ECHA
EUROPEAN CHEMICALS AGENCY

Catalogue of borderline cases between articles and substances/mixtures

November 2023

Disclaimer

The catalogue of borderline cases of substances in articles is a compilation of cases agreed by the members of the Working group on borderline cases of substance in articles (BWG), consisting of representatives of the HelpNet, the Forum and the ECHA Secretariat.

The aim of the catalogue is to help authorities and duty-holders to reach conclusions on the assessment of borderline cases of substances in articles. However, users are reminded that the text of the REACH Regulation **is the only authentic legal reference** and that the information in this document does not constitute legal advice. Usage of the information remains under the sole responsibility of the user. The European Chemicals Agency does not accept any liability with regard to the use that may be made of the information contained in this document.

The catalogue should be regarded as a 'living' document. It is not exhaustive and further cases and assessments will be added over time, as they are agreed upon by the BWG members.

Version	Changes	Date
Version 1	First edition	March 2023
Version 2	Introduction of new cases: · Leca nuts – link to overview · Silver catalyst – link to overview · Metal soap made of stainless steel – link to overview · Insulated wire – link to overview · Cable with insulated wires – link to overview This example also also shows a proposal to calculate the concentration of a Candidate List substance in the electrical cable – link to detailed assessment · Match and safety match – link to overview · Sparkler – link to overview · Pocket lighter – link to overview · Cavity sealing systems – link to overview · Fire protection putty – link to overview	November 2023

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1. Introduction

The Borderline Working Group was established in March 2021 under the HelpNet Steering Group with representatives of the REACH national helpdesks, Enforcement Forum members and ECHA. Its objectives are to:

- discuss difficult questions received by national helpdesks and ECHA on borderline cases between substances/mixtures and articles; and
- create a catalogue of detailed borderline substances/mixtures versus articles case assessments.

This document aims to assist users to determine whether an object fulfils the REACH article definition (REACH Article 3(3)) and only expresses the views of the authors.

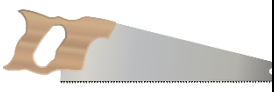
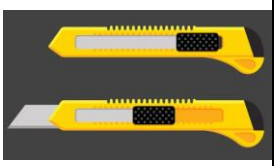
The assessments are carried out on a case-by-case basis and follow the guidelines of Chapter 2 of the *Guidance on requirements for substances in articles* (available from the ECHA Guidance on REACH page).

The detailed assessments and conclusions only apply to the identified and described objects. It does not necessarily mean that the assessment of similar objects would lead to the same conclusions. The description aims to clarify the particular object being assessed.

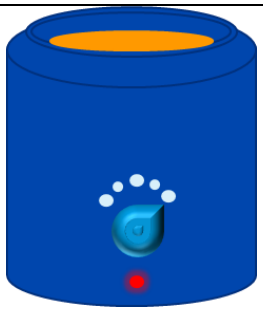
The objective of the catalogue is not only to document specific cases but also to find common elements among them. This allows for an evaluation of the potential for applying similar reasoning to other comparable cases. Suggestions for similar cases are provided as notes under the object name in the 'Object' column of the overview of agreed assessment of the borderline case between article and substance/mixture.

2. Overview of agreed borderline cases

Table 1: Overview of agreed borderline cases

Object	Picture	Description	Conclusion	Detailed assessment
Drill bit [Note: similar objects Chisel and scraper blades Saw blade Rasp blade Knife blade Retractable blade]	 Figure 1: Twist drill bit [Note: similar objects  Figure 2: Chisel blade  Figure 3: Saw blade  Figure 4: Rasp blade  Figure 5: Knife blade  Figure 6: Retractable blade	A twist drill bit is an item made from a sturdy material (usually metal) and shaped in a way that enables it to drill holes when rotating in objects made of different materials. It is a rotating cutting tool.	Article	Link

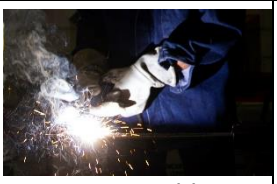
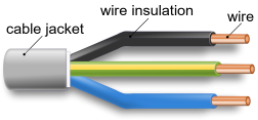
Water-soluble plastic foil bag (to enclose a content)	 Figure 7: Water soluble film pouch (to enclose a content)	A water-soluble plastic foil bag is used to enclose a liquid or a solid. When used, in contact with water, the water-soluble plastic foil bag dissolves and releases the contents.	Article	Link
Water soluble foil bag with content (e.g. water soluble tablets)	 Figure 8: Water soluble foil bag with solid and liquid content  Figure 9: Water soluble dishwashing tablets	The water-soluble plastic foil bag enclosing a liquid or a solid content dissolves when in contact with water and as a consequence breaks and releases its content. There are several types of such objects, the most common being water-soluble dishwashing tablets.	Combination of an article and a substance /mixture	Link
Wax of an electronic candle (flameless) for decoration	 Figure 10: Electronic candle	A decorative object. The (paraffin) wax hull is shaped in the form of a candle. It houses a lamp (and other electric components), which illuminates and works as a heating source, while the object is flameless. There is no combustion and no wax consumption. If the candle contains a fragrance infused into the paraffin wax, released as the wax warms up (the wax does	Article	Link

		not melt), the object is an article with 'a substance intended to be released'.		
Electronic wax "melter"* (flameless) [Note: similar objects Electric room freshener (diffuser) Electric insecticide (diffuser)	 Figure 11: Electronic wax melter  Figure 12: Electric diffuser	The electronic wax "melter" is an air freshener (diffuser) and often a decorative object. The wax "melter" houses an electronic heating source or melter, e.g. a lamp, and a compartment with paraffin wax infused with a fragrance. This type of electronic wax "melter" is used to melt wax containing a fragrance to release the fragrance for scenting purposes. The molten wax is removed and replaced by new wax after all fragrance has been released.	Combination of an complex object and a mixture	Link
Coated electronic wax candle	 Figure 13: Coated electronic wax candles	The wax is shaped in the form of a candle (see ' Wax of an electronic candle') and is coated. Furthermore, the object contains a lamp (and other electric components), which illuminates and works as a heating source, therefore, it is flameless. There is no combustion and no wax consumption.	Article (coated article)	Link
Coated conventional candle	 Figure 14: Burning candle	Moulded or dipped mass of wax or tallow containing a wick that may be burned. The wax or tallow is coated.	Combination of an article (wick) and a mixture (wax and coating)	Link

Permanent magnets	 Figure 15: Note on magnetic board	Permanent magnets are manufactured in different sizes and forms depending on their specific applications. The materials to be used to produce permanent magnets must either be materials with permanent magnetic fields or materials with a susceptibility to be magnetised by applying an external magnetic field.	Substance/ mixture	Link
Plastic or rubber granules (as infill material for sports pitches and playgrounds)	 Figure 16: Artificial turf surface	Plastic or rubber granules are used as soft infill materials to make sports pitches and playgrounds. The rubber granules are often made from end-of-life tyres (ELTs) that are broken up and ground into smaller pieces. The plastic granules result from shredded plastic objects.	Substance/ mixture	Link
LECA nuts	 Figure 17: Leca nuts	For LECA (lightweight expanded clay aggregate) production, clay is extracted and introduced to rotary kilns. These kilns are heated to temperatures 1100–1300 °C. As it is fired, the organic compounds in the clay burn off, forcing the pellets to expand and become honeycombed while the outside surface of each granule melts and is sintered. The resulting nuts are lightweight, porous and have a high crushing resistance.[1] LECA nuts have a rounded shape due to the movement in the kiln. They are produced in different sizes and densities. They are used in a variety of applications, namely in the manufacture of lightweight concrete, concrete blocks and slabs, geotechnical fillings,		Link

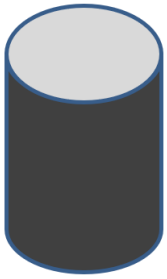
[1] References:
E.g. A. M. Rashad, Constr. Build. Mater. 170 (2018) 757-775;
E. Roces et al. Constr. Build. Mater. 313 (2021) 125486;
S. Schiavoni et al. Renew. Sustain. Energy Rev. 62 (2016) 988–1011;
B. B. Mathew et al. J. Toxicol. 2016 (2016) 4369604.

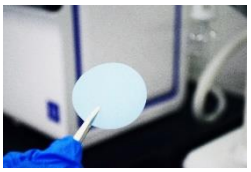
		insulation materials, and gardening.		
Silver / aluminium oxide catalyst		The silver/aluminium oxide (Ag/Al2O3) catalyst is manufactured by binding silver particles to a porous aluminium oxide pellets (support). The silver particles in the catalyst pellet are strongly bonded to the surfaces of the porous aluminium oxide support and cannot be separated from the support during intended use to release silver powder. The silver particles can be recovered and recycled from the catalyst after it is discharged at end of life from the reactor. The silver catalyst is specially manufactured to consist of a support (substrate) material (porous aluminium oxide pellets) with the silver particles on the external surface and internal porous surfaces, bound via chemical reactions and/or physicochemical interactions. The resulting silver/aluminium oxide (Ag/Al2O3) catalyst particle, characteristically, has numerous catalytic active sites on the whole available surface of the support material and a high surface to volume ratio due to the porosity of the carrier. The catalyst particle contains a relevant active substance/moiety distributed over all the accessible surface area, i.e. external surface and internal porous surfaces.	Substance / mixture	Link
Pyrotechnic inflator of an airbag system	 Figure 18: Car interior with used airbag system	In the event of a collision, the pyrotechnic material in the inflator is ignited and gases are produced or released which inflate the airbag. The airbag system is a complex object. Within the airbag system, there is the inflator that contains a pyrotechnic mixture, the propellant (chemical composition is highly important) that upon a trigger/ignition releases gases immediately.	Combination of articles and a mixture	Link

3D printing filament used as thermo-plastic raw material for 3D-printers	 Figure 19: 3D-printing filaments	Thermoplastic is the raw material for fused deposition modelling 3D-printers. There are many types of filaments available, with different properties, requiring different temperatures for printing.	Substance/ mixture	Link
Soldering or welding metal wire	 Figure 20: Welding	Soldering and welding wires are metal alloys manufactured with the profile of a wire. They are used for welding or soldering, i.e. to join two or more items.	Mixture (alloy)	Link
Electric insulated wire	 Figure 21: Insulated wire (insulation applied by extrusion of melted insulating material)	The insulated wire is produced by "applying" a melted insulated material (mixture) to the metal wire, e.g. through extrusion over the metal core wire (no shrink-on tube).	Article with an insulating substance/mix ture	Link
Electrical cable with insulated wires	 Figure 22: Insulated wires coated with a cable jacket that was incorporated by extrusion  Figure 23: Electric guide (electric wire) 3×2.5 mm (diameter)	The melted material is extruded onto the insulated wires to make the protective jacket. The inner insulated wires act as an internal mould for the jacket. The cable is a complex object made of two or more insulated wires protected by a cable's jacket. The jacket layer may be peeled off by electrician to reveal inner wires.	Complex object made of two or more articles Note: the detailed assessment also shows a proposal to calculate the concentration of a Candidate List substance in the electrical cable.	Link
Glow stick	 Figure 24: Glow stick	A glow stick consists of a closed glass tube in a plastic container. The glass tube contains a liquid and is surrounded by another liquid in the plastic container. When the inner glass tube is cracked, both liquids react producing chemiluminescence (light).	Combination of articles (containers) and mixtures	Link

Match and safety match	 Figure 25: Match	A match is made of a small wooden stick or stiff paper, coated at one end with a flammable or oxidising substance or mixture that can be ignited. The ignition takes place by applying friction, i.e. when scratching or stricking the flammable solid against a suitable surface.	Combination of a carrier and a substance/ mixture	Link
Sparkler	 Figure 26: Sparkler	A sparkler consists in a thin metallic wire covered with a solid layer which, after being ignited, undergoes exothermic chemical reactions that produce light on the surface and by emiting bright colored sparks. Often, they also produce other effects (e.g. smoke and sound). Sparklers are generally made around a thin non-combustible metallic wire that has been dipped into a mixture and allowed to dry. The solid layer around the metal wire commonly contains[2]: - an oxidiser, - a metallic component (to make sparks), - a combustible binder, - a fuel component, - and regulators/colourants.	Combination of a carrier (article) and a solid energetic mixture	Link

[2] Reference examples:
M. Scheid et al. Chem. Teacher Int. (2021) 3, 285–294;
M. Remškar et al. Air Qual. Atmos. Health (2015) 8, 205–211
https://www.chemie.de/infografiken/179/the-chemistry-of-sparklers.html
https://www.mcgill.ca/oss/article/technology-you-asked-general-science/how-do-sparklers-work

Pocket lighter	 Figure 27: Pocket lighter	A pocket lighter is a portable device which generates and sustains a flame. It consists of a container (e.g. plastic or metal) filled with a flammable liquid or compressed gas (fuel). It usually incorporates a means to ignite the fuel, a means for extinguishing the flame, and a controlled release set-up for the fuel.	Combination of articles (container and controlled release set-up) and a substance/mixture (fuel)	Link
Heat source for tobacco products, based on a chemical reaction	 Figure 28: Heat source for tobacco products based on a chemical reaction	The heat source is made of a powder mixture of charcoal, calcium peroxide and, to a small extent, binders. The powder is formed into a cylinder from moist agglomerates. The cylinders are given a specific shape that is precisely matched to the end-product. A metal foil is attached to this object on one of the flat sides, which ensures that the heat-generating part of the product is shielded from the tobacco in the end-product and thus prevents the generated heat from burning the tobacco instead of just heating it.	Combination of an article (foil) and a mixture (charcoal and additives)	Link
Standard gold bar *(or gold bullion or gold ingot)*	 Figure 29: Gold bar	A gold bar (also called gold bullion or gold ingot) is a piece, usually a bar, of refined metallic gold (Au). A standard gold bar of specific gold purity and weight is held by central banks as gold reserves and held by private citizens and companies for investment.	Substance	Link

Perforated disk metal coffee filter (nonwoven) [Note: similar object funnel/cone-shaped metal coffee filter]	 Figure 30: Perforated disk metal coffee filter  Figure 31: Funnel metal coffee filter	Perforated reusable metal coffee filters are available, and are often used in certain coffee machines and other coffee maker devices. A non-woven metal perforated filter can be produced by perforating and cutting a suitable thin metal sheet, or by using other fabrication techniques. Despite the common name being coffee "filter", it works as a sieve – straining solids from a fluid in a single screen layer or barrier. This example does not cover filters made from cloths or meshes of metal wires or filaments.	Article	Link
Porous transversal (micro) filtration membrane	 Figure 32: Transversal filtration membrane  Figure 33: Transversal microfiltration membrane within a microfiltration device	A porous transversal (micro)filtration membrane is used for filtration – the separation of matter from other matter (e.g. in solutions, emulsions, and suspensions) through a multilayer lattice of an interposing medium. Porous transversal (micro)filtration membranes have a large number of applications, where the feed flows transversally through the membrane (from upper surface to lower surface of the multilayer lattice of the membrane). There are different types of porous membranes, made of different base polymers: e.g. cellulose, polyamides, polyols, polyphenols, polyvinylidene fluoride (PVDF), poly(tetrafluoroethylene) (PTFE), polypropylene (PP), and polyethylene (PE). There are also different fabrication processes. The pore structure, cross-section morphology, and thickness of the fabricated membrane is dependent on several factors, for instance the selection of polymer, polymer concentration in the	Substance/ mixture	Link

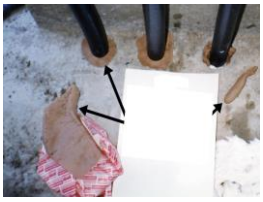
		casting solution, viscosity of the casting solution, solvent, non-solvent, additives (including pore formers), temperature, and fabrication process.		
Perforated paper coffee filter	 Figure 34: Paper coffee filter	A perforated paper coffee filter is used for brewing coffee. It usually has a single use, after which it is disposed. The paper used has a specific morphology (microstructure) and is perforated with needles. Paper coffee filters are made from crepe paper (crinkled), where pulp with coarse long fibres is usually used. The paper is treated to increase surface area and to provide a crinkly crepe-like texture. It can be bleached or unbleached. Paper coffee filters are available in different shapes, to fit on different coffee making devices or set-ups, thicknesses, and pore sizes.	Article* **Note: This conclusion is achieved if the main function is sieving and not filtration. For more information, consult the detailed assessment.*	Link
Metal soap made of stainless steel	 Figure 35. Metal soap made of stainless steel	Stainless steel soap is an object made of stainless steel resembling a soap bar or in a convenient hand-held shape. Its assumed purpose is to remove or reduce strong odours.	Mixture (alloy)	Link
Cavity sealing system	 Figure 36: Cavity sealing system	Expanded material incorporated in openings, cracks and joints to seal e.g. in a building or in a car body, often applied with an extruder. The sealing systems are used to prevent noise and/or water and moisture from entering into a closed space.	Mixture	Link
Fire protection putty		A fire protection putty is a highly viscous and flexible material with high plasticity, i.e., it can undergo continuous deformation and be reworked indefinitely.	Mixture	Link

	Figure 37: Fire protection putty	The putties are used for sealing in buildings walls and floors, as well as around pipes and cables. The material is moldable to the size and shape of the opening, but does not have a special shape, surface or design in itself. The putty intumescent material reacts and swells in the presence of intense heat or fire, and therefore closing openings and joints.		

3. Table of detailed assessment of agreed borderline cases

Table 2: Detailed assessment of agreed borderline cases

Object	Step 1: Identify the function of the object (Function: the purpose for which an object is to be used)	Step 2: Are shape/surface/design more relevant for the function of the object than the chemical composition? Yes: considered an article No: considered a substance/mixture or a combination of a substance/mixture and article(s)	Step 3 **Object contains substance/ mixture than can be separated from the object?** Yes: ➔ Step 4 No: ➔ Step 6	Step 4 **Q4a-c** Mostly yes: substance/ mixture and article Mostly no: ➔ Step 5	Step 5 **Q5a-c** Mostly yes: article Mostly no: substance/ mixture and article	Step 6 **Q6a-d** Mostly yes: article Mostly no: substance/ mixture	Conclusion
Drill bit **Note:** Based on this assessment, the same conclusion is reached for other similar objects such as: 1a. Chisel and scraper blades 1b. Saw blade 1c. Rasp blade	The function is: **Cutting and removing material (to make a hole)**	Yes. The surface and the shape are crucial, e.g. cutting edge and spiral indentation. They are more important for the function (cutting and removing material) than the chemical composition. The chemistry of the material (the drill bit is made of) is important to provide the necessary performance and durability properties, such as hardness and wear resistance during use. However, it does not determine its function because the properties of the material are related to performance, durability and quality of the result. They do not determine the result in itself.	n.a.	n.a.	n.a.	n.a.	Article

1d. Knife blade 1e. Retractable blade							
Water-soluble plastic foil bag (to enclose a content)	The function is: **Containment and delivery (during use) of the content (e.g. detergent)** The containment is done by enclosing, holding, preventing releases of the content, while protecting that content (e.g. detergent) and preventing its direct contact with the skin. It also facilitates handling and transportation of the content. It delivers the content during use by dissolving itself in water.	Yes. The shape, surface and design are more important for the function than the chemical composition as explained generically in subchapter 2.5 of the '*Guidance on requirements for substances in articles'*. The water-soluble plastic foil bag, which works as packaging for the content, is considered an article under REACH in its own right (see *Example 18: Polymer processing* in Appendix 4 of the '*Guidance on requirements for substances in articles'*). Its solubilisation into water allows the delivery of the content and determines its end of service life.	n.a.	n.a.	n.a.	n.a.	Article
Water soluble foil bag with content (e.g. water soluble tablet)	The functions of the ***object as a whole*** (e.g. water soluble tablets) are: **Deliver or release the content**.		n.a	n.a	n.a.	n.a.	Combination of an article (the bag) and a substance/ mixture (the content)
Wax of an electronic candle **(flameless)**	The functions of the wax hull are: - **Decoration;** - **Lamp holder;** - **Housing for electric components** - **Accessory –**	Yes. The shape and design of the wax hull are more important for the functions than the chemical composition of the wax mixture. In those cases where there is a scenting function, such function is an accessory function as defined in subchapter 4.1 of	n.a.	n.a.	n.a.	n.a.	Article with intended release of a substance or substances according to REACH Article 7(1).

	release of a fragrance (scenting)	the '*Guidance on requirements for substances in articles'*. The release of the fragrance substance or substances from the wax hull, which does not melt, is boosted by the heat released by the lamp. The release of a substance or substances is intended, because a fragrance is infused into the wax the hull is made of, and occurs under normal or reasonably foreseeable conditions of use as explained in the above mentioned subchapter of the '*Guidance on requirements for substances in articles'*. Therefore, the wax hull of an electronic candle as described in this example is considered an article with intended release of a substance or substances (fragrance) according to REACH Article 7(1).					
Electronic wax "melter" (flameless) [Note: similar objects Electric room freshener (diffuser) Electric insecticide diffuser]	The functions are **scenting** and **decoration**.	The wax and its container or base is somewhat relevant for the decoration function, but it is key for the scenting function, i.e. the scenting function is the most important concerning the wax (chemical composition of interest). Scenting and decoration are both main functions. However, the scenting function is directly related with the wax composition – the chemical composition of interest, which is consumed upon use, preventing the scenting function. The decoration function is directly related with other components of the "melter". Therefore, the wax holder acts as a container for the wax for release or controlled delivery of the fragrance into the air. Therefore, the wax holder in an electronic wax "melter" (flameless) for scenting (air freshener), is regarded as a combination	n.a.	n.a.	n.a.	n.a.	Combination of an article (container) and a mixture (wax)

		of an article (container) and a mixture (wax with fragrance).					
Coated electronic wax candle	The main function is decoration.	Yes. The wax is shaped in the form of the candle and the coating is completely incorporated in the shaped article (see 'Wax of an electronic candle'). It is a coated article (see scenarios III-A) and III-B) in table 5 of the '*Guidance on requirements for substances in articles'*).	na	Na	na	na	Article
Coated conventional candle	The candle is lit to sustain a flame. The wick does not sustain the flame, it carries the molten wax to the centre of the flame, the burning of the wick is a secondary effect.	No. A conventional wax candle is a combination of an article and a substance/mixture. Therefore, a coated wax candle is a combination of an article and a mixture. In this case, the article is the wick. (The coating and the wax are either: - 2 different mixtures, - 2 substances, or - one substance and one mixture).	n.a	n.a.	n.a.	n.a	Combination of an article (wick) and a mixture (wax and coating)
Permanent magnets	The function is: attract or repel other magnetic objects	No. Permanent magnets are used due to their magnetic properties, e. g. in cupboards to keep a door closed. They attract or repel magnetic objects through a magnetic force. According to the *'Guidance on requirement for substances in articles'* Chapter 2.2: the magnetic properties of the permanent magnet are strongly related to its chemical composition and determine its function. Therefore, a permanent magnet is regarded as a substance or mixture. (See Q&A 1292 on ECHA's website)	n.a	n.a	n.a	n.a	Substance/ mixture
Plastic or rubber granules (as infill material for sports pitches	The function is: **A raw material or ingredient (filler)** [to make (synthetic)	No. Granulates are solid particles produced in different sizes, i.e. they do not have special shapes or surfaces. They can be made from rubber or other	n.a	n.a	n.a	n.a	Substance/ mixture

and playgrounds)	pitches and playgrounds]**.**	vulcanised or polymeric material of recycled or virgin origin, or obtained from a natural source. For its function, the chemical composition of the granulate is more important for the function than the shape/surface/design. As an infill material in pitches and playgrounds, it cushions the ground (shock absorption and traction) which are directly related to their softness, a physical property directly related with the chemical composition of the granules. Therefore, the plastic or rubber granules are regarded as a substance or mixture.					
Leca nuts	The function depends on the type of use: e.g. - Ingredient in a mixture - Filler - Insulator - Adsorbent - Substratum	No. The relevant characteristics for the identified functions are the following: - (Light)weight - Size - Sphericity, roundness and smoothness - Density - Porous sizes – porous surface area - Porosity - Water absorption rate - Shear resistance - Thermal conductivity coefficient - Thermal diffusivity - Sound absorption - Wettability (in particular for aqueous medium) - Chemical composition - Chemical nature of the internal surface of the prorous Most of these properties are directly related with the microstructure (porous sizes and porosity) and the physical and chemical characteristics of the material they are made of, and to a much lower extent with size and surface – outermost layer - smoothness. Therefore, the shape, surface or design are not determinant for the identified functions of the LECA nuts. It is important to stress that the concept	n.a	n.a	n.a	n.a	Substance/ mixture

		of shape refers to the three-dimensional form of an object outlined by the surface. The concepts of size and shape only overlap for perfect regular three-dimensional geometrical shapes, where the variation in each geometrical variable (e.g. length, width, depth, radius, semi-axes) among the units of an ensemble is very small. The LECA nuts within an ensemble show significant variations in size, as well as irregular shapes and surfaces. Following the workflow in section 2.3 of the '*Guidance on requirements for substances in articles*', the Step 2 question can be answered with 'no' (based on sections 2.1 and 2.2), i.e., the relevant characteristics of a LECA nut for its function are more related with the chemical composition than with the shape, surface or design and therefore is regarded as substance or mixture under REACH.					
Silver/aluminium oxide catalyst	Catalyst	To be an article, the shape, surface or design of the object "must be deliberately determined and given during a production step. Manufactured solid materials are by definition obtained in specific shapes and surfaces (e.g. granules, crystals, flakes, powders, etc.). These shapes and surfaces may be inherent to the physical properties of the manufactured materials. They may also be solely determined by the chemical starting materials used and the manufacturing process conditions applied. In both these cases, the manufactured materials are most likely to be substances (as such or in mixtures), even though the shapes and surfaces may also be deliberately controlled for the main purpose of optimising the further processing and/or the handling of the	n.a	n.a	n.a	n.a	Substance / mixture

		solid materials" (section 2.2. of the SiA Guidance). Both the aluminium oxide and silver particles result from a chemical manufacturing process, where no special shape, surface or design is given to them: e.g., there are significant variabilities in their dimensions (dispersity in size and shape) and surface. Some heterogeneity can also be expected for the surface density and distribution of silver particles on and within the porous Al2O3 substrate. Therefore, the shape, surface or design of the the aluminium oxide and silver particles is not deliberately determined and given during manufacture and cannot be regarded as articles under REACH. The most important properties for the silver/aluminium oxide (Ag/Al2O3) catalyst pellet or particle are its activity, selectivity, stability and low corrosiveness. These are to a great degree chemical-dependent properties. The activity and selectivity are dependent of the chemical nature of the active sites (chemical affinity) of the silver particles, but also of other intrinsic characteristics such as: - Surface density and distribution of the silver particles on the porous substrate (at both external surface of the particle and internal porous surfaces); - Size of the silver and Al2O3 substrate particles; - Hydrophilicity/hydrophobicity; - Surface to volume ratio of the porous Al2O3 substrate; - Specific surface area of the porous Al2O3 substrate; - Morphological characteristics of the porous Al2O3 substrate, e.g. pore size distribution and pore shape, porosity, ratio between					

		accessible and inaccessible pores. Other process conditions also contribute to the activity and selectivity of the silver catalyst such as mass and heat transport during reaction, flow conditions in the reactor, temperature, pressure and potential use of promoters or inhibitors. The intrinsic properties of the silver catalyst particle listed above are not the shape or surface as defined in the subchapter 2.2 of the Guidance on requirements for substances in articles (SiA Guidance), which are not to be confused with other chemical, physicochemical and physical characteristics that result from the chemistry of the material(s) the silver catalyst is made of (see subchapter 2.2 of the SiA Guidance) Furthermore, the catalytic function is a typical chemical technical function (processing aid or regulator) according to Table R.12-13 and Table R.12-15 of the *Guidance on Information Requirements and Chemical Safety Assessment - Chapter R.12: Use description*. During use in the reactor, the catalyst particle may undergo cleavage and/or fragmentation, losing its initial shape and surface and still is able of performing its function, which also indicates that these properties are not the most important ones for the function. Thus, the catalysis is mostly dependent of the intrinsic properties listed above, i.e. properties that result from the chemistry of the material(s) that the silver catalyst particle is made of and not of the shape and surface. The chemical composition determines the function of the particle as a catalyst.					

		Conclusion: Both the aluminium oxide and silver particles are to be regarded as substance/mixture, as well as a silver/aluminium oxide (Ag/Al2O3) catalyst particle under REACH.					
Inflator of an airbag system	**Main function(s) of the inflator:** generation and release of gas(es) **Chemical composition in question:** pyrotechnic mixture (propellant)	No. The main function of the pyrotechnic inflator (generate and release gases) is mostly dependant of a chemical reaction (non-detonative self-sustaining combustion/explosion). The output of the reaction is almost coincidental with the function of the inflator (generate gases accompanied by a large increase in volume or pressure). It seems that the chemical composition of the pyrotechnic mixture (chemical composition of concern) is the most important element for the function of the inflator. Therefore, **it should be considered as a combination of articles** (container) **and a mixture** (pyrotechnic mixture).	n.a.	n.a.	n.a.	n.a.	Combination of articles and a mixture (pyrotechnic mixture)
3D printing filament used as thermo-plastic raw material for 3D printers	The function is a raw material for 3D printing	No. A 3D printing filament is a raw material for 3D printing. A filament is made from a melted thermoplastic polymer, often mixed with other additives. During 3D printing, the filament is heated above its glass transition temperature, losing its shape, and consumed during use, to construct the 3D object. From this, and notwithstanding the convenience for the specific shape of a 3D printing filament for handling and feeding the 3D printer, it is clear that the chemical composition of the wire is more important for its function than the shape, surface or design. In conclusion, 3D printing filament is to be considered a substance or a mixture	n.a.	n.a.	n.a.	n.a.	Substance/ mixture

		under REACH. The assessment of such filament is not covered by example 18 of the appendix 4 to the '*Guidance on requirements for substances in articles*'.					
Soldering or welding metal wire	The function is **to join or hold two or more articles or objects together**.	No. During application in joining two or more articles or objects together by welding or soldering, the welding or soldering metal wire as a whole is fused, losing its shape, and consumed during use. The chemical interaction and compatibility between the molten flux and the metal substrates is to be joined, as well as the (eventual) prevention of oxidation of the metals to be joined, during the joining process (welding or soldering) are the most important properties for the function of a welding or soldering wire. From the above, and notwithstanding the convenience for the specific shape of a welding or soldering wire for handling and applying a fusible welding or soldering material, it is clear that the chemical composition of the wire is more important for its function than the shape, surface or design. Note that alloys are regarded as 'special mixtures' according to REACH Article 3(41) and recital 31, as explained in Q&A 31 on ECHA's website. In conclusion, a welding or soldering wire is to be considered a mixture (alloy) under REACH. The assessment of such wire is not covered by example 16 of the of the appendix 4 to the '*Guidance on requirements for substances in articles'*.	n.a.	n.a.	n.a.	n.a.	Mixture (alloy)

Electric insulated wire	The function of the metal wire is to carry electric current.	The electrical core metal (e.g. copper, aluminium) wire, before applying the melted insulation material, is in principle an article (e.g. see example 16 in Appendix 4 to the *Guidance on requirements for substances in articles* (SiA Guidance)). After applying the insulation melted material through e.g. extrusion and cooling, the insulation layer becomes part of the article. This production process is similar to a coating operation. Calculation of the concentration of a Candidate List substance: Providing that a Candidate List substance is only present in the solid insulation layer, scenarios III. A) and III. B) of Table 5 in section 3.2.3.1 of the *Guidance on requirements for substances in articles* are applicable to the insulation wire for the purpose of calculating the concentration of that Candidate List substance in the electric insulated wire.	n.a.	n.a.	n.a.	n.a.	Article with an insulating substance/mixture
Electrical cable with insulated wires	The function of the electrical cables is to carry electric currents.	The cable is a complex object made of two or more insulated wires protected by an outer jacket. Calculation of the concentration of a Candidate List substance: For a Candidate List substance in the **metallic wire** the reference is the metallic wire without the insulation layer (scenario I of Table 5 in section 3.2.3.1 of the *Guidance on requirements for substances in articles* (SiA Guidance)). For a Candidate List substance in the **insulation layer of the insulated wire**, the reference is the total mass of the metallic wire and the insulation (see electric insulated wire example). For a Candidate List substance in any of	n.a.	n.a.	n.a.	n.a.	Complex object made of two or more articles. The "once an article, always an article" principle applies to each inner insulated wire. If the insulated wires are placed on the market as individual articles, they are considered distinct insulated wires (articles).

		the **insulations of the cable with insulated wires**, the reference is the total mass of the respective metallic wire, the respective insulation and *1/n* of the mass of the cable jacket (for a cable consisting of *n* insulated wires, and *n* ≥ 2). For a Candidate List substance in the **cable jacket** (outer protective layer), the mass reference is the mass of the whole cable.					
Glow stick	The function is **to emit light**	No. The function is achieved by mixing two mixtures that, when combined, undergo a chemiluminescent reaction emitting light. The function is thus determined to a greater degree by the chemical composition of the mixtures rather than the shape of the object.	n.a.	n.a.	n.a.	n.a.	Combination of articles (containers) and mixtures
Match and safety match	The function is to create and sustain a flame	The creation of a flame is dependent of the flammable and/or oxidising properties of the active ingredients on the match head (coated end). These are inherently physico-chemical properties derived from the chemistry of those ingredients. Without the substance/mixture deposited on the match head, the function of a (safety) match is never fulfilled – no flame is created. The wooden stick/stiff paper on its own will never create a flame, even if it is suitable to sustain a flame. Therefore, the chemical composition of the match head is unumbiously more important to create a flame than the shape, surface or design of the match. The match is regarded as a combination of a carrier (made of wood or other combustible material), and a flammable and/or oxydising substance/mixture under REACH.	n.a.	n.a.	n.a.	n.a.	A match is a combination of a carrier (made of wood or other combustible material), and a flammable/ oxidising substance/mixture

Sparkler	The function is to produce light effects, mainly as flying sparks, frequently accompanied by smoke and sound	The creation of the light effects (mainly sparks), often accompanied by smoke and sound is dependent of the chemical ingredients of the solid mixture deposited over the metal wire, while undergoing self-sustained exothermic chemical reactions. The production of those effects derive from the chemistry of those ingredients. Without the solid mixture deposited on the mettalic wire, the function of a sparcler is never fulfilled – no light effects are produced. The metallic wire on its own will never create the light effects. Thus, the chemical composition is more important than the shape/surface/design of the sparkler to get the light effects. The sparkler is regarded as a combination of a carrier (metallic wire), and a solid energetic mixture under REACH.	n.a.	n.a.	n.a.	n.a.	A sparkler is regarded as a combination of a carrier (metallic wire) and a solid energetic mixture
Pocket lighter	The function is to create and sustain a flame	For a pocket lighter, the flammable (and often volatile) fluid, used as fuel, due to its chemical and physicochemical properties is key for creating and sustaining the flame. The flame is created when the flammable fluid is ignited and it is sustained while being fed by the same fluid, i.e. the flame is extinguished if the controlled delivery of the fluid is interrupted in any way. Without the fluid, the function of a lighter is never achieved – no flame is created and sustained. The whole "container"/ delivery device of a lighter is a complex object made of several articles (body, base, springs, etc.). Without the fuel fluid the lighter container cannot fulfil the main function of	n.a.	n.a.	n.a.	n.a.	Combination of articles (container and controlled delivery set-up) and a substance/mixture (fuel)

		the lighter. A lighter is therefore regarded as a combination of articles (functioning as container and controlled delivery set-up) and a substance/mixture (the flammable fluid working as fuel for the flame). In this example, the chemical composition assessed was the flammable fluid (fuel). Other components (objects) of the lighter need to be assessed separately to decide whether they are articles or not under REACH (e.g. a sparkwheel).					
Heat source for tobacco products based on a chemical reaction	The functions of the carbon heat source are to undergo an exothermic reaction (combustion) and transfer heat. The function of the foil is to create a barrier between the carbon heat source and the tobacco, preventing direct contact and the burning of the tobacco	No. The main function of the object is only achieved through an exothermic chemical reaction, which shows that the chemical composition is key for the function. Other characteristics relevant for the function are the surface area and the porosity to allow the inflow of air, which are closely related with the chemical composition. The foil is given a special shape and is an article which, however, needs to have a high thermal conductivity. The chemical composition of the carbon heat source seems to be more important for the identified function. Therefore, it is considered a combination of an article (foil) and a mixture The mixture is fully consumed upon use and the object is discarded.	Yes, mixture can be separated	4a yes 4b no 4c yes	n.a.	n.a.	Combination of an article and a mixture
Standard gold bar *(or gold bullion or gold ingot)*	The function is: **to store value**	No. The value stored by the gold bar is intrinsically linked to the chemical element gold (Au) i.e. the value of metallic gold stored in a gold ingot does not depend on its physical properties shape, surface or design.	n.a.	n.a.	n.a.	n.a.	Substance

		To achieve its function (to store value), the gold bar is required to have a very high degree of metallic gold purity. Furthermore, it is also required to have the density, the colour and the inertness (very stable against wear (e.g. corrosion/oxidation) of metallic gold. These are all intrinsic properties related to metallic gold. In conclusion, even if the shape, surface and design of a standard gold bar facilitates identification, handling, storage and transportation, it is the chemical composition that determines to a greater degree its function: to store value. Therefore, a gold bar must be seen as a substance according to the REACH Article 3(1) definition. Please note that gold (Au) (EC 231-165-9, CAS 7440-57-5) is registered under REACH.					
Perforated disk metal coffee filter (nonwoven)	The function is: to retain coffee grounds - **sieving** Sieving means, in this case, a **two-dimensional** mechanical or physical size exclusion separation at a single screen layer (a sieve), e.g. perforated sheet or woven mesh.	Yes. The sieving function (retention of coffee grounds) is determined by the size of the holes (e.g. diameter) in the perforated screen layer or barrier. In this case, the size of the holes in the perforated metal disk which works as a coffee sieve. Any oversized solid particles contained in the "feed" (suspension of ground coffee in water), cannot pass through the perforated metal disk holes (screen), being retained above the disk (used coffee grounds), while the fluid (brewed coffee) passes though the holes. Therefore, the shape, surface and design are more important for the sieving function of the perforated disk metal coffee filter (nonwoven) than its chemical composition. The perforated disk metal coffee filter	n.a.	n.a.	n.a.	n.a.	Article

		(non-woven) is an article under REACH.					
Porous transversal (micro) filtration membrane	The function is **filtration** and sorption. Filtration means, in this example, the mechanical or physical **three-dimensional separation** of solid matter from other matter through a multilayer lattice of an interposing medium. Filtration in this case differs from sieving (as defined in 'Perforated paper coffee filter'), because the separation occurs through a three-dimensional multilayer lattice of an interposing medium (membrane), and not only at the upper surface (the outermost layer).	No. In filtration, one or more components are separated from a fluid (feed), based primarily on size differences of solid particles. The main difference between filtration and sieving relies on the screening barrier used. In addition, often sorption also plays a role on the separation when a membrane is used, i.e. separation of components based on physical, chemical and physicochemical interactions. For instance, a membrane separates not only solid particles, but also hydrophobic substances from an aqueous feed. The fluid that passes through the membrane is called filtrate. The most important properties for the function of a porous transversal (micro)filtration membrane (separation of one or more components from a fluid (feed)) are: - porosity, pore size distribution and pore shape; - ratio between accessible and inaccessible pores; - hydrophilicity/hydrophobicity of the membrane; - tensile strength; - surface; and - thickness. It is important to highlight that during the fabrication process of a membrane, no special surfaces are given to the membrane, since they result from the casting (demixing and/or precipitation), and the thickness may have some variabilities. Typically, the polymer is dissolved in a casting solution, which undergoes phase separation by induced demixing and/or precipitation during casting in a support. The casted membrane is dried and rolled in a master	n.a.	n.a.	n.a.	n.a.	Substance/ mixture

		roll. The porous membrane roll is then further cut into different dimensions (shapes), usually disks of different diameters. The intrinsic properties of the material, the porosity and microstructure are more relevant for the function than the special shape (thickness) of the object given during production. The characteristics that are relevant to perform the function are mostly related to characteristics that result from the chemistry of the materials the filter (membrane) is made of or from the fabrication process used. Following the workflow in Section 2.3 of the '*Guidance on requirements for substances in articles'*, the Step 2 question can be answered with 'no' (based on Section 2.2), i.e. the filter is thus a substance or mixture. Therefore, a porous transversal (micro)filtration membrane is regarded as a substance/mixture because the chemical composition is the determinant factor for the function.					
Perforated paper coffee filter	The main function is to retain coffee grounds. Therefore, both **sieving** (more important) and filtration are functions of a perforated coffee filter (see 'Porous transversal (micro) filtration membrane' and 'Perforated paper coffee filter'). An accessory function of perforated paper coffee filter is the separation of fatty molecules such as diterpenes from the	Yes. The retention of coffee grounds by the perforated paper coffee filter seems to be determined by the size of the holes (e.g. diameter) in the perforated paper, but also by the interstices between the coarse long paper fibres. The perforated paper coffee filter, taking into account the size of the coffee grounds, seems to work more as a sieve for the coffee grounds (see ' Perforated paper coffee filter') than as a filter (see 'Porous transversal (micro) filtration membrane'). The morphology of the paper fibres in the filter are more like a mesh than as a porous material. The retention of diterpenes by perforated	n.a.	n.a.	n.a.	n.a.	Article*

	brewed coffee.	paper coffee filter is an accessory function, and not the main function, which is sieving. Therefore, a perforated paper coffee filter is regarded as an article. *Note: If a manufacturer of a paper coffee filter considers that e.g. morphology, microstructure, hydrophilicity/ hydrophobicity of the paper, tensile strength and other properties of the paper are more important for the function, then they should consider the coffee filter as a substance/mixture as described in ' Porous transversal (micro) filtration membrane' and not an article.					
Metal soap made of stainless steel	The function is to **remove** or **reduce** odours.	The mechanism of the stainless steel 'soap' is not fully understood. However, the removal of substances responsible for the odour seems to entail a chemical reaction at the surface of the soap. It has been proposed that the formation and re-formation of a passive chromium oxide film on the alloy object may be relevant for removing or reducing odours. The chemical composition of the soap is more relevant for the identified function than the shape, surface or design, which are only relevant to be convenient hand-held, even if there is no release of a substance or mixture during use. Therefore, the object would be regarded as a mixture (alloy). The REACH Regulation refers to alloys as "special mixtures". Therefore, an alloy is to be treated in the same way as other mixtures under REACH.	n.a.	n.a.	n.a.	n.a.	Mixture (alloy)

Cavity sealing system	(Waterproofing, soundproofing, and/or fireproofing) sealant	A cavity sealer is a mixture which expands during its application to seal cracks and openings, e.g., in a building or in a car body. The technical function of a cavity sealer is to work as a barrier or as a sealant (see definition in Table R.12-15 of the *Guidance on Information Requirements and Chemical Safety Assessment - Chapter R.12: Use description*). After application, the expandable sealing material does not present a special shape, surface or design. After application, the dry cavity sealer mixture is incorporated in the building, or in the objects of a vehicle, device or equipment. When used to seal cracks or openings in articles or between assembled articles, it is considered similar to the incorporation of an adhesive (mixture) in scenario II of Table 5 in section 3.2.3.1 of the *'Guidance on requirements for substances in articles'*.	n.a	n.a	n.a	n.a	Mixture
Fire protection putty	Moldable and intumescent (under intense heat) sealant (sealing an opening or joint in the event of intense heat or fire)	A fire protection putty does not have a special shape, surface or design, because it is a highly viscous and mouldable material which can undergo continuous deformation. In an event of fire (or intense heat), the putty undergoes swelling, moulds to the opening or joint and becomes hardened. From the above, a fire protection putty is regarded as a mixture under REACH. When hardened in an object other than a building or fixed structure, it is to be considered similar to the incorporation of an adhesive (mixture) in scenario II of Table 5 in section 3.2.3.1 of the *'Guidance on requirements for substances in articles'*.	n.a	n.a	n.a	n.a	Mixture

4. Appendix: List of figure sources

Figure	Source
Figure 1: Twist drill bit	https://pixabay.com/de/photos/bohrer-bohrmaschine-metall-1827131/ accessed on 30/09/2020, author: LeoNeoBoy
Figure 2: Chisel blade	https://www.vecteezy.com/photo/2545010-set-of-chisels-on-the-workbench, accessed on 30/09/2020, author: Yurii Romanov
Figure 3: Saw blade	https://pixabay.com/vectors/handsaw-tool-hand-saw-wood-work-159622/, accessed on 16/11/2022, author: OpenClipart-Vectors / 27376
Figure 4: Rasp blade	https://pixabay.com/photos/files-rasps-tools-set-iron-steel-4463773/, accessed on 16/11/2022, author: papazachariasa / 454 images
Figure 5: Knife blade	https://burst.shopify.com/photos/japanese-kitchen-knife-and-tomatos, accessed on 30/09/2020, author: Rohann Agalawate
Figure 6: Retractable blade	https://www.freepik.com/premium-vector/cutter-knife-vector-blade-paper-craft-utility-stationery-office-craft-cut-razor_25448739.htm, accessed on 20/10/2022, author: kolonko
Figure 7: Water soluble film pouch (to enclose a content)	Vieira Prazeres, T. J. 2022
Figure 8: Water soluble foil bag with content	https://picjumbo.com/putting-dishwashing-capsules-in-a-dishwasher/ accessed on 10/03/2023 author: Viktor Hanacek
Figure 9: Water soluble dishwashing tablets	https://www.istockphoto.com/fi/valokuva/pesuaine-kapseli-gm844466276-138359293?phrase=dishwasher%20capsules accessed on 6/03/2023 author: s-cphoto
Figure 10: Coated electronic wax candles	https://www.pexels.com/photo/three-pillar-candles-370883/, accessed on 06/02/2023, author: hafid
Figure 11: Electronic candle	https://www.pexels.com/photo/christmas-decor-with-flaming-candle-at-home-6101988/, accessed on 06/02/2023, author: Laura James
Figure 12: Electronic wax melter	Frauman, E. 2023
Figure 13: Electric diffuser	https://pixabay.com/de/photos/aroma-duft-diffuser-diffusor-4076727/, accessed on 6/02/2023, author asundermeier
Figure 14: Burning	https://pixabay.com/de/photos/kerze-flamme-flimmern-kerzenlicht-

candle	452966/, accessed on 05/10/2020, author: Denise Chaney
Figure 15: Note on magnetic board	https://pixabay.com/de/photos/postit-haftnotiz-gelb-schl%C3%BCssel-3237369/, accessed on 03/11/2020, author: globenwein, the image was modified
Figure 16: Artificial turf surface	https://pixabay.com/de/photos/kunstrasen-mittelfeld-fu%C3%9Fball-1436614/, accessed on 01/10/2020, author: Stefano Ferrario
Figure 17: Leca nuts	https://en.wikipedia.org/wiki/Expanded_clay_aggregate, accessed on 14 February 2023, author: Samuel Grant
Figure 18: Car interior with used airbag system	https://pixabay.com/de/photos/crashtest-kollision-auffahrunfall-1620608/, accessed on 30/04/2021, author: Marcel Langthim
Figure 19: 3D printing filaments	https://pixabay.com/de/photos/crashtest-kollision-auffahrunfall-1620608/, accessed on 30/04/2021, author: Marcel Langthim
Figure 20: Welding	https://unsplash.com/photos/idffd__L5rQ, accessed on 16/11/2022, author: Salvador Escalante
Figure 21: insulated wire (insulation applied by extrusion of melted insulating material)	https://commons.wikimedia.org/wiki/File:Wire_transparent.jpg, accessed on 25/10/2023, author: Mx1991
Figure 22: Three insulated wires coated with a cable jacket that was incorporated by extrusion	https://en.wikipedia.org/wiki/Electrical_cable#/media/File:Leitungsende_Abisoliert_en.svg accessed on 24/10/2023, author: Marekich
Figure 23: Electric guide (electric wire) 3×2.5 mm (diameter)	https://commons.wikimedia.org/wiki/File:Electric_guide_3%C3%972.5_mm.jpg, accessed on 25/10/2023, author: Petar Milošević
Figure 24: Glow stick	https://pixabay.com/de/photos/knicklichter-bunt-licht-leuchten-693818/, accessed on 01/10/2020, author: Hans Braxmeier
Figure 25: Match	https://pixabay.com/vectors/match-matches-fire-matchbox-1717377/ accessed on 05 April 2023, Author sinisamaric1
Figure 26: Sparkler	https://unsplash.com/photos/qwvv5QD0It0/ accessed on 05 April 2023, Author Nong V
Figure 27: Pocket lighter	https://unsplash.com/photos/rXgg90zA820It0/ accessed on 05 April 2023, Author Jozsef Hocza
Figure 28: Heat source for tobacco products based on a	Vieira Prazeres, T. J. 2022

chemical reaction

Figure 29: Gold bar	https://unsplash.com/photos/Y9U4XZYbSQ4 accessed on 20/10/2022, author: Jingming Pan
Figure 30: Perforated disk metal coffee filter	https://unsplash.com/photos/1SUtSGT3TD0, accessed on 06/02/2023, author: cafeconcetto
Figure 31: Funnel metal coffee filter	Tunnela, O. 2022
Figure 32: Transversal filtration membrane	https://unsplash.com/photos/KJVmGWFEb8E, accessed on 20/10/2022, author: RephiLe water
Figure 33: Transversal microfiltration membrane within a microfiltration device	https://unsplash.com/photos/sw99zUK8hCc, accessed on 20/10/2022, author: RephiLe water
Figure 34: Paper coffee filter	https://unsplash.com/photos/rwwMB7kTNes, accessed on 07/03/2023, author: Devin Avery
Figure 35. Metal soap made of stainless steel	https://commons.wikimedia.org/wiki/File:Stainless_steel_hand-soap.jpg, accessed on 26/10/2023, author: AstroHurricane001
Figure 36: Cavity sealing system	https://commons.wikimedia.org/wiki/File:Expanded_foam_upon_heating.jpg accessed on 25/10/2023, author: Cjp24
Figure 37: Fire protection putty	https://commons.wikimedia.org/wiki/File:Fsp_firestop.jpg accessed on 25/10/2023, author: Achim Hering

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