Pneurop PN02 - Compressors

PN02 position paper on the proposed REACH restriction of PFAS

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1. Introduction

Pneurop is the European association of manufacturers of compressors, vacuum pumps, pneumatic tools and related equipment. Pneurop members are national associations, representing more than 200 manufacturers in 7 EU Member States, the United Kingdom and Turkey. The European market turnover of the represented company exceeds 20 billion euros.

Pneurop agrees that PFAS should only be used where strictly necessary and fully supports the restriction of PFAS into the environment. However, as there are no alternatives available today and in the foreseeable future for critical applications, the use of those PFAS containing applications should remain possible in a controlled way (collection, recycling, appropriate disposal).

We must avoid regrettable substitutions for our customers in the medical, food and beverage, energy and many other sectors.

Even though the amount of PFAS in our products is very small (<< 0,1% by weight), there are PFAS containing parts in all of them. The impact of a ban in Europe will imply a closure of the European factories of our members with 100% loss of employment (>>10.000 people) and revenues (>20b€).

Pneurop is submitting four papers to elaborate in more detail the use, value, and challenges of our major product types.

In this paper we describe the impact of the planned restriction of PFAS on the European compressor industry.

2. Executive summary

Compressors are indispensable for many applications in daily life, such as

- The majority of typical industrial manufacturing / assembly processes,
- Treatment of drinking water and waste water,
- Production and packaging of food and beverages,
- Production of technical and medical gases,
- Production processes in the chemical and pharmaceutical industries,
- Maintenance of mobility by air, land and sea
- and many others.

PFAS materials are used in air compressors due to their exceptional characteristics. The range of applications includes lubricants, filters, seals, bearings, cable sheathing, sliding coatings and diaphragms. Since PFAS materials, which are much more expensive than standard materials, are only used in cases where no alternative is available, Pneurop rejects the total restriction of PFAS. Many important applications or areas of use cannot be realized without PFAS materials.
Substitution by other (less or not at all suitable) materials would lead to increased wear, rapid failures or increased maintenance efforts, and would harm the environment and economy far more than a responsible use of them.

Pneurop PN02 therefore supports

- Restriction of the use of PFAS in consumer products and the elimination of the release of PFAS into the environment. But the use of PFAS-containing materials should remain possible for those applications for which no alternatives are available in the present and foreseeable future.

- In our view, labeling PFAS-containing products for collection, effective recycling, and disposal are the much better way towards a safe and sustainable future.
- Regulations that prevent PFAS from entering the environment or affecting human and animal health. However, a blanket ban on PFASs carries the risk of increasing pollution through potential emissions, increased energy and resources demand, as well as leading to a reduction in the durability and safety of technical equipment. In our view, these regulations should be proportionate and reflect a risk-based approach rather than a hazard-based approach.
- In order to make the use of PFAS materials and their quantities in corresponding products transparent, we support approaches that aim for information requirements on the presence and quantities of the substances of concern. In other global markets, for example in the USA, PFAS materials are first made declarable throughout the value chain before they are restricted. In this way, the industry has some time to prepare for a possible ban, as it knows exactly which components and processes are affected.

3. Importance of air compressors for industry and society

Compressed air is of fundamental importance in many areas of industry and society. From the extraction of raw materials to the production and packaging of products, compressed air is used. Compressed air is widely used in both industry and the trades. Industrial applications range from water treatment to food processing, chemical industry, oil and gas industry, mining, paper mills, manufacturing of consumer goods, waste disposal and many more. Furthermore, compressed air plays a fundamental role in healthcare and pharmaceuticals. Other applications to support the green transition (use in wind turbines, generation of nitrogen for inerting hydrogen plants) are being worked on at the moment.

PFAS-containing materials' unsurpassed chemical resistance, temperature resistance, unique tribological properties and the combination of these characteristics make them irreplaceable for use in air compressors.No alternative material currently available guarantees comparable performance, safety and service life.
Due to the combination of high temperature stability, resistance against aggressive chemical substances, and low coefficient of friction, PFAS is essential in most compressed air applications and is utilised to ensure the safety and integrity of the equipment, to ensure adequate service life and performance, and to generate or use compressed air efficiently.

Of particular note is the fact that the compression of gases to industry standard pressures inevitably causes high temperatures that cannot be avoided. In many cases, PFAS-containing material is the only option to withstand such hot gases and redesigning with other materials is not even possible.

The lack of PFAS-free alternatives is also a big issue for other key applications and is not limited to air compressors. It also applies to other equipment such as valves, pumps and downstream industries such as pharmaceutical, chemical, petrochemical and aerospace.
In addition, electronic components are also critical for air compressors. Some electronic products require the use of PFAS materials to ensure functional safety. Air compressors cannot function without these electronics.

PFAS materials used in compressors are very expensive because of their high performing characteristics, therefore they are generally only used when absolutely necessary for either safety or performance reasons.

4. Essential functionalities in air compressors

- Oils and lubricants

  Oils containing PFAS are used to seal the gaps of the components that generate positive/negative pressure. Without this gap sealing of the rotating components, the generation of compressed air is much more complex. Furthermore, oils are used as coolants.

  Lubricants containing PFAS are used to lubricate the bearings compressor elements and electric motors, the compressor stages, gearboxes, the crankshafts of the connecting rods.

- Seals / Gaskets

  Materials containing PFAS are used for mechanical seals, O-rings, flat and face seals. Due to their higher cost compared to other natural or synthetic elastomers, the use of PFAS materials is limited to absolutely necessary applications and when no other suitable elastomer replacement is available. The main advantage of PFAS elastomers their excellent chemical resistance to many highly aggressive fluids. Furthermore they retain their elasticity and sealing properties even at very high temperatures.

- Plain bearings/sliding bushes

  Most PFAS-based bearings are made of PTFE and are used in applications where standard metal bearings cannot be used due to high coefficients of friction and poor temperature resistance. Unlike other fluoropolymers, PTFE does not melt, has an exceptionally low coefficient of friction, high self-lubricating properties and can be used over a wide temperature range. These properties make PTFE an ideal material for applications involving dry lubrication, aggressive chemicals and high temperatures. Without a dry lubrication capability, the generation of breathing air, for example, can only be realized with a much higher energy input.

- Cables / electrical wires

  Cables used in compressor packages are often provided with special flame retardants for safety reasons and maintain their flexibility even under difficult operating conditions. Substitution of the PFAS materials would be feasible, but only in conjunction with further disadvantages that would negatively influence safety in use and result in a shortened service life of the machines.

- Coatings

  Many components of a compressor package (compressor elements, vessels, fasteners, air treatment equipment etc.) require sophisticated coating for high temperature resistance, corrosion protection or advanced sliding properties. As an example, compressors require a variety of fasteners with defined mechanical strength and corrosion resistance to ensure tightness and safe operation. Typically, high-strength fasteners are protected from corrosion by cathodic protection. However, for applications in seawater and other aggressive environments, this level of protection is often insufficient. To overcome these problems, the application of a PFAS-based (xylan) coating to high-

strength carbon steel fasteners is necessary. This provides very good corrosion protection, and is superior to stainless steel even in environments such as hot soil or aggressive chemicals.

The ban on PFAS-based fastener coatings would lead to a shortened service life of fasteners and, in certain cases, to technical limitations. In addition, costs would increase as they would have to be replaced by high-alloy nickel-containing materials, the production of which requires a lot of energy and resources.

- Integrated refrigerant dryers

In many applications a small footprint of a compressor installation is an important factor due to limited space at the users side. To serve this need full featured packages are often used, where an air treatment, typically a refrigerant dryer, is integrated into the housing of the compressor package. As with the ban of PFAS Material the total concept of refrigerated compressed air dryers would be disrupted, no such integration would be possible any more. Refrigerant dryers with other gases than PFAS containing ones, would be not suitable any longer due to intolerable safety issues. (see also Pneurop PN 14 position paper).

5. Conclusions

- Even if there are substitutes for certain applications, they will often require a different mechanical design. This can make spare parts obsolete for products already entered the market before the ban. A simple replacement is then not possible and in the worst case even the entire product has to be replaced. This is in sharp contrast to the EU's objectives within the framework of the ESPR (Ecodesign for Sustainable Products Regulation), whose core elements include the reparability and sustainability of products.
- A general ban of PFAS would cause a loss of global competitiveness of European companies that use compressed air, as there would either no longer be any compressed air solutions at all for many sectors or the remaining compressor technologies would cause significantly higher life cycle costs or have a much shorter service life.
- For the EU compressor manufacturers it will be not possible to stay attractive outside of the European market, where PFAS containing products / components are not being banned.
- Pneurop PN02, which represents European compressor manufacturers, supports regulations designed to prevent hazardous PFAS from entering the environment. However, in some applications, the use of PFASs remains essential for safety, efficiency and functional reasons. Since there are currently no viable substitutes for these applications, the use of PFASs for these described applications should be allowed to continue so that pollution of the environment by other more hazardous substances can be prevented. The first step should be to make PFAS declarable throughout the value chain.

On behalf of PN02 (Compressors)
Tim Preece (Secretary)
Peter Boldt (Chair)

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Appendix 1

List of identified uses – Analysis of alternatives

Application	Use	Property	PFAS	Alternative Material	Recognized disadvantage
Oil injected rotary compressors	oil as a lubricant	gap sealing between revolving parts oft he air end	….	Mineralic oil without PFAS containing additives	The lifetime of the lubricant is much shorter, higher maintenance necessary
	oil as a coolant	Cool down the air ends	….	Water	Water in combination with metal parts don't match, other, more expensiv materials for the air ends must be chosen
Oil free rotary compressors	sliding coating	Sliding properties, temperature resistance, corrosion resistance	PTFE	n/a	n/a
all kind of air compressors	gaskets & sealings *	good oil and temperatur resistance	PTFE, FKM, FFKM, FPE, PFPE	natuaral rubber	leaks appear within a short usingtime
	sliding bushes	very good dry lubricationg	PTFE	lead or brass	Brass normally contains lead and the use of lead in electrical devices is strictly reglemented
	electrical wires	flame retardent and high flexibitlity	….	PVC or rubber	high risk of self ignition and broken insulation
piping and connections	anti corrosion coating	high resistance against aggressive atmosphere	PFAS based coating	cathodic protection	corroded or porous material within a short usingtime
Integrated refrigerant dryers	Fluorinated refrigerant as a safe refrigerant *	non flamable, non explosive, non toxic	PFAS	natural refigerant like propane or butane	flamable or explosive
				CO_2	as it is a high pressure refrigerant, the components must handle up to 75bar. Its best energy efficiency is under 15°C condensing temperature, so it is not suitable for an integrated dryer.
				Ammonia	As is has a hughe enthalphy, it is not suitable für smaller dryers. It is also dangerous for humans, special machineroom regulations are existing.
	gaskets & sealings	good oil and temperatur resistance	PTFE (Teflon)	natuaral rubber	leaks appear within a short usingtime
	sliding bushes	very good dry lubricationg and oil resitant	PTFE	lead or brass	Brass normally contains lead and the use of lead in electrical devices is strictly reglemented
oil free piston compressor	sliding coating of piston	piston & cylinder are protected against wear by a good sliding property	PTFE	…	piston & cylinder are worn in a very shorft lifetime
	gease of piston bolt *	high Resistance against high temperatures	PTFE	conventional grease	worn out bearing seat within a short using time
	piston compression ring	good sliding properties at high temperature and pressure, very good wear resistance, high resistance against high	PTFE	…	lack of sealing of the compression process in a very short time

		temperatures, good mechanical properties			
belt driven machines	top coating of v-belts	good abrasion resistance	PTFE, PVDF	natural or synthetic rubber	high abrasion, lifetime quatered
safety valves	sealing	high Resistance against high temperatures and pollution	FKM	copper or brass	if pollutions present, the risk of a leak is very high
to be continued	…	…	…	…	…

* see also appendix 2 for further information

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Appendix 2

Qualification, quantification

Example of grease in piston pin

Functional explanation: The piston pin transmits the force from the connecting rod to the piston and must allow a tilting movement of the piston. The piston pin is therefore subjected to oscillating motion and is subjected to very high temperatures as a result of the compression work.

Risk: If the grease fails, the connecting rod-piston connection can no longer absorb the oscillating movement. This results in increased wear of the cylinder and of the piston, up to and including a defect due to a jammed piston.

Qualification

	compressor type	techn failure by	runtime to failure
manufacturer. A (no PTFE)	oilfree piston compressor	loss of lubricity	230h
manufacturer. B (no PTFE)	oilfree piston compressor	Not temperature resistant	40h
manufacturer. C (with PTFE)	oilfree piston compressor	No failure appears	Until reg. maintenance

Quantification

	reached runtime	required runtime	additional efforts
manufacturer. A (no PTFE)	230h	3.000h	13 times higher
manufacturer. B (no PTFE)	40h	3.000h	75 times higher
manufacturer. C (with PTFE)	3.000h	3.000h	none

Conclusion: When PTFE-free greases are used, the maintenance effort of the investigated compressor is so high that this unit cannot be used economically. Only when using the PTFE-containing grease was the requiered operating time up to standard maintenance achieved.

Example of shaft sealing

Functional explanation: The purpose of a shaft seal is to seal a rotating shaft so that a) there is no oil leakage and B) there is no ingress of pollution.

Risk: Due to a laking shaft seal, oil leaks from the compressor and can get via the pulley onto the V-belts. The V-belts would then slip and there is a risk of catching fire. In addition, oil can be released into the environment in an uncontrolled manner.

Qualification

	compressor type	testing pressure stage	runtime to failure
manufacturer. A (no PTFE)	screw compressor	10 bar	1h
manufacturer. B (no PTFE)	screw compressor	10 bar	0,25h
manufacturer. C (with PTFE)	screw compressor	10 bar	without failure

Quantification

	reached runtime	estimated usingtime	additional efforts
manufacturer. A (no PTFE)	1h	for years	much higher, not usable
manufacturer. B (no PTFE)	0,25h	for years	much higher, not usable
manufacturer. C (with PTFE)	without failure	for years	in scope, so usable

Conclusion: When PTFE-free shaft sealings are used, the maintenance effort of the investigated compressor is so high that this unit cannot be used economically. Only when using the PTFE-containing shaft sealings was the expected operating time will be reached.

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Example of fluorinated refrigerant in integrated dryers

Functional explanation: The integrated dryer should dehumidify the compressed air. It is placed inside the housing of the compressor and is therefore subject to the same regulations for a safe machine as the compressor. The possible risks caused by the machine must be kept as low as possible

Risk: If the dryer fails, there is a possible risk of a leaking refrigerant circuit. The refrigerant discharges immediately and disperses inside the machine.

Qualification

	dryer type	techn failure by	possible risk
common safety refrigerant	integrated refrigerant dryer	leaking refrigerant	none
Propane	integrated refrigerant dryer	leaking refrigerant	creating a flammable or explosive atmosphere
Butane	integrated refrigerant dryer	leaking refrigerant	creating a flammable or explosive atmosphere
Ammonia	…	…	…
CO_2	:::	:::	:::

Quantification

	evaluation of risk level	required safety devices	result
common safety refrigerant	low	none	refrigersnt usable
Propane	high	leakage sensor with emergency shutdown, explosion protection of the control cabinet	refrigerant not usable
Butane	high	leakage sensor with emergency shutdown, explosion protection of the control cabinet	refrigerant not usable
Ammonia	…	…	…
CO_2	…	…	…

Conclusion: If PFAS-free refrigerants are used, the compressors must be classified as high-risk machines. The wide field of use will therefore be severely restricted, and compressed air would no longer be so readily available everywhere. Manufacturing and operating costs will increase.