Orgalim **Policy** Exchange

PFAS-free solutions: the challenge ahead

15 May 2024 | 14.30 – 16.00

orgalim | EUROPE'S TECHNOLOGY INDUSTRIES

Moderator

Daniel Wennick

Policy Director,
Orgalim - Europe's Technology Industries

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Before we start…

- The event is recorded and all attendees are muted
- The recording of the event, presentations, Orgalim views and recommendations will be shared early next week via email.
- Due to the very high number of participants, the chat functionality is not available. However, the questions submitted by participants were integrated in the moderated panel discussion.
- You will find in the Handouts section a copy of the agenda and the speakers' bios
- Please promote this event on our social media channels

@Orgalim_EU Orgalim

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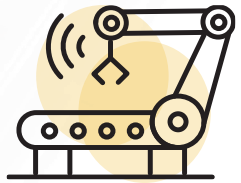
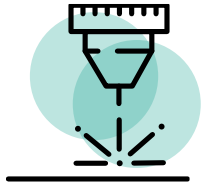
About Orgalim

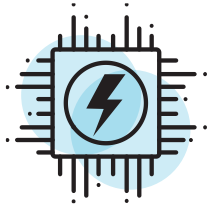
Europe’s largest industrial branch



Mechanical Engineering



Metal Technology

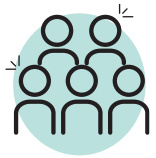


Electrical Engineering, Electronics, ICT

Annual turnover

2,819

billion EUR



Direct employment

11.9

million people

Annual exports

714

billion EUR

Our industries comprise of

770,000

companies

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Membership

National Industry Associations

European Sector Associations

Orgalim for corporates

For more information about Orgalim membership, please contact communications@orgalim.eu

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Membership

48 Member Associations, 10 Corporate Members, 21 Countries

National Associations

Austria
FMTI

Belgium
AGORIA

Croatia
Croatian Chamber of Economy
HUP

Denmark
DI

Finland
Technology Industries of Finland

France
FIEEC
FIM

Germany
VDMA
WSM
ZVEI

Great Britain
BEAMA
GAMBICA

Ireland
Ibec

Italy
ANIE
ANIMA

Latvia
MASOC

Lithuania
LINPRA

Luxembourg
FEDIL Metal

The Netherlands
FME
METAALUNIE

Norway
Norsk Industri

Portugal
AIMMAP

Slovenia
GZS-CCIS

Spain
SERCOBE

Switzerland
SWISSMEM

Sweden
TEKNIKFÖRETAGEN

Associate members

Turkey
MAKFED

Sector Associations

AFECOR
AQUA
CECAPI
CECE
CEIR
CEMA
CEMEP
CEO
C.E.F.A.C.D.
EFCEM
EGMF
EUNITED
EURALARM
EUROPACABLE
EUROPUMP
FARECOGAZ
FEM
FEPA
PNEUROP
T&D Europe

Orgalim for Corporates

AMAZON
DANFOSS
EATON
FASTEMS
PEPPERL+FUCHS
PHOENIX CONTACT
SCHNEIDER ELECTRIC
SIEMENS
SMITHS
TEXAS INSTRUMENTS

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Agenda

14.30 – 14.35	Opening remarks
14.35 – 14.55	Keynote speaker
14.55 – 15.05	Industry views
15.05 – 15.55	Moderated panel discussion
15.55 – 16.00	Closing remarks

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Keynote

Martijn Beekman

Policy Officer, DG GROW,
European Commission

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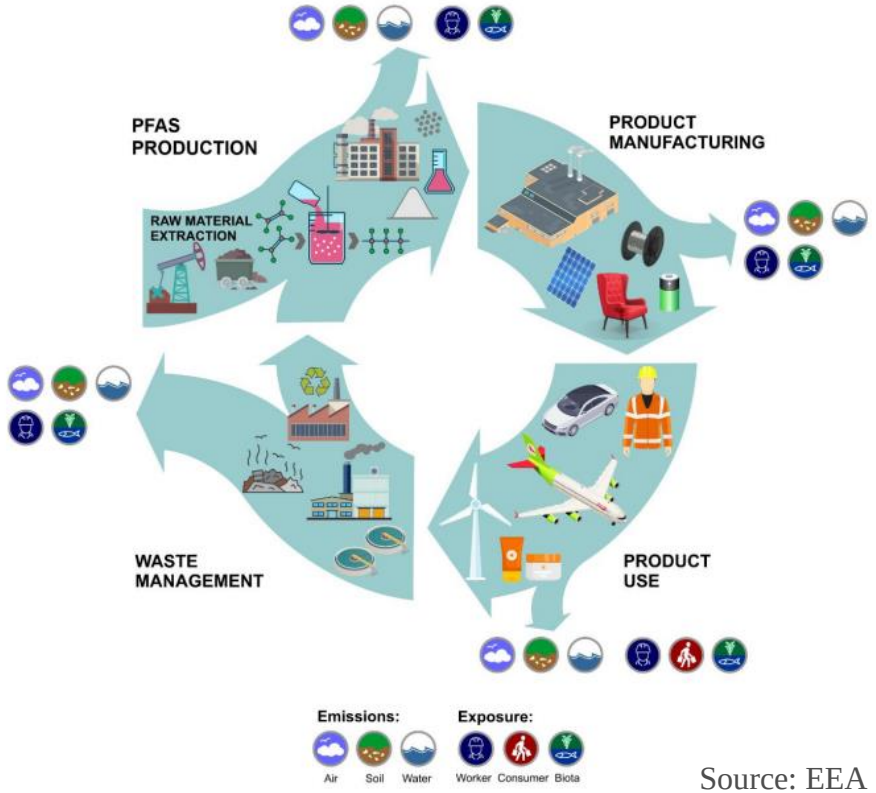
REACH restrictions on PFAS
and substitution initiatives

Challenges in addressing PFAS pollution

- Serious human health and environmental concern.
- Used in critical applications needed for twin transition to a green and digital economy and strategic autonomy.
- Balanced approach



Source: EEA

Action on PFAS in EU legislation

REACH restrictions: PFHxA, PFAS in fire-fighting foams, UPFAS

Industrial emissions directive and E-PRTR

POPs Regulation

F-gas Regulation

Drinking Water Directive

Water Framework Directive

Groundwater framework directive

Food Contaminants Regulation

Stockholm Convention – PFAS

Global ban on Persistent Organic Pollutants (POPs), in Europe implemented by the POP regulation

- Chemicals list in Annex A (elimination)
  - PFOA (C8)
  - PFHxS (C6)
- Chemicals list in Annex B (restriction)
  - PFOS (C8)
- Chemicals proposed for listing
  - Long chain PFCAs (C9-C21)

STOCKHOLM CONVENTION

The Stockholm Convention on Persistent Organic Pollutants ...

European Commission

REACH restriction - PFAS

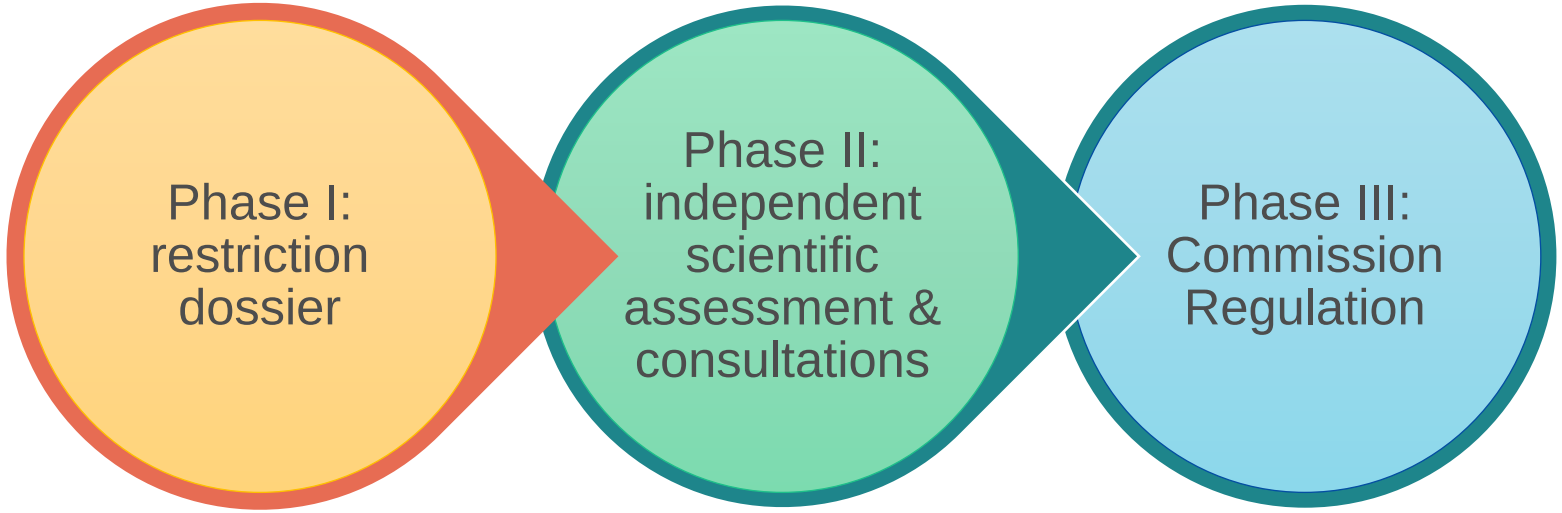
Annex XVII of REACH

- C9-C14 PFCAs (entry 68)
- TDFAs, trideca-fluorooctyl silanetriol (entry 73)
- PFHxS, RAC-SEAC opinion published 2020 → POP regulation

Upcoming restrictions in Annex XVII of REACH

- PFHxA
- PFAS in firefighting foams
- UPFAS (Universal PFAS)

REACH UPFAS restriction



Five national authorities	Scientific Committees	Commission with Member States (comitology)

COM role and some considerations

- At this stage, COM is an observer in RAC and SEAC.
- Derogations and transitional periods could be justified by taking into account:
  - Risk, including emissions during life-cycle (proxy for the risk);
  - Availability of alternatives;
  - Socio-economic impacts.
- The Commission envisages that there will be derogations for **critical uses where no alternatives are currently available**.
- Important to minimise emissions of PFAS in the entire life cycle for any use that is derogated.
- Based on the RAC and SEAC opinion, the Commission is committed to work as fast as possible on this dossier and put forward a balanced restriction of PFAS .

PFAS substitution in the EU: the history

- Initially started with regulatory pressure
  - PFOS restriction
  - PFOA restriction

→ Regrettable substitution moving away from C8 chemistry

- CSS: group approach
- Papers from academia
- Pollution cases/ public awareness
- Group restrictions

} Moving towards substitution of all PFAS

How is PFAS substitution progressing in EU?

Substitution activities are well advanced for:

- Fire-fighting foams
- Consumer articles
  - Outdoor clothing and other textile applications
  - Cookware
  - Food and other packaging
  - Mixtures (ski wax, cosmetics, waterproofing sprays)

Substitution activities initiated, for example (non-exhaustive):

- Applications of F-gases
- Solar panels
- Batteries
- Membranes

What are current challenges in the EU?

- Finding the right balance in:
  - Restricting uses where alternatives are available, with sufficient (but also not too long) transitional periods for companies to comply
  - Ensuring consistency across EU policy objectives, also delivering green and digital transition and a high level of protection of human health and the environment
  - Stimulating substitution without overregulation

Industry views

Kirsten Metz

Senior Manager Chemicals and Environmental Policy, ZVEI and Vice-Chair of Orgalim Chemicals Task Force

Arthur Vandenberghe

Sustainability Policy Officer, FIM and Chair of Orgalim Chemicals Task Force

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Industry views

What we support

- The use of hazardous substances should be reduced.
- Emissions of hazardous PFAS should be limited.
- PFAS applications that have caused environmental problems, and where suitable alternatives exist, shall be controlled.
- Other tools to minimise identified PFAS risks from industrial sites should be considered.

Industry views

What concerns us:

- The Green Deal will be hampered if the use of PFAS does not remain possible where there are no substitutes available at full scale.
- A PFAS general ban could adversely affect our members' production and lead to economic problems.
- Effective market surveillance to ensure effective enforcement and a level playing field will be challenging to achieve.
- A variety of different PFAS measures have recently been proposed by some EU Member States.
- Unpredictability due to the non-defined timeline for PFAS restriction creates uncertainty for our industries.

Industry views

Our recommendations

- A general ban on PFAS should not be implemented as long as substitutes for all uses are not recognised and not all uses of PFAS are reflected in the restriction dossier.
- A risk-based and substance-based approach should be used for the PFAS restriction proposal.
- An EU harmonised approach on PFAS in products should be developed instead of national, uncoordinated measures.
- An impact assessment should be carried out on the ability of ECHA and National Enforcement Authorities.
- An information obligation for "intentionally added" PFAS prior to restriction would allow a smoother implementation.

Industry views

Our recommendations

- A clearly defined procedure for derogations is essential.
- The repair-as-produced principle should be applied.
- A general exclusion of fluoropolymers without relevant risk is needed.
- Under the New Essential Use Concept, fluoropolymers should not be banned.
- The threshold level 25 ppb for solid materials should be removed and replaced by a threshold level of 0.1% PFAS in the weight of the product when intentionally added in the manufacturing process

Moderated panel

Dr Ulrich Hutschek

Principal, Tim Consulting on behalf of VDMA

Denise Lee

Global Product Regulatory Compliance Program Manager, John Crane – a Smiths Company

Holger Sack

Head of Product Compliance & Safety, Vega on behalf of ZVEI

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Brief presentation of the meta-study

PFAS substitutes in drive technology

Dr. Ulrich Hutschek

May 15, 2024

TIM CONSULTING

Technologie- und Innovationsmanagement

Dr. Ulrich Hutschek

- Principal at TIM Consulting
- 15 years of professional experience in innovation and technology management
- Consulting of corporations and SMEs on innovation excellence and technology strategy
- Former head of innovation management for a mechanical engineering company
  (1,600 employees) and head of the corporate incubator

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Key partners

FVA sharing drive innovation

VDMA

HS PF

Industry partners

SCHAEFFLER

FREUDENBERG INNOVATING TOGETHER

SKF

SAINT-GOBAIN

SEW EURODRIVE

FUCHS

KLÜBER LUBRICATION

setral® Competence in Lubricants

KAPP NILES

NORD DRIVESYSTEMS

iwis wir bewegen die welt

KONZELMANN KUNSTSTOFF · INNOVATIONEN

Project approach I/II

Particularly affected Applications → **Particulary relevant Functions** → **Identification of related Research** → **TIM Consulting AI System Entity recognition**

- Seals
- Sliding elements
- Insulation materials
- Lubricants

- Sliding properties
- Long-term stability
- Mechanical stability
- Thermal stability
- Chemical resistance
- Electrical insulation

- **26.138 Papers** from the field of materials research

- **428 Materials** in 32 material categories identified

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Project approach II/II

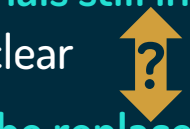
TIM Consulting AI System Entity recognition → Application-specific Analysis → Evaluation of Substitution potential

Allocation often not possible

- **428 Materials** in 32 material categories identified

- Seals
  30 Materials
- Sliding elements
  35 Materials
- Insulation materials
  26 Materials
- Lubricants
  20 Materials

- Case 1: PFAS substitution possible in the short term
  Affects applications with rather low requirements
- Case 2: Alternative materials still in the development stage
  Substitution potential unclear
- Case 3: C-F bond cannot be replaced
  Affects high-performance applications in particular



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(Pictures source: ZVEI Fact Sheet “PFAS in PAMCo”)

Research for PFAS-free alternatives in the Process Automation, Monitoring and Control sector

ZVEI Taskforce PFAS

Holger Sack 15.05.2024

zvei
electrifying ideas

Product range and requirements

Product range

- Measurement and control devices
  - Sensors, Actors and Encoder
- Monitoring and Control systems
- Process Infrastructure

(Pictures source: ZVEI Fact Sheet “PFAS in PAMCo”)

for various industry sectors like:

- Food, Pharmaceutical, Energy, Chemical, Petrochemical, Building materials, Environment/Recycling …

with:

- Lifetime of 15+ years
- Internal development times of 2-5 years
- Supplier certification times of 2-4 years
- Customer certification times of 2-4 years
- Required availability time of spare parts of 10-25 years

Requirements:

- broad chemical resistance to virtually all chemicals
- extreme temperature performance -200°C to + 260 °C
- extreme pressure performance
- Corrosion resistance
- Intrinsic flame resistance
- Good electrical and dielectric properties
- Low friction / non-adhesive resistance
- Purity / inert
- UV resistance
- Water resistance

→ Fluoropolymers are the most suitable

Search/Research for substitutes – Result examples

- Non-PFAS Polymers
  - Polyetheretherketone (PEEK) and Polyphenylene Sulphide (PPS) have slightly higher temperature performance than fluoropolymers. However, fluoropolymers are the best choice when both high temperature and chemical resistance are needed simultaneously.
  - Acetal: excellent lubrication properties, but low chemical resistance and temperature limitations.
  - polyimides such as Vespel™: too high compressive strength, no good low-pressure seals, incompatible with some media such as water and steam.
  - The best suitable substitute for a fluoropolymer is … also a fluoropolymer, e.g. PCTFE is a good back-up material for PTFE and vice versa

- Corrosion resistant metals:
  - stainless steel (SS), titanium, Hastelloy, nickel, copper, and brass were explored as alternatives to fluoropolymer liners
    ➔ unacceptable because of significant incompatibility with some chemicals and lack of purity in certain applications.

- Non-PFAS Elastomers
  - Ethylene Propylene Diene Monomer (EPDM), Hydrogenated Nitrile Butadiene (H-NBR), and Silicone ➔ unsuitable due to their inferior chemical resistance, temperature limitations, and mechanical properties

Search/Research for substitutes

- Intense literature research and consultation of external experts from the broader materials industry
- Various research projects were carried out by internal laboratories, external institutes and/or universities

- multiple classes of materials have been considered
- a combination of available data and publications have been used

Conclusion:

- No alternatives to fluoropolymer materials so far
- Material limits of basic requirements are often exceeded

(Pictures Source: ZVEI Fact Sheet “PFAS in PAMCo”)

Graphite as a PFAS Alternative in the Mechanical Sealing Industry

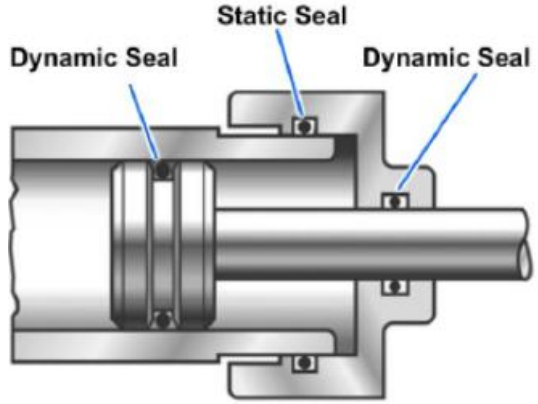
Denise Lee

15 May 2024

Overview of Sealing Devices & Materials

Types of Mechanical Seals:

- A **static seal** functions against mating surfaces that have no relative motion between each other. Depending on the direction of compression, a static seal can be classified as either axial or radial.
- **Dynamic seals** exist when there is motion between surfaces. Typical motions include reciprocating, oscillating, and rotation. Operational factors can greatly affect how dynamic seals perform. Factors such as swelling of seals in fluids, surface roughness of mating surfaces, lubrication, internal pressure, compression, elasticity, and friction from surfaces.



Functionality

- To contain media (powders, gas and liquids) inside hardware

  (process or storage equipment).

Sealing Materials:

- Sealing materials are selected based on the specific application requirements:
  - Environmental conditions: media, temperature, pressure, speed, abrasion
  - Inability to damage other equipment (i.e., hardware) in which the seal is housed
  - Be compatible with the counter surface to maximize sealing efficiency

john crane
a smiths company

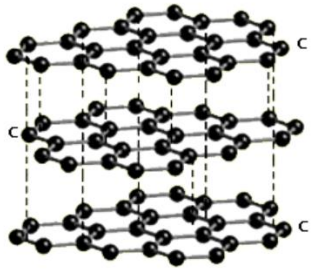
Flexible Graphite

Cons

- Flexible Graphite is susceptible to chemical attack in the presence of strong oxidizing fluids including air, at extremely high temperatures.
- Graphite's service life is inferior to that of fluoropolymers.
- Graphite needs to be pre-set/compressed to ensure a seal and requires a constant load to maintain its performance.
- Layered Graphite parts do not maintain their shape under very high pressure.
- Graphite is an organic material. When exposed to moderate to high temperatures – even when treated with oxygen inhibiting chemicals - the carbon will begin to oxidize, and over time the graphite sealing material will lose its integrity and performance will diminish.
- Equipment maintenance intervals will be diminished resulting in increased maintenance costs.
- Graphite should not be used for food contact applications or any application where graphite contamination could be an issue. (Flexible graphite will particle transfer.)
- Graphite is relatively weak at low temperatures thereby limiting its use in key industrial sectors.
- Poor performance in high temperature water applications due to the water penetrating the layers. When the part is subjected to high temperatures, the water expands and causes the layers to delaminate.
- Low volume of high-quality suppliers.
    - Linear flat layers are less expensive to manufacture, but tend to leak through the layers unless they are pre-set and have a constant load.
    - Wrinkled layers – formed from expanded graphite - are expensive to manufacture but have better performance.

Pros

- Graphite is …
    - …a naturally occurring material.
    - …not toxic and has no products of biodegradation.
    - …naturally lubricious.
- It is unique in that it has properties of both a *metal* and a *non-metal*.
- It can be used in both *static* and *dynamic* sealing applications.
- It is widely used in the following market sectors:
    - Nuclear
    - Chemical
    - Petrochemical
    - Automotive
    - Pulp & Paper
- Flexible graphite is so malleable that it will conform to irregularities.



Flexible Graphite Atomic Structure

john crane
a smiths company

Question #1

Should graphite be used as an alternative to PFAS in the Hydrogen sector?

Due to the harsh environment in combination with the sensitivity of the fuel cell for contamination, very stable sealing materials are needed.

- Fluorine-free-elastomers (i.e., graphite) are under evaluation but contamination of the fuel cell – limiting its lifetime – as well as oxidative deterioration of the material itself are issues.
- Fluorine-free-elastomers suffer from dimensional stability and require mechanical reinforcement.
- When adding a metal sheet to strengthen Graphene and/or Flexible Graphite…
  - ✓ Chemical resistance is sacrificed.
  - ✓ Cost is increased significantly.

Conclusion: Further R+D is needed, there is no guarantee of success at this stage, and thus it is impossible to predict when/if these potential alternatives will be ready for deployment. Therefore, I would recommend regulators to take a very cautious approach in restricting PFAS uses for this key\sector of the EU economy.

john crane
a smiths company

Question #2

On top of the challenge of finding suitable PFAS alternatives, are there other operational complications, specific to the sealings industry, that regulators should take into account while considering restrictions/temporary derogations?

- **Repairs under Warranty:** Need to be able to replace existing PFAS-containing components with PFAS-containing materials until the end of life (EOL) for the seal. Otherwise, there is liable to be prolonged downtime while a new seal is designed and manufactured. That comes at an xpensive to both the customer and the manufacturer.

- **Inventory:** Time allotted for stock depletion needs to be tied to the product's EOL (End of Life).

Type of Mechanical Seal	Expected Lifespan Range
Single Spring	1 – 2 years
Cartridge	2 – 4 years
Bellows	3 – 5 years

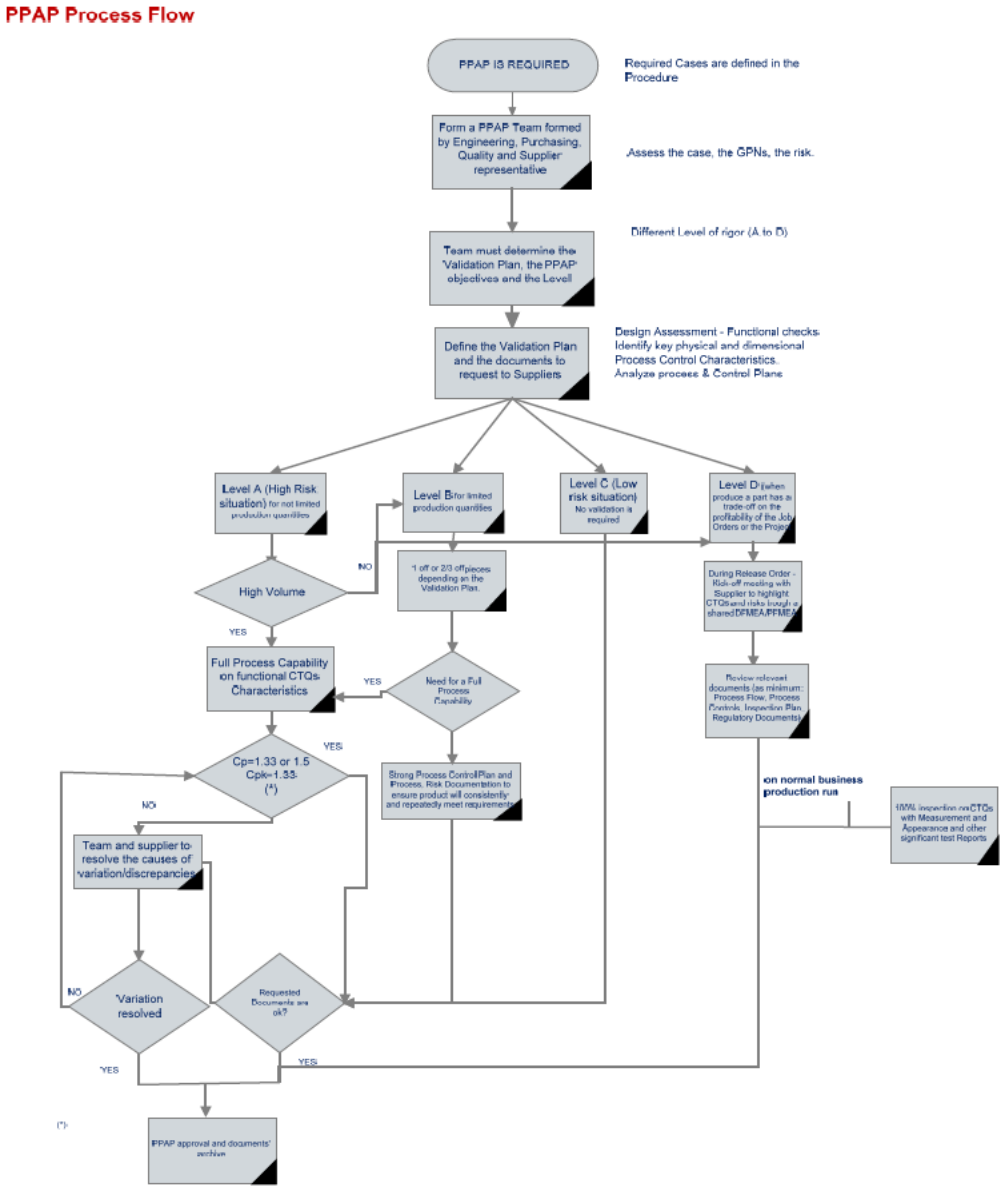
- **Manufactured Products that Span Multiple Market Sectors:** A Seal Support System complements the functionality of a mechanical seal. A well-maintained seal support system contributes to…
  - *Leak Prevention* by providing the necessary lubrication and cooling to the mechanical seal.
  - *Extending the lifespan* of mechanical seals, thereby reducing the frequency of replacements and associated downtime.
  - *Cooling* by dissipating the heat generated during the sealing process, preventing overheating, and maintaining the integrity of the seal.
  - *Pressure Control* in that the seal pot helps maintain the pressure differential across the mechanical seal, crucial for preventing leaks and ensuring proper sealing.
  - *Fluid Containment* in that it captures any leaked or excess fluid.

These systems require electronic components as well as semiconductors. Regardless of the market sector that the seal and sealing support system will be used in, there needs to be one derogation - as opposed to discrete market sector waivers - for all the products manufactured by the mechanical sealing industry. At this stage, the overlap/interdependency between sectors does not seem to be taken into account in the EU PFAS restriction proposal, which is very concerning for the sealing industry.

Question #2 Continued

On top of the challenge of finding suitable PFAS alternatives, are there other operational complications, specific to the sealings industry, that regulators should take into account while considering restrictions/temporary derogations?

- **Customer PPAP (Production Part Approval Process):** Regulators need to take into consideration the fact that manufacturers can't just change a material and expect that a customer will accept the change. The length of time to complete the PPAP process will depend on the risk rating associated with the material change and the level of validation required. For General Industry, that could take 1 year to complete. For Aerospace, the PPAP process could take 10 years to complete. The derogation should therefore not only look at the (estimated) time needed for R&D but also consider the implementation phase/approval process prior to deployment of new alternatives. As enablers of critical applications, seals should be granted a long exemption to ensure their deployment can happen properly, without halting key activities (e.g., in aerospace).



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Questions & Answers

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