *Test sample:*	Drei Gewebeshirts (5-mal vorbehandelt durch ELIS mit [redacted] *Three woven fabric shirts (pre-treated 5 times by ELIS* Muster / *Sample* 1 [redacted] Muster / *Sample* 3
Prüfzeitraum: *Period of testing:*	26.05.2023 bis / *to* 12.06.2023
Untersuchungsziel: *Aim of test/s:*	Teilprüfung nach EN 13034:2005+A1:2009 (DIN EN 13034:2009-08) - Schutzkleidung gegen flüssige Chemikalien - Leistungsanforderungen an Chemikalienschutzkleidung mit eingeschränkter Schutzleistung gegen flüssige Chemikalien (Ausrüstung Typ 6 und Typ PB [6]) - *Partial test according to EN 13034:2005+A1:2009 (DIN EN 13034:2009-08) - Protective clothing against liquid chemicals - Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (Type 6 and Type PB [6]) -*
Probenahme: *Sampling:*	Der Prüfgegenstand wurde uns vom Auftraggeber übersandt. *The test sample has been delivered to us by the client.*

Der Bericht umfasst* 4 *Seiten. */ The report comprises 4 pages.*

ERGEBNIS / *RESULT*

VORBEHANDLUNG DURCH WÄSCHEN

Laut Angaben des Auftrage[redacted]e Muster bereits 5-mal mit [redacted]

PRE-TREATMENT BY WASHING

According to customer state, the [redacted] already washed 5 times with [redacted]

FLÜSSIGKEITSABWEISUNG

LIQUID PENETRATION

DIN EN 13034:2009-08[A], Abschnitt 4.1		*DIN EN 13034:2009-08[A], part 4.1*	
DIN EN 14325:2018-08[A], Abschnitt 4.12 + 4.13		*DIN EN 14325:2018-08[A], part 4.12 + 4.13*	
Prüfung gemäß DIN EN 6530:2005-05[A]		*Test according to DIN EN 6530:2005-05[A]*	
Prüfungstemperatur:	(20 ± 1) °C	*Test temperature:*	*(20 ± 1) °C*
Durchflussgeschwindigkeit:	10 s	*Flow rate:*	*10 s*
Prüfmittel:		*Test agents:*	
Natronlauge	10 %	*Sodium hydroxide*	*10 %*
Schwefelsäure	30 %	*Sulphuric acid*	*30 %*
Butan-1-ol	unverdünnt	*Butan-1-ol*	*undiluted*
o-Xylol	unverdünnt	*o-Xylol*	*undiluted*
Prüfanordnung:	Die Flüssigkeiten wurden auf die rechte Warenseite aufgebracht.	*Test procedure:*	*The liquids are applied to the outer side of the fabric.*

Penetrationsindex: Höchster Wert aus 3 Einzelversuchen in Längs- und Querrichtung

Penetration index: Maximum value of 3 separate trials in lengthwise and crosswise direction.

Abstoßungsindex: Kleinster Wert aus 3 Einzelversuchen in Längs- und Querrichtung.

Rejection index: Minimum value of 3 separate trials in lengthwise and crosswise direction.

Vorbehandlung siehe Abschnitt Vorbehandlung.

Pre-treatment see section pre-treatment.

Muster / *Sample* 1	Penetrationsindex / *Penetration index* (P) in %			Abstoßungsindex / *Rejection index* (R) in %		
	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*
Natronlauge / *Sodium hydroxide*	0	0	3	98,73	98,64	3
Schwefelsäure / *Sulphuric acid*	0	0	3	98,35	98,10	3
Butan-1-ol / *Butan-1-ol*	6,42	4,20	1	76,91	78,64	–
o-Xylen / *o-Xylene*	19,32	28,64	–	65,91	52,95	–

Muster / *Sample* 3	Penetrationsindex / *Penetration index* (P) in %			Abstoßungsindex / *Rejection index* (R) in %		
	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*	Längs / *Lengthwise*	Quer / *Crosswise*	Erreichte Klasse / *Achieved level*
Natronlauge / *Sodium hydroxide*	0	0	3	97,83	97,83	3
Schwefelsäure / *Sulphuric acid*	0	0	3	98,18	98,18	3
Butan-1-ol / *Butan-1-ol*	10,49	20,12	–	71,73	56,54	–
o-Xylen / *o-Xylene*	57,61	60,45	–	10,68	0	–

Klasse / *Level*	Penetrationsindex / *Penetration index*	Abstoßungsindex / *Rejection index*
3	< 1 %	> 95 %
2	< 5 %	> 90 %
1	< 10 %	> 80 %

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