Frequently Asked Questions on Glass under REACH

GAE Position

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List of questions

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1. What is the nature of glass?

Glass is a collective term for a range of materials of different elemental compositions in a glassy state.

Glass is an inorganic material obtained from different inorganic raw materials, which react at high temperature to form a new random network (synthesis), where different elements are generally bonded together by oxygen bridges.

The general chemical reaction to form silicate-glasses can be illustrated by the following simplified equation:

a SiO_2 [sand] + b Na_2CO_3 [soda] + c $CaCO_3$ [lime] + d $CaMg(CO_3)_2$ [dolomite] + e Na_2SO_4 [sodium sulphate] +….. → x $Si_mNa_nCa_oMg_p……O_s$) [glass] + y CO_2 ↑+ z SO_2 ↑ + …..

Raw materials used in a glass formulation undergo physical (melting) and chemical (formation of the network) processes. During the chemical reaction to form glass (synthesis), different inorganic substances (a, b, c, d, e,…) are transformed into a non-crystalline vitreous substance (x).

The physico-chemical properties of the new substance glass (chemical resistance, mechanical resistance, transmittance, colour, etc.) are a function of the network formed. Different elemental compositions lead to different glass chemical structures and consequently different physico-chemical properties of the final material.

2. What is the composition of glass?

Glass is a substance of variable composition, which by convention is expressed in terms of oxides of the elements (SiO_2, Na_2O, K_2O, CaO, MgO, PbO, etc.). Although conventionally glass compositions are expressed as oxides of the different components, glass is a substance that does not contain these oxides as such.

Glass can better be identified by its chemical formula $Si_mNa_nCa_oMg_p……O_s$ [glass]. The physico-chemical properties of the substance glass (chemical resistance, mechanical resistance, transmittance, colour, etc.) are a function of the network formed. Different compositions lead to different glass chemical structures and consequently to different physico-chemical properties of the final material. Due to its nature glass is generally recognized as a no dangerous material.

The GLASS Best Available Technologies References (BREF) lists four main categories of glass:

- soda-lime-silica glass
- borosilicate glass
- lead crystal glass
- speciality glass.

The typical compositions for each of the common types of glass are shown below.

Soda-lime-silica glass for container, flat and domestic glass

This category covers more than 95 % of the glass produced in Europe. A typical soda-lime-silica glass composition is:

- 45% oxygen
- 35% silicon (originating mainly from quartz sand)
- 10% sodium (originating from soda ash)
- 10% calcium (originating from limestone)
- 1% aluminium (originating mainly from feldspar or oxides of aluminium)

Low levels (normally below 1 % w/w) of other elements can be present in the glass matrix.

Borosilicate glass for continuous filament fibres, glass wool, domestic glass (cookware) and special applications

A typical composition of borosilicate glass is:

- 35% oxygen
- 30% silicon (originating mainly from quartz sand)
- 15% calcium and/or magnesium
- 10% sodium or potassium
- 5% boron (originating e.g. from borax, boric acid or colemanite)
- 5% aluminium (originating from feldspar or oxides of aluminium)
- 1% other elements like Ti, Fe and F to impart specific properties on the glass

Lead crystal for domestic glass

A typical composition for lead crystal glass is:

- 25% oxygen
- 30% silicon (originating mainly from quartz sand)
- 25% lead
- 10% sodium or potassium
- 10% calcium (originating mainly from limestone)
- 1% other components like Ti, Fe and F to give specific properties to the glass

Specialty glass

Specialty glass covers a wide range of glass types. It is often based on a soda-lime-silica, borosilicate or alumina-silicate composition, in addition of other compounds designed to impart specific properties on the glass or glass-ceramics.

3. How is glass made?

Glass is usually molten from raw materials in a continuous process. This process is carried out in glass furnaces that are optimised according to economic and environmental aspects. From the hot melt, the final product is shaped in the forming machines.

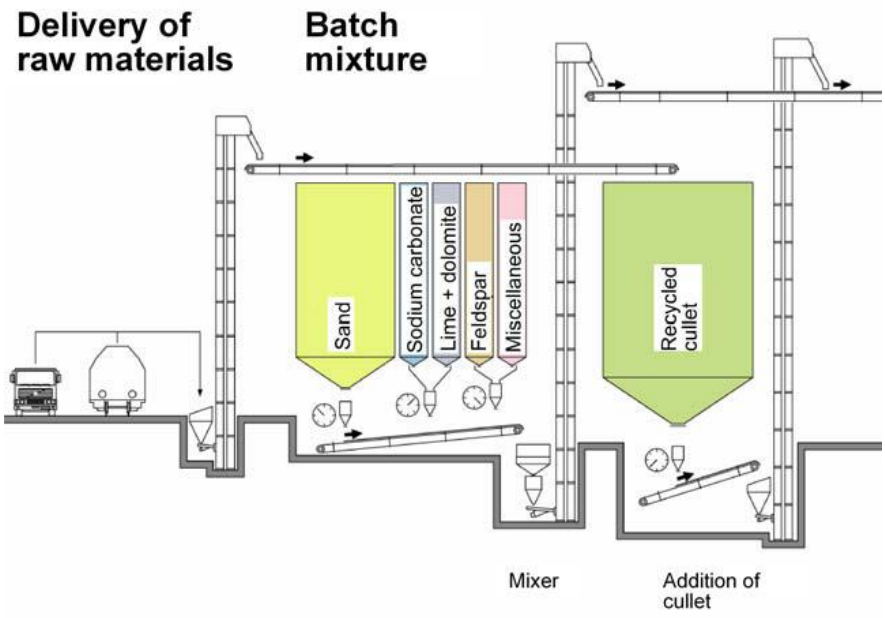
Glass products show an almost infinite variety of qualities and properties, which can be obtained by selecting/designing the glass composition for the required application.

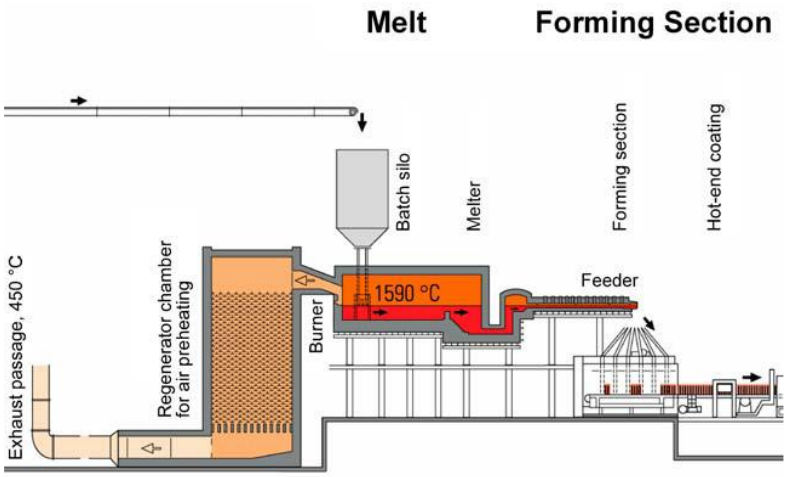
Glass is typically made in furnaces at a temperature of about 1.400-1600°C in the molten glass. A continuous process is operated in the melting tank and includes heating, melting, chemical reactions and removal of gases from the melt.

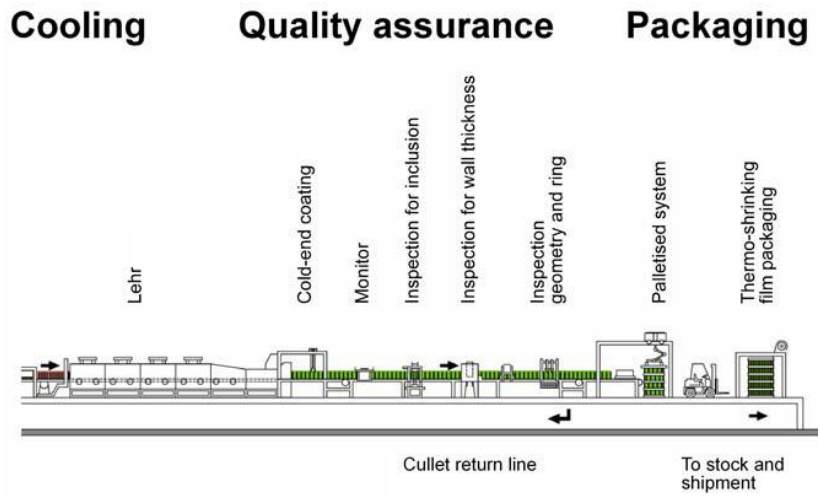
The construction of the glass furnace conforms to the required qualities of the glass melt, in particular the maximum required melting temperature and the corrosiveness to the refractory material that protects the furnace. Legal requirements concerning gas emissions are a further important criterion of the quality of a furnace. Glass furnaces can generally be classified into those operated in continuous and those operating in discontinuous mode. Different sources of heat (fuel, gas, electric, combination thereof) can be used to melt the raw materials and form the glass.

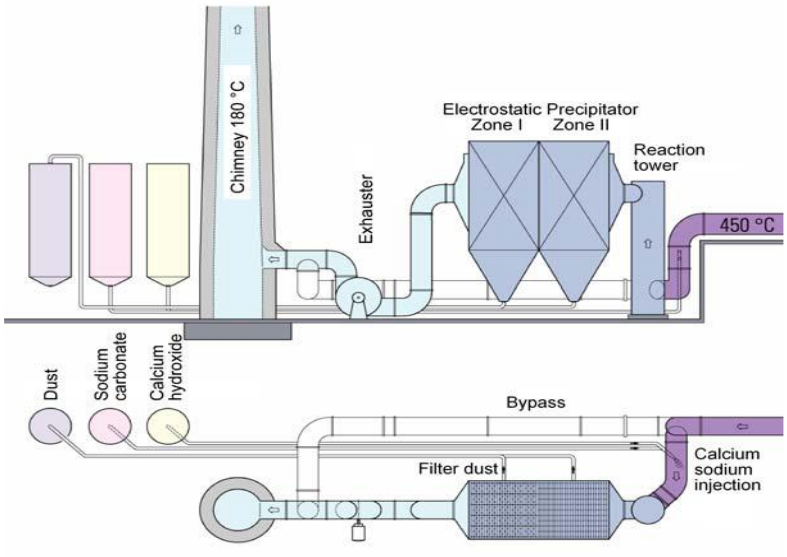
Below is shown a typical type of process:

"Industrial glass production illustrated by container glass production (Source: Verallia Oberland AG)"




Melt
Forming Section
Batch silo
Melter
Forming section
Hot-end coating
Exhaust passage, 450 °C
Regenerator chamber for air preheating
Burner
1590 °C
Feeder


Cooling
Quality assurance
Packaging
Lehr
Cold-end coating
Monitor
Inspection for inclusion
Inspection for wall thickness
Inspection geometry and ring
Palletised system
Thermo-shrinking film packaging
Cullet return line
To stock and shipment


Chimney 180 °C
Electrostatic Precipitator
Zone I
Zone II
Reaction tower
Exhauster
450 °C
Dust
Sodium carbonate
Calcium hydroxide
Bypass
Filter dust
Calcium sodium injection

4. If glass is a substance, then why has it not been registered under REACH?

Under the REACH Regulation glass is considered as a UVCB substance (substance of unknown or variable composition, complex reaction products or biological materials). It is not a mixture.

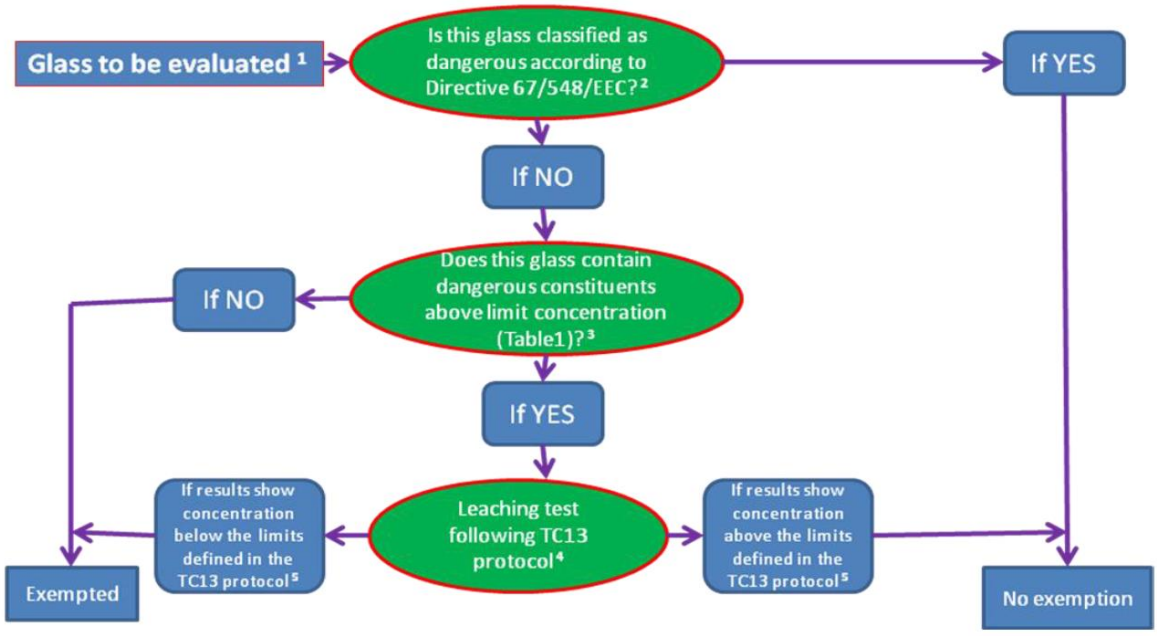
According to Annex V of the REACH Regulation, glass is exempted from certain provisions, in particular Title II (registration of the substances), Title V (downstream users) and Title VI (evaluation), if it fulfils the following requirements:

"The following substances unless they meet the criteria for classification as dangerous according to Directive 67/548/EEC and provided that they do not contain constituents meeting the criteria as dangerous in accordance with Directive 67/548/EEC present in concentrations above the lowest of the applicable concentration limits set out in Directive 1999/45/EC or concentration limit set out in Annex 1 to Directive 67/548/EEC, unless conclusive scientific experimental data show that these constituents are not available throughout the life-cycle of the substance and those data have been ascertained to be adequate and reliable: Glass, ceramic frits".

It is the responsibility of the producer to assess the substance glass, and to document the conclusive scientific data to demonstrate that his substance fulfils the criteria. Considering the intrinsic inertness of glass, Glass Alliance Europe considers that the majority of glass types fulfil the criteria laid down in Annex V (11) of REACH.

To help with the assessment of the exemption criteria, Glass Alliance Europe developed a specific methodology (see *GAE REACH Dossier*). The methodology takes into consideration the specific characteristics of glass and the ECHA Guidance for Annex V.

The flowchart of the assessment is shown below:



5. Some raw materials used to make glass appear on the European Agency's list of Substances of Very High Concern (SVHC) – the Candidate List. I make or buy an article containing glass, so do I need to notify ECHA? Is the glass article dangerous?

The obligation to notify ECHA under Art. 7(2) of REACH and to communicate down the supply chain under Art. 33 of REACH only applies to articles that contain Candidate List substances in a concentration above 0.1 % (w/w).

It is possible that substances included in the Candidate List are used to produce glass articles. During the process of glass making, the substances are chemically transformed into a manufactured glass substance, which is subsequently or during the same process turned into articles. In these cases, the substances are completely transformed and no longer present in the final glass article.

Consequently, for articles made of glass only there is no obligation to notify ECHA under Art. 7(2) of REACH, nor to communicate information down the supply chain under Art. 33 of REACH. This was confirmed in ECHA Q&A – ID 1218 – 12/09/2016 relating to boron compounds.

In the event that glass articles contain other substances, mixtures or articles than glass (complex articles), it is the responsibility of the glass manufacturers to assess whether communication obligations and eventual notification are required.

6. Is glass a substance or an article?

Glass can be both a substance and an article. According to Annex V, glass is considered as a UVCB substance and may be put onto the market as such (glass with random shape to be used in another process that uses glass as raw material. Thus, glass is a substance under REACH.

However, most glass is transformed directly from the molten stage into article, without any separate step.

The glass products thus created (e.g.: bottles, wine glasses, cook-ware) and put on the market are articles according to Article 3 section 3 of the REACH regulation, because their shape, surface or design determines the function to a greater degree than their chemical composition.

7. I have the chemical analysis or a technical data sheet of a glass product which says that it contains oxides (SiO_2, Na_2O, CaO, B_2O_3, etc.) – does this mean that glass is a mixture of oxides?

No, glass is not a mixture of oxides. Glass is a substance of variable composition, which by convention is expressed as oxides of the elements (SiO_2, Na_2O, K_2O, PbO, etc.). Although traditionally glass compositions are expressed as oxides of the different elements, glass is not a mixture of the different oxides or raw materials, but a substance which does not contain these oxides as such.
Glass can better be identified by its chemical formula $Si_mNa_nCa_oMg_p\ldots\ldots O_s$ [glass]. The physico-chemical properties of the substance glass (chemical resistance, mechanical

resistance, transmittance, colour, etc.) are a function of the network formed. Different compositions lead to different glass chemical structures and consequently to different physico-chemical properties of the final material. Because of its nature glass is generally recognized as an inert material.

8. What happens to the raw materials when glass is made?

Glass is an inorganic material obtained from different inorganic raw materials, which chemically react at high temperature. Raw materials that make up a glass formulation undergo physical (melting) and chemical (formation of the network) processes. During the chemical reaction to form glass (synthesis), different inorganic substances (a, b, c, d, e, …) are transformed into a vitreous (glassy) substance (x). In the glass, the chemical elements are incorporated via new and strong chemical bonds that become an integral part of the glass structure.

The general chemical reaction to form soda lime glass can be illustrated by the following simplified equation:

a SiO_2 [sand] + b Na_2CO_3 [soda] + c $CaCO_3$ [lime] + d $CaMg(CO_3)_2$ [dolomite] + e Na_2SO_4 [sodium sulphate] +….. → x $Si_mNa_nCa_oMg_p……O_s)$ [glass] + y CO_2 ↑+ z SO_2 ↑ + …..

The physico-chemical properties of the new substance glass (chemical resistance, mechanical resistance, transmittance, colour, etc.) depend on the exact elemental composition and the network formed. Different compositions lead to different glass chemical structures and consequently different physico-chemical properties of the final material. For example, the main effect of boron in a borosilicate glass is to increase the mechanical and chemical resistance and the thermal shock resistance of the glass.

More information on this aspect can be found in the answers to questions 2 and 3.

9. Are any of the original raw materials present in the glass product?

No, they are not. See answers to questions 1, 2 and 7.

10. What does it mean that the raw materials used to produce glass are transported isolated intermediates?

Raw materials used in a glass formulation undergo physical (melting) and chemical (formation of the network) processes. During the chemical reaction to form glass (synthesis), different inorganic substances (a, b, c, d, e, …) are transformed into a vitreous (glassy) substance (x).

Raw materials that are used in the manufacture of glass meet the definition of intermediates inasmuch as they are transformed by synthesis into the new substance glass. They are transported isolated intermediates, since they are produced elsewhere and transformed at the glass manufacturers' sites.

This is further explained in a legal opinion obtained on that specific issue and updated on December 2017 as consequences of some case-law of the EU Court (C-650/15) as well as the ECHA Board of Appeal (FieldFisher - Legal opinion on the use of raw materials in the manufacture of glass as intermediates under REACH – Update December 2017).

The glass industry considers that within ECHA's use-descriptor system raw materials belong to Product Category PC19 ("intermediates") and their Environmental Release Category consequently is ERC6A ("Industrial use resulting in manufacture of another substance (use of intermediates))."

11. Do I need a Safety Data Sheet (SDS) for glass?

No, SDSs are only required for hazardous substances and mixtures. They are not required for non-hazardous substances, mixtures or articles (more information can be found in Art.31 of the REACH Regulation). The vast majority of glass types are non-hazardous. Furthermore, glass is generally put on the market as an article (an object, which during production, is given a specific shape, surface or design which determines its function to a greater degree than does its chemical composition) and SDSs are not required for articles.