

INFORMATION PAPER

13 February 2024

SUBJECT: Impacts of Per- and Polyfluoroalkyl Substances (PFAS) on DoD Clothing and Equipment

1. PURPOSE. Provide background information on PFAS regulations, impacts on DoD Clothing and Equipment items, and DEVCOM SC's efforts to develop and identify Science & Technology solutions.
2. BACKGROUND.
  - a. New, breakthrough technologies are needed to replace Per- and Polyfluoroalkyl Substances (PFAS) used in military and commercial applications. PFAS are classified by the Environmental Protection Agency (EPA) as "Forever Chemicals" due to their widespread persistence in the environment. They can be found in nearly half of all US drinking water and are associated with cancer, reproductive health issues, and developmental delays. There are over 9,000 different PFAS compounds, due to the broad, umbrella definition of PFAS currently used, including polymeric forms, used in food packing, personal care products, water/stain resistant products, and non-stick cookware.
  - b. The Department of Defense (DoD) uses finishes with PFAS to provide water, oil, and stain repellency on clothing and equipment items and uses laminated films with PTFE (polytetrafluoroethylene, of which PFAS can be a precursor, intermediary and by-product) to provide barriers and membranes, against wind, water, and chemicals. These properties are essential to ensure DoD protective clothing and equipment items provide Warfighters with the protection needed, particularly in extreme weather and Chemical Biological Radiological Nuclear (CBRN) environments. Many clothing and equipment requirements can ONLY be met using PFAS. Currently, non-PFAS water repellent finishes do not provide the same level of durability as their PFAS counterparts, and no PFAS-free alternative has been developed which can provide any level of oil repellency.
  - c. Repellency becomes critical when Warfighters are exposed to toxic chemicals, chemical warfare agents, fuels, motor oils, and contaminants to prevent absorption into and/or through fabric layers. What may be considered comfort issues for a typical consumer (ex. wet clothing), may create life-threatening situations for the Warfighter who must perform for many hours under extreme conditions or enter a CBRN environment. Additionally, non-PFAS finishes struggle to meet military requirements for clothing and equipment items over the expected life cycle of an item.
3. FACTS.
  - a. As of February 2024, 36 states have introduced and/or adopted policies around PFAS. Some regulations address PFAS in textiles (CA, CO, NY, WA); while others consider a ban of ALL added PFAS (ME). Differing state legislations create logistical challenges for industry. Major domestic suppliers like Milliken, Mount Vernon Mills, Saint Gobain and 3M are voluntarily exiting PFAS manufacturing due to lawsuits and impending EPA restrictions. In many cases non-PFAS replacements are not available, which results in product lines being permanently discontinued. The DoD "Report on Critical Per- and Polyfluoroalkyl Uses" (2023), written in response to the 2023 National Defense Authorization Act (NDAA), specially mentions critical uses of PFAS in DoD clothing & textiles such as fabric finishes for repellency, chemical barriers, parachutes, membranes for wind & rain barriers, etc. Being defined as critical use provides a justification for an exemption from a potential EPA ban, however there are currently no regulations from the EPA banning the use of PFAS. There is no protection for industry from civil litigation, state legislation, or the economic

impacts from the loss of the civilian market. It is expected that supply chain challenges that DoD are facing will continue as companies voluntarily divest from the PFAS market.

- b. In response to the PFAS challenge, DEVCOM SC Soldier Protection Directorate established a Natick Soldier System Center (NSSC) PFAS Working Group (May 2023) and later split into two working groups in October 2023: PFAS Research Working Group & PFAS Impacted Items IPT. The objective of the Impacted Items IPT is to maintain a cross service database of items (& components) affected, determine the functionality PFAS provides, identify timelines and manufacturer alternatives, track waivers, & evaluate non-PFAS alternatives. The Research Working Group monitors the R&D of PFAS alternatives - both repellent finishes and barriers for protection. Representatives span all services and ALL areas to include clothing, shelters, chemical/biological protections, aerial delivery, combat feeding, and hydration. Each Working Group representative has an established relationship with their respective Program Manager (PM) and is responsible for communicating and informing any outcomes to their PM. Currently, the PFAS Impacted Items group is tracking 100+ fielded items that are, or will be, affected by PFAS regulations. State-of-the-art solutions from industry and developmental chemistries are continuously assessed by these PFAS working groups. While some solutions are considered acceptable in the consumer market, they do not provide essential performance characteristics and protection levels required by the DoD.
  - c. It is essential that the DoD invest in research to develop fluorine-free alternatives that provide Warfighters with the same level of protection currently obtained using PFAS. Oil repellency and chemical protection without PFAS are a major challenge, and no viable alternatives have been found to date. The carbon-fluorine bond is unique and in addition to many other properties, molecules with this structure can provide oil and liquid repellency and the robust barrier properties found in chemical/biological protective membranes to a level that no other known compound can provide. Achieving oil repellency using a non-fluorine alternative is considered the “holy grail” in the textile world, and may require looking at factors such as fiber content, fabric geometry, and surface chemistries/properties to meet end use requirements equivalent to those obtained using PFAS.
  - d. Soldier Protection Directorate (SPD) currently leads several proposals & topics submitted to develop PFAS alternatives that include Small Business Research Initiatives (SBIRs) & Small Business Technology Transfer (STTRs) programs focused on biosynthetic approaches, a Congressional 6.1 topic proposal, two DPA Title III Project Applications and two Safer Alternatives for Readiness (SAFR) programs. In addition, four proposals have been accepted for funding by the Strategic Environmental Research and Development Program (SERDP) in response to a Statement of Need proposed by DEVCOM SC and the Defense Threat Reduction Agency (DTRA) has funded several SBIR Phase I non-PFAS topics over the last year.
4. CONCLUSIONS/KEY CHALLENGES. The rapidly evolving regulatory and legislative environment, business decisions being made by industry suppliers to discontinue PFAS products, and the lack of non-PFAS alternatives available commercially or in development, has created a major challenge for the DoD. Based on feedback from the textile industry and current SPD research, a significant breakthrough in chemistry is necessary for a non-PFAS alternative that can provide the oil repellency, barrier properties and durability equivalent to its PFAS counterpart.
5. Points of Contact for this information are:
- a. Molly Richards, Research Chemical Engineer FCDD-SCD-PMI, [molly.n.richards2.civ@army.mil](mailto:molly.n.richards2.civ@army.mil)
  - b. Margaret Auerbach, Textile Technologist FCDD-SCD-PME, [margaret.a.auerbach.civ@army.mil](mailto:margaret.a.auerbach.civ@army.mil)
  - c. Erin Anderson, Biologist FCDD-SCD-PMI, [erin.e.anderson11.civ@army.mil](mailto:erin.e.anderson11.civ@army.mil)
  - d. Natalie Pomerantz, Deputy Lead Systems Engineer, FCDD-SCD-PEI, [natalie.l.pomerantz.civ@army.mil](mailto:natalie.l.pomerantz.civ@army.mil)