



ADVANCED RECHARGEABLE & LITHIUM BATTERIES ASSOCIATION

PFAS restriction proposal

RECHARGE statement for 2nd Call for Evidence – October 2021



A - GENERAL

The competent authorities for REACH of the Netherlands, Germany, Denmark, Sweden and Norway are currently preparing a REACH Annex XV Restriction Dossier for the group of PFAS (per- and polyfluoroalkyl substances).

The advanced rechargeable and lithium batteries value chain in Europe, as represented by RECHARGE, studied this restriction proposal and more specifically one of the 16 reports accompanying it, the “**report summary electronics and energy – July 2021**” dealing with batteries.

This position paper aims:

- **First, at providing more information on the PFAS used in batteries, on their potential emissions and potential alternatives,**
- **Then, at expressing RECHARGE position regarding this wide horizontal restriction introduced in the “Chemicals Strategy for Sustainability” framework.**

B – PFAS IN BATTERIES: MAIN USES, POTENTIAL EMISSIONS AND POTENTIAL ALTERNATIVES

B.1. Questions in relation to the use in batteries

Per- and polyfluoroalkyl substances (PFAS) are a huge and diverse group of chemical compounds. The proposed entry into the Registry of Intention (ROI) includes a broad definition of PFAS that could cover over 9000 substances!

Among the very large PFAS family, the fluoropolymers sub-group is widely used in the battery industry. Fluoropolymers are polymers with fluorine atoms directly attached to their carbon backbone. Despite their chemical structure, **fluoropolymers are different to other PFAS** and have specific toxicological and environmental profiles. Fluoropolymers are high molecular weight polymers and have unique physicochemical properties that constitute a distinct class within PFAS.

According to our current knowledge, **only fluoropolymers are used in the battery industry**. These battery uses of fluoropolymers may be divided in two main categories:

- **Use at electrode level as binders:** PVDF (polyvinylidene fluoride) and PTFE (polytetrafluoroethylene),
- **Other uses at cell/battery level:** separator coatings, additives in the electrolyte, gaskets/seals, pipes, valves and sealings (for instance FEP and PTFE).

B.1.1. Use of PTFE in lithium primary batteries

PTFE is a paramount component for lithium primary batteries. In these liquid cathode systems (Li-SOCl₂, Li-SO₂Cl₂, Li-SO₂, Li-MnO₂), we need a positive electrode with electronic conductivity, very high surface and high porosity to accommodate the insoluble reaction products.

This can be achieved only with carbon black and PTFE binder.

PTFE is unique among polymers, as it has a superplastic phase, where it is possible to simply mechanically fibrillate it, with fibrils down to tens of nanometers. As a consequence, the carbon black is solidly maintained by a network of fibrils that keeps its surface free.

By contrast, other polymeric binders work by adhesion to the carbon black surface and so cover its surface leading to a deactivation of the carbon black surface.

Lithium primary batteries are mainly used in:

- **Smart metering** (smart electricity/gas/water/heat allocation meters),
- **Electronic Toll Collection (ETC)**,
- **E-call**,
- **Asset tracking** (container tracking, dangerous goods transportation tracking, GPS devices, farm animal tracking, wild animal tracking)
- **Industrial Internet of Things (IoT)** (parking sensors, embedded roadway traffic/vehicle sensors, sound/noise sensors, vibration sensors, pressure sensors, shock sensors, inertia sensors, temperature monitoring and reporting, building environmental sensors, connected “smart” fire hydrants....)
- **Medical devices** (thermal imaging equipment, insulin pumps, infusion pumps, portable cardiac defibrillators, ambulatory monitoring devices, ...)
- **Portable military** (night vision equipment, Manpack radios, Portable handheld radios, intrusion detection, area denial systems)
- **Environmental monitoring** (pollution control monitors, sewage and wastewater monitors, ocean temperature, current and waves monitors, irrigation control devices, soil moisture monitors, remote weather stations, land slide detection, earthquake detectors and earthquake monitoring, tsunami warning sensors),
- **Security/Safety systems** (aircraft emergency lighting, emergency life raft beacon, lifejacket emergency beacon, EPIRB (Emergency Position-Indicating Radio Beacon) land/sea/air, remote security/ surveillance systems. heat (fire detection), smoke detectors, anti-theft devices,

wireless home security systems, bridge and building stress monitors, road studs-ice alert/warning systems...)

- **Oil & Gas** (Pipe Inspection Gauges (PIG), Measure While Drilling (MWD), Slick Line sensors)
- **Electronics** (watches, smart keys, remote controls, car keys, key lights, memory back-up ...)

The lithium primary cells and batteries are often permanently installed in electrical devices and provide energy for up to 40 years.

According to the Urban Mine Platform (www.urbanmineplatform.eu), **7 000 tons** of primary lithium-based batteries were put on the Market in Europe in 2015. PTFE content is less than 1%. **PTFE tonnage** present in lithium primary batteries may be estimated at less than 100 tons in Europe in 2015.

B.1.2. Use of PVDF in lithium-ion cells

PVDF is a paramount component for the manufacturing of positive electrodes for Li-ion cells. PVDF exhibits high electrochemical, thermal and chemical stability. In addition, PVDF is easy to process and offers excellent performance with small amount of binder.

The main property of the binder is to provide interconnectivity and adhesion within electrode active materials and to current collectors. It is of outmost importance regarding the very long cycling life span of Li-ion batteries.

Initially introduced on the market by Sony in the 1990's for phones and laptops, Li-ion batteries are today used in numerous applications from small portable batteries until large industrial batteries:

- **ICT** (cellular phones, smartphones, tablets, laptops, power banks, digital cameras, MP3 ...),
- **Cordless Tools** (cordless power tools, cordless gardening tools, shavers, toothbrush),
- **Light Means of Transport** (e-bikes, e-scooters ...),
- **Electric Mobility** (HEV, EV, PHEV, e-bus, e-trucks, e-ferries ...)
- **Off-Road Mobility** (electrification of industrial vehicles for construction, mining, agriculture, airport/harbor equipment, forklifts)
- **Energy Storage Systems** (energy storage solutions for network services and renewable energies, micro-grids for home, commercial and industrial applications)
- **Space & Defense** (communications, scientific and observation satellites, satellite launchers, space vehicles, military aircraft, weapon systems, submarines)
- **Other industrial applications** (datacenters, telecom, medical)

According to the Urban Mine Platform (www.urbanmineplatform.eu), **90 000 tons** of lithium-ion batteries were put on the market in Europe in 2015. PVDF content is less than 1%. The value of 8% used in the calculation the “Report summary Electronics and Energy” was a very large over-estimation of the reality as the 8% was representing the remainder of the Li-ion cell composition (positive binder, negative binder, separator, conductive agents ...). PVDF tonnage present in lithium-ion batteries may be estimated at around 1 000 tons in Europe in 2015.

B.1.3. Estimation of tonnages of fluoropolymers present in batteries POM in Europe

According to RECHARGE internal consolidated data, around 150 000 tons of Li-ion batteries (including portable, industrial and EV batteries) were put on the European market in 2020. PVDF represents less than 1% of the total weight of the Li-ion battery.

The primary lithium batteries put on the European market in 2020 may be estimated from 10 000 to 15 000 tons, representing roughly 10% of the Li-ion batteries present on the European market. PTFE represents less than 1% of the total weight of the Li-ion battery. PTFE is only a minor part of the fluoropolymers present in batteries in Europe.

We believe that the calculations summarized on Table 3 from the “Report summary Electronics and Energy”, with estimated PFAS tonnages used in batteries in EEA, ranging from 10 000 to 19 000 tons, with an average at 15 000 tons are largely over-estimated.

RECHARGE estimates that the PFAS present in batteries in Europe in 2020 are POLYMERS (mainly PVDF) with a tonnage between 1500 and 2000 tons. This tonnage is expected to grow significantly in the coming years and may perhaps reach 15 000 to 20 000 tons before 2030. (see an estimation of Li-ion giga-factories announced in Europe in Annex 1).

B.1.4. Estimation of potential emissions

Emissions during battery manufacturing

- Main steps of primary lithium cells and batteries manufacturing

PTFE dispersion is mixed with electrode components and carbon black. This wet mix is then processed and heated below the degradation temperature of the PTFE. The dried mix is then further used for cell manufacturing

Empty drums of PTFE dispersion, PTFE containing residues from the processes as well as scrap cathodes are collected as chemical wastes and disposed of according to applicable European regulations.

- Main steps of lithium-ion cells and batteries manufacturing

PVDF is mixed with its organic solvent NMP and other electrode components. This wet mix is then coated on a metallic foil. This electrode is further heated below the degradation temperature of PVDF. The dried electrode is then further used for cell manufacturing.

Empty bags of PVDF, PVDF containing residues from the processes as well as scrap cathodes are collected as chemical wastes and disposed of according to applicable European regulations.

Potential residues of fluoropolymers (either empty packaging or cleaning solutions) are always collected as chemical wastes and disposed of according to applicable European regulations. **No PFAS emissions are foreseen during battery manufacturing.**

Emissions during battery use

During battery manufacturing, active substances, binders (like PTFE and PVDF) and additives are embedded in a mechanical substrate to form electrodes. These electrodes are then further assembled with the other battery components such as separator, electrolyte, connectors and casing to obtain a finished battery. This battery is defined in the REACH regulation as “an article with no intended release” meaning that, **under normal and reasonably foreseeable conditions of use, no end-user of this battery will be exposed to any chemical substances. No PFAS emissions are foreseen during battery use.**

Emissions during battery recycling

Fluoropolymers are totally decomposed (as compounds), during the pyrometallurgical recycling processes. The fluorine reports to the flue dust. Flue dust is further processed in a hydro-metallurgical process to extract specific remaining metal content. **No PFAS emissions are foreseen during battery recycling.**

As a summary, no PFAS emissions are foreseen during:

- **Battery manufacturing,**
- **Battery use,**
- **Battery recycling.**

B.2. Questions in relation to alternatives for batteries

Table 4 from the “Report summary Electronics and Energy” assumes that “solid-state batteries” are non PFAS alternatives for batteries.

If, on one hand, it is correct to point out that solid-state batteries are currently on a low technology readiness level, on the other hand **it is incorrect to consider solid-state batteries as “non PFAS alternatives to batteries”**.

In solid-state batteries, dry processes are used to manufacture the electrodes. As already explained before, PTFE is unique among polymers, as it has a superplastic phase, where it is possible to simply mechanically fibrillate it. For dry process for lithium rechargeable batteries electrodes, it is the same superplastic property of PTFE that makes it a preferred choice. The only difference with liquid cathode is that the active material for Lithium rechargeable has much lower surface area than carbon black, so that a very small amount of PTFE is enough, generally around 1-2%.

In the case of dry processes, there are some alternatives to PTFE with thermoplastic polymers, but the process is much more complicated, involves spray drying or extrusion. It is still far from achievement, and the active material surface is always only partly covered and inactive.

PTFE and PDVF will be used in the manufacturing of solid-state batteries.

C – PFAS HORIZONTAL RESTRICTION

On 14 October 2020, the European Commission issued its **Chemical Strategy for Sustainability towards a Toxic-Free Environment**. Among others, regarding the Most Harmful Chemicals, the Commission will (...) prioritise (...) substances for restrictions **for all uses and through grouping, instead of regulating them one by one**. This new type of restriction is often referred to as “horizontal restriction”.

RECHARGE supports that “Chemicals are produced and used in a way that maximises their contribution to society including achieving the green and digital transition, while avoiding harm”.

However, we want to stress the importance of identifying an EU wide **unacceptable risk** before submitting substances to a restriction process (article 68 of REACH regulation). **RECHARGE cannot support a broad horizontal restriction of several thousands of substances in the case of PFAS, irrespective of their actual risk**. Indeed, accelerating the regulatory process by combining and merging all PFAS into one group of substances ignores the fact that the PFAS definition covers substances with very different toxicological profiles.

Although fluoropolymers can be categorized as PFAS based on their structure, their properties are distinctly different from other PFAS substances and as such, this broad and diverse family of substances should not be grouped all together. **Fluoropolymers** are high molecular weight polymers and have unique physicochemical properties that constitute **a distinct class within PFAS**. Fluoropolymers that meet the OECD polymer of low concern criteria are non-toxic, bio-compatible, non-soluble and immobile molecules and they are deemed as such **to have insignificant environmental and human health impacts**

Therefore, RECHARGE advocates that prior to any REACH restriction, a segmentation of the PFAS family of substances should be made.

KEY MESSAGES:

- A sustainable and competitive batteries industry is essential in Europe's energy transition and in reaching the EU 2050 climate goals.
- No alternatives are available for the use of PTFE and of PVDF in primary Lithium and Lithium-ion technologies and these fluoropolymers will also be used in solid-state batteries.
- RECHARGE advocates for the segmentation of the PFAS family of substances before performing any grouping-based assessment.
- Environmentally stable compounds such as Fluoropolymers Products needs to be placed in a separate category so they can continue to contribute to a sustainable and competitive batteries industry, critical for the EU Green Deal's goals.
- There should be only restrictions in the case of unacceptable risks (REACH art 68).



ABOUT RECHARGE

Representing the battery industry of the future, RECHARGE is the industry association of the advanced rechargeable and lithium batteries value chain in Europe. Advanced rechargeable batteries are a strategic key technology that contribute to a more empowered, sustainable and circular economy by enabling decarbonized electricity and mobility. Founded in 1998, RECHARGE's unique membership covers all aspects of the battery value chain: From suppliers of primary and secondary raw materials to battery and original equipment manufacturers (OEMs), to logistic partners and battery recyclers. For more information, visit www.rechargebatteries.org or follow us at [@RechargeEurope](https://www.instagram.com/RechargeEurope).

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Annex I – The rechargeable battery market and main trends 2020-2030 from AVICENNE Energy presentation (ICBR 2021 -September 22nd, 2021)

