TRANEMO TEXTIL AB – ANSWERS

Draft agenda points and questions – meeting with PPE companies (protective clothing)

Introduction

PPE can include items such as safety helmets, gloves, eye protection, hazmat suits, high-visibility clothing, safety footwear, safety harnesses, ear plugs, ear defenders and respiratory protective equipment (RPE). This document focuses on protective clothing.

Agenda point 1 - Critical properties (performance) for protective clothing

Questions

1. Please describe quantitatively critical properties (performance) for protective clothing, see table 1, in the form of comparable measurements / studies between performance for fluorochemistry and alternative non fluorochemistry? See answer below in table 1 columns.

Table 1: *Critical properties (performance) vs Standards for protective clothing (CEN/TC 162)*

Critical properties (performance)	**Standards for protective clothing (CEN/TC 162)**	**Tranemo Comments to Q 1:1: critical properties.**	**Q 2:4: Acceptable quantitative measurement results/limits**
Electrostatics	EN 1149 series	N/A for fluorocarbons. Antistatic properties are not reached by PFAS but with antistatic fibres.	N/A
Liquid chemicals	**EN 13034:2005+A1:2009** EN 14605:2005+A1:2009 EN 16523-1:2015+A1:2018	Tranemo uses EN 13034 only (EN 14605 and EN 16523-1 are N/A). Based on customer's risk assessment most of the garments still need PFAS to fulfil their demands. PFAS-free finish can only be used if the customers risk assessment allows that and that it passes the chemicals needed within EN 13034 (PFAS free may today pass	Depending on protection needed. If only protection against small splashes of low concentrated acid and alkaline is needed, a PFAS-free DWR could be sufficient. However, if customers risk assessment demand protection against other chemicals

Critical properties (performance)	Standards for protective clothing (CEN/TC 162)	Tranemo Comments to Q 1:1: critical properties.	Q 2:4: Acceptable quantitative measurement results/limits
		H2SO4 30% and NaOH 10%, but not o-Xylene or Butanol). And for oil repellence there is no alternative available as of today's technology. The standard EN 13034 is under development and there will be a new one in the coming years. We do not yet know the extent of this new standard, but the same chemicals tested today seem to be involved also in the updated version.	and/or oil repellence then C6's is needed as of today's existing technology. EN 13034 is included in highest risk category 3 within the PPE regulation, so it is very important to comply with the customer's demand.
Protection against chemicals	EN ISO 17491-3, -4:2008 EN ISO 17491-4:2008 EN ISO 19918:2017/A1:2021 EN ISO 6530:2005	EN ISO 19918 is N/A for Tranemo articles. EN ISO 17491-4 and EN ISO 6530 are the test standard included in EN 13034 and therefore relevant and the same answer as above is applicable here.	For EN ISO 17491-4 and EN ISO 6530 the same answer as for EN 13034 applies.
Liquid and gaseous chemicals, including aerosols and solid particles	EN 464:1994	N/A for Tranemo articles	N/A for Tranemo articles
Against rain	EN 343:2019	Fluorocarbon will not necessarily be needed to fulfil EN 343. PFAS-free options can provide a good enough protection against water.	PFAS-free DWR provides good protection for EN 343 since only water repellence is needed to fulfil the certification. There is a risk not fulfilling highest class 4 without fluorocarbons, but that must be

Critical properties (performance)	Standards for protective clothing (CEN/TC 162)	Tranemo Comments to Q 1:1: critical properties.	Q 2:4: Acceptable quantitative measurement results/limits
			tested and evaluated. No qualitative or quantitative information can be given at this stage in regards of the eventual loss of function due to elimination of PFAS.
Splashes of molten metal	EN 348:1992	A standard for gloves protection. Tranemo uses this standard very limitedly. No qualitative or quantitative information can be given at this stage in regards of the need of fluorocarbons	No information to be given at this stage.
For firefighting activities	EN 469:2020	N/A for Tranemo articles.	N/A
High visibility	EN ISO 20471:2013	Fluorocarbon will not automatically be needed to achieve high visibility. Instead Tranemo recommends washing garments regularly to avoid getting them permanently dirty.	EN ISO 20471 does not demand DWR finish to achieve fluorescence and luminance. Fabrics with PFAS-free, or completely DWR-free could be sufficient to fulfil EN ISO 20471.
Use, care and maintenance	CEN/TR 14560:2018 CEN/TR 15419:2017 CEN/TR 17330:2019	Guidance for creating a risk assessment, which are more directed to our customers. We have not any qualitative or quantitative information to give at this point.	N/A
Others?	EN ISO 11612	Since fluorocarbons are oil repellent there	This is overlaying most of the other
	EN 61482-2		

Critical properties (performance)	Standards for protective clothing (CEN/TC 162)	Tranemo Comments to Q 1:1: critical properties.	Q 2:4: Acceptable quantitative measurement results/limits
	EN 11611	is additional protection added with fluorocarbons since oil and dirt can act as risk factors in regards of flammability. However, to achieve good flammability PFAS's are not a demand. The protection of flammability is reached by using inherent fibres which provide the protection.	standards since Tranemo must guarantee that the eventual loss of PFAS's will not affect the flammability badly due to removal of stain or oil repellence*. There is not enough data on this at today's stage to set any measurements or limits.
	EN 14116		
	EN 407 (gloves)		

2. Are these data available to us? See above explanations in table 1.

Agenda point 2 – Standards for protective clothing need for PFAS

Questions and remarks

3. Are there comparable quantitative test results between fluorochemistry and non-fluorochemistry available to us performed with the test standards listed in table 1 (*or others, please specify*)?
   Tranemo have a new FR collection which contain PFAS free DWR. This protects against water and water-based stains and chemicals. It is tested and approved according to EN 13034 for sulphuric acid (30%) and sodium hydroxide (10%). Tranemo have both tested positive results internally and made standardized EN 13034 (according to EN ISO 6530) at accredited lab to make sure also the PFAS-free finish repels the acid and alkaline within the standard of EN 13034. The test report from the accredited lab is approved by our notified body who approves the CE-marking of the garments.

   Since our customer's risk assessment mostly demand EN 13034-certification and/or oil repellence it is not possible as of todays technology to fully substitute the PFAS's.

   Tranemo has made a wear trial of a trouser in comparing PFAS and completely DWR-free, one leg with PFAS C6 and the other leg without any DWR. After long use and dirt exposure, after washing the results on both legs were equally dirty/clean. The Tranemo thesis is that fluorocarbons therefore are not automatically needed to achieve better high visibility after washing, but instead Tranemo recommends washing the garments more regularly to avoid the permanent dirt.

Tranemo will be part of a Master thesis project during spring 2022 (collaboration between Swedish School of Textiles, RISE IVF and Chalmers University) which will focus on testing the comparison between PFAS and PFAS-free finishes on protective garments. After that study is finished, Tranemo will have more quantitative test results.

4. Please indicate which quantitative measurement results/limits are acceptable for your markets for the test methods listed in table 1 below (*or others, please specify*).
   Please see answers in right column in table 1.

   Important notice! Almost all the FR garments have several certifications, including from different areas within the PPE risk categories. For example, a jacket can be certified according to both EN 343 (cat 1, rain protection), EN ISO 20471 (cat 2, high visibility), and EN 13034 (Cat 3, chemical protection) and EN ISO 11612 (cat 2&3).
   This means that the highest risk on a fabric should decide the need of PFAS's. Even if EN 343 can be achieved by PFAS-free alternatives, EN 13034 might not be sufficient with PFAS-free finish. It probably needs a C6 to achieve demanded protection according to customer's risk assessment.

   *The process of changing a component within a PPE-fabric is very complex. To even change a minor component, one must re-certify fabrics and garments again. This means that if PFAS's are to be changed to PFAS-free surface treatment, Tranemo and our fabric suppliers must secure the protection of all the certifications that the fabric holds. For example, if a fabric is certified: EN ISO 11612, EN ISO 11611, EN 61482-1, EN 13034 etc, all these tests must be updated with the new finish. First it must be approved by accredited lab on fabric level and then all the garments' certification must be updated according to the new fabric test results. This is both a very costly and a very time-consuming process.

Agenda point 3 - Potential alternatives to PFAS

In the ongoing restriction work of PFAS in EU/EEA, a range of non-fluorinated alternatives to PFAS have been identified

- Hyperbranched functionalized polymers (dendric polyurethanes)
- Paraffins (hydrocarbons)
- Waxes (fatty acid esters)
- Silicones (polydimethylsiloxanes abbr. PDMS)
- Polymeric compounds such as non-fluorinated (meth)acrylates
- Plasma treatment
- Graphene structures
- Other?

Questions

5. For these above listed non fluorinated alternatives (and possibly other) to fluorochemistry, what are the biggest specific challenges to phase in those non fluorinated alternatives that may be feasible for your applications?

Oil repellence and protection to chemicals - *Some chemicals, e.g. acids and alkaline, in low concentration, can be repelled by PFAS-free finish, but the others needs PFAS's based upon todays knowledge and the technical limitations of the PFAS-free alternatives.*

6. Have you evaluated other fluorochemicals / materials as substitutes for the currently used fluorochemistry? If so, please specify this chemistry.

We have evaluated hydrocarbon based PFAS-free (paraffins) DWR at Tranemo.

An important notice is the flammability potential of other DWR than PFAS. When PFAS are applied onto fabric it does not pose as an additional risk, it does not increase flammability.
If paraffins or other DWRs are being used the flammability of the finish must be evaluated to see if it's suitable. Paraffins are hydrocarbon based and are quite easily ignitable in their own. One must make sure that the finish applied onto the fabric does not pose as an additional risk for the flammability.

Agenda point 4 – Quantities of PFAS in protective clothing

Questions

7. What are the quantities of PFAS used in protective clothing applications in the EEA?
   No information.
8. Annex I of the PPE regulation (EU 2016/425) divides PPEs into three risk categories. What share of the quantities of PFAS are used in the three risk categories, respectively?
   Fabrics (by article, in approximate %):
   Cat 1 = 8 %
   Cat 2 = 18 %
   Cat 3 = 74 %

   Important notice: The percentual grouping of PPE-categories on fabrics is approximate since the same fabric can be used in both 2 and 3 depending on which certifications it holds.
   It is not definite that a fabric itself is either cat 2 or 3. The garments however are defined according to the highest PPE-level.
   It is therefore important to have the highest risk category in mind on the *fabric level* when evaluating if PFAS's are essential or not, even if the fabric is used in both category 2 or 3 garments.

9. Do you apply industrial re-impregnation of PFAS in your products? If so, what quantities of PFAS are used for industrial re-impregnation of your products?
   Tranemo recommends reimpregnation by at least every 5th wash on EN 13034 garments to fulfil protection also after washing. This service is not provided by Tranemo, but our partners in the industrial laundry business provides this reimpregnation to our customers. We also recommend re-heating (by tumbler for example) the garments after wash to re-activate the PFAS finish which will prolong the repellent functions in between re-impregnations.
   The reactivation and reimpregnation process will continuously be needed also for PFAS-free options, for example if using hydrocarbon DWR's.

For EN ISO 20471 certified garments there is no recommendation to reimpregnate garments to maintain stain-/oil-/dirt repellence. Industrial laundries do not automatically re-impregnate garments where the highest risk is EN ISO 20471 (cat 2, PPE regulation) – as far as our knowledge extends.

Agenda point 5 – Emissions and waste management

Questions

10. What are the quantities of emissions of PFAS from reimpregnation of your products?
    Tranemo can only recommend reimpregnation, but it is up to the industrial laundry partner to do so. Tranemo therefore has no informative number of emissions.
11. What measures can be taken to minimize the emissions from reimpregnation? What are the costs associated with these measures?
    Tranemo can only recommend reimpregnation, but it is up to the industrial laundry partner to do so. Minimize emissions from reimpregnation and their additional costs are questions for the industrial laundry partners.
12. How are your PFAS containing protective clothing dealt with at end-of-life?
    The producer's responsibility is not yet applied onto textiles.
    A reasonable theory would be to incinerate garment in high temperature (over 1000'C) to get rid of any PFAS. It is still under research at which temperature should be sufficient to remove the PFAS completely.
13. What are the quantities of emissions of PFAS from protective clothing in the waste phase?
    Tranemo has no information.
14. What measures can be taken to minimize the emissions from the waste phase? What are the costs associated with these measures?
    Our idea: To recommend incineration for garments containing PFAS's – and to not allowing it to end up in land fill or extended life span outside our, our customers and our laundry partners, control.

TRANEMO – additional comments

- For Tranemo, the PPE garments containing PFAS's are today certified in accordance with EN 13034 Type 6 [PB].
  Due to design demands the EN 13034 might not be reached, but the repellent function of the fabric still needs to be there.
  This is because EN 13034-garments are subordinate to the main protections: flame, electric arc, hi-vis and anti-static. For example, if the design for EN 13034 contradicts another certification, then EN 13034 will be lost as certification in garment certification. However, having repellent fabrics is still very important for those garments.
  This is because the main idea of EN 13034 Type 6 Partial Body protective wear is to get oneself away from the danger in case of an accident - repellent fabrics gives additional reaction time to do so. By having the fabrics repellent to chemicals, the wearer gets more time to react and get oneself away from the danger and remove all the contaminated clothing. Workers are not supposed to continue working if an accident occurs. If that kind of protection is needed, then Partial Body protection Type 6 [PB] as certification is not sufficient and higher chemical protection must be evaluated in the customers risk assessment. It is the

same as when comparing EN 469 with EN ISO 11612 when you are deliberately exposed to risk (EN 469) compared to when a risk arises in the event of an accident (EN ISO 11612).

- It is mentioned and suggested 3-10 years as transition time in the TULAC-report for removal of PFAS for PPE. Tranemo find it very unlikely to find a substitute for PFAS's when it comes to oil- and chemical repellence during this period. Tranemo is agreeing and supporting the broader ban of all PFAS. However, if the protection for the wearer using the garments is affected and reduced, there cannot a complete removal of PFAS's. The personal safety for workers must be Tranemo's number one priority.

- One must also consider the safety stock of PPE garments. To be able to supply our customers with PPE we need a safety stock – which is we need to have several years of stock. If an alternative to PFAS with excellent properties against oil- and chemical repellence is found in the future, the transition time for the stock also must be taken into consideration. According to Tranemo's calculation, at least 5 years must be added to the transition time to make sure the stock is able to rotate from PFAS to PFAS free.