



Information Document on Arkema fluoropolymers Kynar® produced without PFAS surfactants

With respect to the ongoing REACH restriction process on PFAS, the EU

Chemicals Strategy for Sustainability and the Commission PFAS Action Plan, Arkema would like to offer more information on its fluoropolymers.

Through intense research and development activities, **Arkema has developed an innovative patented technology to produce PVDF fluoropolymers without the use of PFAS surfactants (Kynar® FSF® PVDF)**, using only non-persistent **non-fluorinated** surfactants. Today, Arkema's two largest PVDF production plants use no PFAS surfactants at all in the production of PVDF.

Our innovative technology can enable the regulator to consider a restriction on the **use of fluorinated surfactants** in the manufacture of fluoropolymers.

In acknowledging the regulatory concern about the use phase and end-of-life of fluoropolymers, we would like to provide additional supporting evidence to demonstrate that Arkema FSF® fluoropolymers are even if they are included in the PFAS definition due to some structural analogy they don't present the same safety properties and should not be evaluated in the same way in term of risk. They deserve a particular regulatory approach.

Arkema has invested significant financial and human resources to generate data on the fate of Kynar® FSF® PVDF along its life cycle.

1. It does not degrade in the environment, is made without the use of PFAS surfactants and there is no leach out of monomers or oligomers. After ageing Kynar® FSF® PVDF continues to meet OECD PLC criteria.

Ageing in different conditions

No degradation of the polymer was observed nor leach-out in the liquid environment (measured by GPC analysis) in air, water, high temperature, in N2 atmosphere, in acidic conditions, under UV exposure, for 4 months.

Aerobic Biodegradability

We tested our polymer according to OECD Guideline 301F for 60 days and found no degradation of the polymer and no leach-out of smaller molecules in the environment.

Anaerobic biodegradability

The product has been tested by a third party at 37°C according to ASTM D5511 with cryogenic grinding products (<1mm) to be in worst case conditions, for 90 days, representing more than 6 years of landfilling. As a result, no degradation and no leach-out of small molecules in the environment was observed.

These recognized testing methods and associated results demonstrate the non-degradation of Kynar FSF PVDF in the environment and no leach out of small molecules in the environment.

Durability should not be confused with environmental persistence and should be sought after. Durability means no compromising of the natural environment, no loss of biological diversity and represents an opportunity to promote a sustainable and durable society over a disposable one.

2. Kynar® FSF® PVDF is PLC according to OECD criteria

Arkema's alternative polymerization aid is non-fluorinated and non-persistent. Moreover, Kynar® PVDF FSF® polymers meet the OECD criteria on 'polymers of low concern' and based on our actual knowledge they do not pose ecological and human health hazards and risks, despite such claims being indicated in the Commission PFAS Action Plan. All data to prove the compliance of Kynar® with OECD PLC criteria have been generated and are available. These include monomer residuals content under 50ppb.

The elimination of the fluoro-surfactant combined with data generated regarding PLC status and on potential degradation demonstrate the favorable profile of PVDF.

With respect to mobility, bioavailability and (eco)toxicity, PVDF is a polymer of high molecular weight and insoluble in water. The high molecular weight prevent the PVDF to penetrate cell membrane and so PVDF is not bioavailable. As it is insoluble in water, some ecotoxicological evaluation methods could not be performed. Finally this insolubility limit the mobility capacity of those polymers.

Arkema is willing to actively provide the needed data evidence for a scientific-based regulation proposal. With this objective in mind, Arkema is launching incineration simulation studies in order to offer a complete view of PVDF end of life options (recycling, landfill, incineration).

3. Kynar® FSF® PVDF durability is the best alternative to disposability when the product end-of-life is appropriately managed

At the end of life, Arkema's PVDF manufactured without PFAS surfactants is fully mechanically recyclable. We created the program Virtucycle® to help customers recycle in open-loop and closed-loop initiatives for post-industrial and/or post-consumer recycling. Arkema plays the unique role of "matchmaker" by matching 'source suppliers' with 'target consumers' for high performance polymers.

There are also projects to reuse PVDF following batteries' recycling. An increasing % of the black mass (a mix of the active material, carbon black, electrolytes and PVDF) in batteries is recycled. PVDF could be then separated and reused. In China, Japan and South Korea there are large treatment facilities for batteries and battery waste, sometimes dealing with more than 50 000 tons per year of black mass. Arkema in partnership with Chalmers University of Technology is candidate to a European funded project to extract PVDF through chemical process from the black mass in battery. We are also collaborating with the academia to evaluate a solution to recover Kynar® PVDF through a process of dissolution/precipitation.

Some additional simulation studies have been launched with respect to the incineration process.

4. Arkema is committed to addressing concerns regarding the use phase of PVDF

Kynar® PVDF FSF® polymers are exclusively managed through industrial supply chains. Moreover, Arkema is sponsoring a RMOA and SEA analysis regarding the use of PVDF in different key functions (Li-Ion Batteries, Chemical Process industry, including ultra-pure water for semiconductors production, Architectural coatings). We expect the study to provide us with an estimation of emissions, during use and end-of-life, of PVDF homopolymer and copolymer as well as their monomers and the cost to reduce emissions. We would appreciate the opportunity to present additional data when they become available in Q2.