# Additional information on 6. Missing uses – Analysis of alternatives and socio-economic analysis

## PFAS polymers in analytical and scientific laboratories

Due to their chemical inertness, products containing solid PFAS polymers (PTFE, PFA, PEEK and others) are in widespread use in analytical and scientific laboratories. They are employed in devices where chemically aggressive conditions cannot be excluded or contamination of an analytical samples must be avoided. These uses have not been addressed by the Restriction Report.

Chemically aggressive conditions are understood as circumstances, where the contact of chemical substances within solutions or gases with the materials of laboratory equipment may lead to significant corrosion, degradation or leaching of these materials.

Chemically aggressive conditions are characterized by the presence of potentially aggressive chemicals with or without combination with high temperature/ pressure. Such chemicals include but are not restricted to:

- strong acids
- strong bases
- oxidizing chemicals
- high content of dissolved salts
- organics solvents
- reactive gases
- other chemicals that react with metals, glassware, and non-fluorinated polymers

In analytical chemistry, a sample may be irreversibly altered by leaching of substances from materials the sample is in contact with. Contaminations may originate from the material itself (e.g., plasticisers or degradation products) or from previous samples that have interacted with the material through processes such as chemical reaction, sorption or diffusion. The latter processes may lead to a carryover of analytes or otherwise interfering substances into samples that will be analysed later.

Examples of adverse processes are corrosion of metals by acids or dissolved salts, degradation of plastic materials by oxidizing agents, leaching of plasticizers by organic solvents into liquid.

The potential consequences of corrosion and contamination are:

- non-acceptable contamination of the original sample, thus changing the composition of the medium in contact with the material so that a non-biased analysis of the sample is no longer possible.
- chemical alteration or destruction of the substances in the medium, so that the original properties cannot be reliably measured.
- function failure of the equipment and danger to the occupational safety of employees.

## Overview of PFAS applications in analytical and scientific laboratories

Below is a list containing examples of PFAS-containing devices used in analytical and scientific laboratories. The list makes no claim to completeness.

| Use | Examples | Alternatives |
|---|---|---|
| PFAS as a coating of metal surfaces to provide durability and inertness under | - Metal tubes lined with PTFE intended for the transport of chemically aggressive fluids/ gases | None known |

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|---|---|---|
| chemically aggressive conditions | - Magnetic stirring rods/bars coated with PTFE<br>- Stirrer blades for use with external stirring motors<br>- Sensors coated with PFAS materials | |
| Tubing and fittings made of PFAS materials | - Tubing made to connect reservoirs of liquid reagents or samples with analytical instruments (e.g., GC, ICP-OES, ICP-MS)<br>- Tubing and fittings inside analytical instruments | None know |
| Inlets made of PFAS materials used within chemical reactors/ autoclaves | - High temperature / high-pressure reactors used for reactions under acidic/ saline conditions | None known |
| Vessels made of PFAS materials used in acid digestion instruments | - Vessels for microwave digestion | None known |
| Vessels made of PFAS materials used to handle/ store/ digest solutions containing fluoride | - Vessels used for fluoric acid digestion | None known |
| PTFE sealing tape | - Reliable and tight connection of metal or plastic fittings | None known |
| Other laboratory equipment for use under chemically aggressive conditions | - Ground joint sleeve to connect glassware | None known |

For non-aggressive conditions, other materials are principally available, although typically they are not offered on the market because they cannot be universally employed (e.g., HDPE, LDPE). Moreover, a laboratory would require to purchases several sets of equipment instead of one to address various possible physical and chemical conditions in experimental and analytical procedures.

## Example: use of PFAS polymers in international standards

In some national and international analytical standard procedures, the use of PTFE vessels is prescribed, e.g., DIN ISO 1486-1:2003-01 (Soil quality - Dissolution for the determination of total element content - Part 2: Dissolution by alkaline fusion). Due to chemical incompatibility, hot fluoric acid digestion of solids can only be performed in pressure vessels containing PFAS inlets. No alternatives are available.

## Example: use of PFAS polymers in high temperature / high pressure reactors

Chemical reactions under higher pressure/ temperature can often only be undertaken in mechanically durable metal reactors. Although there is a choice of different metallic materials (steel, nickel alloys, titanium), none of these metals withstands the action of highly corrosive fluids for a long time. Depending on the type of task, even a minor corrosion may corrupt the fluid and render the results invalid. Therefore, corrosion resistant inlets are used to prevent any unwanted side-reactions between fluids and reactor material. So far, only PFAS products are commercially available for this purpose. Given the limited range of elements in the periodic system, there is virtually no hope that different polymers emerge that provide the same chemical inertness as PFAS products.

Perfluorinated polymers are by far the most stable compounds in the laboratory environment, especially under aggressive conditions.

## Consequences of banning PFAS polymers in laboratory devices

Banning the use of PFAS would inevitably curtail and under circumstances even cease the ability to investigate chemical processes under aggressive conditions, to analyse chemically aggressive samples or to perform analytical methods that require chemically aggressive conditions. Therefore, specific environmental samples cannot be analysed, and the performance/ properties of materials under certain aggressive conditions cannot be tested anymore.

If the ban affects analytical standard procedures, such procedures could not be performed anymore. This would have serious consequences for certification/ authorization processes that link to such standards. After a material alternative has been found, about 10 to 20 years may be needed to initiate and complete a full revision cycle (It took 16 years for DIN ISO 1486-1:2003-01 to be reviewed) and another period of time to revise all ordnances and regulations that link to these standards.