Netherlands Institute
for Sustainable Packaging

FACT SHEET

Glass as a packaging material

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When it comes to producing packaging, there are many different materials to choose from, including metal, plastic, paper, cardboard, wood and glass. The choice of material depends on the requirements that the packaging of a specific product has to meet. This fact sheet provides information about the use of glass as a packaging material in relation to packaging in a circular economy.

Glass is a hard material with a mineral origin. Glass can be either naturally uncoloured (transparent) or coloured, depending on the raw materials used. There are different types of glass. This fact sheet concerns the type of glass that is used for packaging: soda-lime glass. In 2016, 499 kt of soda-lime glass were used in the Netherlands to produce packaging.

Glass for packaging

Glass is primarily used for the production of jars and bottles. Glass is an inert material, making it impenetrable to gases and moisture. Furthermore, colour can be used to filter out certain wavelengths of light, thereby slowing down food spoilage. This makes glass an ideal material in which to package food products with a long shelf life, ranging from several weeks up to several years. The downside of glass is the weight that is needed to achieve the required level of strength and avoid breakage.

Raw materials

Sand is the primary raw material used to produce all types of glass. Glass shards[1] are also used to produce new glass. Various substances - e.g. salts, metals and metal oxides - are added to the sand.

The main component of glass is silicon dioxide (SiO_2), better known as sand. The metal oxides sodium oxide (Na_2O) and potassium oxide (K_2O) are added to lower the melting temperature, which also increases the material's water solubility. Calcium oxide (CaO) and barium oxide (BaO) are then

[1] See also paragraph 'The waste phase of packaging glass – Reuse and collection'

added to lower the material's water solubility again. Furthermore, aluminium oxide (Al_2O_3) can be added to limit the glass' expansion when exposed to heat. In the past, lead was added to achieve a higher level of shininess and slightly lower the melting point. Today, lead is no longer used as a component of packaging glass[2].

Colour

To create coloured glass, certain substances can be added to the raw materials during production. For example, iron oxides produce a green, yellow or brown colour, while cobalt oxide (Co_2O_3) creates a blue colour. Colour is used to protect the packaged product against the detrimental influence of light. The degree of protection differs per colour. Furthermore, coloured glass can be used for marketing purposes. The use of colourants affects the recyclability of glass (see paragraph The waste phase of packaging glass).

The production of glass

The production of glass is a melting process that can be divided into four main stages: melting, refining, homogenising and dosing. The first three stages take place in an oven that is several metres wide and dozens of metres long and has a depth of one to one and a half metres. Melting and producing glass is a continuous process; the glass furnace is generally always on.

Melting

The dry raw materials are mixed and transported to the furnace. In the furnace, used shards of glass – which are being recycled – are added to the mixture. Although the newly added raw materials will initially float on the already molten glass, the heat will eventually cause them to melt as well. The temperature inside the furnace is maintained at around 1,500°C.

Refining

In the hottest part of the oven, compounds are added to the molten glass to ensure that any residual small air bubbles quickly rise to the surface and are removed from the glass. This process is known as refining. The small air bubbles are removed because they negatively affect the quality of the glass.

Homogenising

The molten glass is stirred by slowly blowing large air bubbles in the mixture. This ensures the

[2] Per European regulations, lead may only be used in packaging in very limited quantities (no more than one hundred parts per million), because it is a heavy metal. An exception is made for recycled glass. See the European Decision 2001/171/EG.

ingredients are properly combined and a more homogeneous mass is formed. The presence of compounds that prevent the formation of small air bubbles makes it possible to use this method to stir the glass. Other stirring methods are difficult to use because of the high temperatures involved in the process.

Dosing

The molten glass is carried to dosing mechanisms. With scissors, the hot and syrupy stream of glass is cut into droplets with the weight of a single packaging. These droplets are also known as "gobs." The gobs can then be used to produce various types of packaging.

The production of glass packaging

Glass is primarily used for the production of jars and bottles. The production processes used to make jars and bottles are not the same. Both processes are described below.

Figure 1 – Glass is glowing from heat during the blow-blow process.

Blow-blow production process for bottles

The so-called blow-blow process is utilised to produce bottles (see figure 1). This process consists of two steps (see also Figure 2). The first step is making a pre-form. This is done using the first mould[3].

The gob drops into the mould and is pressed into the mould from above using compressed air. The aperture forms at the bottom of the mould. Next, air is blown in from underneath. At this stage, the distinct shape of a bottle begins to form. The pre-form of the bottle is turned over and placed in the second mould. More air is blown in to ensure the glass is evenly distributed on the inside of the bottle as well.

The bottle is still warm when it comes out of the second mould. By allowing the glass to cool in a controlled manner (a process known as annealing), any residual internal stresses are eliminated. This reduces the risk of breakage.

[3] A mould is a hollow cast. The cavity in the mould is the negative shape of the desired product into which - in this case - glass is poured and then formed.

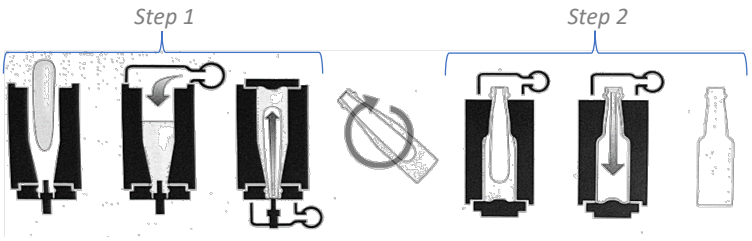

Figure 2 - The blow-blow process to produce a bottle
Source: Zakboek Verpakkingen

Press-blow production process for bottles and jars

This process can be used for the production of both bottles and jars. Once again, the packaging is made via a two-step process. The production process of a jar is shown in Figure 3.

The first step is making a pre-form in the first mould. The gob drops into the mould and is pressed into the pre-form with a stamp. The pre-form is turned over. In the second mould, the packaging is shaped like a jar by blowing air through the packaging's aperture. Lastly, the packaging is left to cool in a controlled manner.

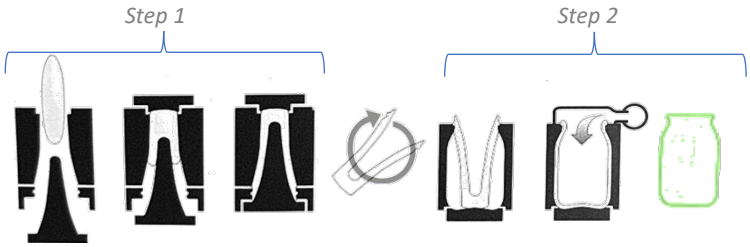

Figure 3 - The press-blow process to produce a jar
Source: Zakboek Verpakkingen

Communication on glass packaging

A label is often added to glass packaging to communicate what the bottle or jar contains. The label can be made of paper or plastic and is attached to the packaging using various types of adhesives. To improve the recyclability of glass packaging, it is preferable to avoid the use of hot-melt adhesives. Another option by which to add text and images to a glass packaging is to use plastic shrink film. However, this may disrupt the sorting process of glass prior to recycling (see also paragraph Sorting before recycling). Lastly, there are various ways to add a coating or printing to glass, such as silkscreening. The European Printing Ink Association (EuPIA) has drawn up guidelines for printing on packaging, e.g. from a food safety perspective.

Figure 4 - Glass bottle with plastic shrink film

The waste phase of packaging glass

Reuse and collection

In the Netherlands, used glass is collected in dedicated glass containers on the street. Depending on the municipality, glass packaging is collected by colour (brown, green and white). These shards can be used during the production of new glass.

Figure 5 - Collecting glass by colour (green, brown and white)

A deposit scheme is used to collect a percentage of glass beer bottles for refilling. On average, these bottles are reused thirty times before finally being recycled.

The quality of the collected glass

In order to properly recycle glass and maintain the high quality of the recycled material even after multiple recycling processes, the quality of the collected stream of packaging glass has to meet certain requirements. For example, porcelain (tableware), earthenware (some alcoholic beverages), mirrors, drinking glasses and oven dishes should not be disposed of in the packaging glass stream. These materials disrupt the recycling process and lower the quality of the recyclate because they do not melt or have a different melting temperature than regular packaging glass. Table 1 contains an overview of the requirements that collected packaging glass has to meet. When designing a packaging, these can be taken into account by adding as few other materials as possible, other than glass.

Material	Maximum quantity in g/tonne
Rocks	< 50
Magnetic metals	< 5
Non-magnetic metals	< 5
Organic material	< 500
Plastics	< 100
Moisture	< 3%

Table 1 - The requirements for packaging glass that is collected for recycling

Sorting before recycling

To ensure that glass can be properly recycled, contaminants are first removed from the incoming glass stream using various techniques.

The collected used glass packaging that are delivered to the sorting facility are partially broken and partially whole. The sorting process begins with the removal of any metals. A magnet is used to remove e.g. metal caps and lids from the stream. Next, major contaminants - such as incorrectly disposed waste - are removed by hand. The glass is then broken and the shards are sieved to divide them by size. The Eddy Current technique[4] is used to remove any non-ferrous metals, such as aluminium.

Optical cameras are used to scan the translucency of the packaging materials on the conveyor to determine whether they are made of glass. Next, NIR[5] equipment is used to scan for any remaining interferants, such as plexiglass and heat-resistant glass such (e.g. oven trays). If glass shards are covered with a non-translucent layer of plastic (e.g. from shrink film), the optical separators cannot recognise the underlying shards and these are removed from the material stream. In some cases, black glass can also be non-translucent; this material is also removed from the glass stream and ends up in the residual waste stream.

In the Netherlands, residual waste is incinerated for energy recovery (using the heat released during incineration). Any glass that ends up in the residual waste stream is not incinerated. Instead, it ends up as part of the bottom ashes. These bottom ashes are washed and used as e.g. a fill or foundation material for road construction.

Recycling

The collected and sorted glass is reheated, melted down and used to produce new (packaging) glass. To safeguard the quality of the recycled glass, there are maximum percentages of reused glass that can be used in the production of new glass. This percentage differs per colour of glass:

- Transparent glass: 25 – 60%
- Green glass: 85 – 95%
- Brown glass: 70 – 85%

Using reused glass lowers the energy consumption of the glass production process and the amount of raw materials needed. For every 10% glass shards that are used, a reduction of the energy consumption by circa 2.5% is achieved.

[4] A technique by which electricity and induction are used to temporarily magnetise non-magnetic (non-ferrous) metals. This makes it possible to remove metals such as aluminium with a magnet.
[5] Near Infrared (NIR) equipment uses infrared light to identify the material that a packaging is made of. The packaging is carried past the equipment on a conveyor belt at high speed.

The sorting and recycling of the glass can be taken into account during the design process of a packaging, for example by keeping the glass translucent, not metallising it and avoiding the use of plastic shrink film. In terms of colour, transparent (white), amber brown or green glass are the preferable choices. Other colours of glass contain other raw materials that may affect the recycling process.

More information about how to take the recyclability of packaging into account can be found in the KIDV Recycle Checks.

Policy

Essential requirements and heavy metals

If a company wants to bring a packaged product to market and/or import it into the Netherlands, the packaging has to meet the requirements of the Packaging Management Decree. It specifies, among other things, the "essential requirements" that have to be met, as well as the maximum permissible quantities of heavy metals in the packaging. The requirements specified in this decree are derived from European Directive 94/62/EG for packaging and packaging waste (see also the Timeline laws and regulations on KIDV's website [only available in Dutch]). They are designed to reduce the environmental impact of packaging and packaging waste. The total quantity of lead, cadmium, mercury, hexavalent chromium or its compounds in a packaging or packaging component can be no higher than 100 ppm[6]. An exception is made for packaging glass regarding the use of lead. On average and measured over a one-year period, the quantity of load used in the production of packaging glass cannot exceed 200 ppm. This is described in European Decision 2001/171/EC.

Recycling targets

Targets have been set at the European level regarding the minimum percentages of packaging materials that must be recycled. The recycling target for glass is 60%. The Netherlands has set a target of 90% (see also table 2). In recent years, the recycling percentage for glass packaging in the Netherlands was around 80%. Various campaigns (e.g. "Glas in 't bakkie"[7]) have been launched to stimulate consumers to collect glass separately. In order to consistently achieve the high recycling target, this is a continuous point of attention for the Packaging Waste Fund (Afvalfonds

[6] Ppm = parts per million (100 ppm = 100 mg per kg)
[7] For more information about the campaign, see Campagne 40 jaar Glasbak (only available in Dutch)

Verpakkingen).

European recycling target for glass	Dutch recycling target for glass	Realised annual recycling percentage in the Netherlands	
		2019	2020
60%	90%	88%	90%

Table 2 - Recycling targets and percentages for packaging glass

What can you do?

Below are some pointers that can help you make your glass packaging more compatible with a circular economy. When modifying your packaging, always keep its required strength and other functionalities in mind. Modifications made to a packaging should never compromise the protection, use and transport of the packaged product.

Weight reduction

Depending on the height and desired strength of a bottle or jar, you can experiment with the thickness of the glass in the mould during the production process in order to reduce the amount of glass required. This saves raw materials and energy.

Use recycled glass

Glass can be recycled without losing its characteristics. Using recycled glass in a packaging saves raw materials and energy, which can reduce the environmental impact of the packaging.

Design for Recycling

Taking the recyclability of a packaging into account during the design phase reduces the risk of pollution and prevents problems during recycling. The Sustainable Packaging Support Tool provides information about how to account for recycling during a packaging's design process.

Communication on packaging

It is important to communicate clearly and correctly to consumers where they should dispose of a packaging after use. This contributes to the effective collection and recycling of glass packaging. You can use the Disposal Guide (in Dutch: 'Weggooiwijzer') for this: https://kidv.nl/disposal-guide.

Conclusion

KIDV has compiled this fact sheet with the greatest possible care; see also the overview of consulted sources. No rights can be derived from this text.

If you have any further questions after reading this fact sheet, you can fill out the question form on KIDV's website.

More information

KIDV has drawn up various fact sheets about packaging and packaging materials, which also cover aspects as laws and regulations, food safety and biobased and biodegradable packaging. These fact sheets can be found in the library on KIDV's website.

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