

Recycling of glass packaging in Republic of Croatia

MIROSLAV KOVAČEC, NATAŠA TOŠANOVIĆ*, NEDELJKO ŠTEFANIĆ**

Vetropack Straža d.d. Glass factory
Hum na Sutli 203, 49231 Hum na Sutli
CROATIA

miroslav.kovacec@vetropack.hr

* Faculty of Mechanical Engineering and Naval Architecture
Section for Production Control
Ivana Lučića 5, 10000 Zagreb
CROATIA

natasa.tosanovic@fsb.hr

** Faculty of Mechanical Engineering and Naval Architecture
Section for Production Control
Ivana Lučića 5, 10000 Zagreb
CROATIA

nedeljko.stefanic@fsb.hr

Abstract: - A wide range of products is produced from glass, since glass is a very widespread packaging material. The production of glass requires the usage of a big quantity of raw materials (silica sand, soda, dolomite, feldspar), and the production cycle itself is extremely energy demanding, so that substantial quantities of energy have to be consumed. The use of old collected and recycled glass reduces the need for the basic raw materials, thus saving energy. Old glass can be remolten several times, not losing in quality. It is used as valuable raw material for the production of glass packaging. From one ton of waste glass, with the addition of energy, one ton of new glass jars will be obtained. The objective of this paper is to present the procedure of collecting and recycling the glass packaging in the Republic of Croatia, which makes it possible to obtain raw material (glass cullet) from the "waste". This raw material is reused for the production of new glass containers, thus preserving the environment and saving the energy.

Key-Words: - glass packaging, glass recycling, waste management

1 Introduction

The production of glass packaging material is a very demanding and complex production procedure which requires the investment of large amounts of energy which includes heating, melting and cooling of glass [1]. This energy can be reduced by using glass cullet in the mixture. By increasing the share of glass cullet in the mixture by 10% the total amount of energy for melting the glass is reduced by ca. 2.5 % - 3.3 %, which means also reducing the impact on the environment [2, 3].

When the Regulations on the packaging and packaging waste came into force in the Republic of Croatia at the beginning of 2006, i.e. of the deposit system of refund for the returned waste packaging, the return rate of old glass packaging tripled. The return rate of old glass packaging in 2005 amounted to 19 %, whereas in 2006 it rose to 58.5 % [4]. Croatia moved thus from the bottom of the rank list of the European countries up to the middle of the

list. However, we cannot be satisfied with the recycling rate of the packaging glass which in the Republic of Croatia in the recent several years ranged between 57 % and 59 %. It indicates that over 40 % of the glass packaging placed on the market ends up on municipal landfills or unauthorised dumping sites.

Glass packaging is a very widespread packaging material which is used to produce containers for cooling drinks, mineral water, wine, beer, spirits, children's food, glass jars for food preservation and others. The containers are of various colours: green, amber, flint-transparent, blue, etc.

In the recycling system of the waste glass packaging in the Republic of Croatia, the waste glass containers are collected and delivered to the factories to be recycled and there they pass through various levels of purification and separation of glass from other materials in order to obtain glass cullet of maximal purity. This purified glass cullet is then

used in the glass factory as one of the most important raw materials for the production of high-quality glass containers.

2 Legislation of the Republic of Croatia and EU in packaging waste management

The Regulations about the packaging and waste packaging in the Republic of Croatia were brought on 27 July 2005. The main reason of these Regulations is the reduction of the production of packaging waste, i.e. reduction of the total mass of waste in the Republic of Croatia, by separate collection of packaging waste and its reuse as valuable secondary raw material [5].

The Regulations stipulate the method and conditions of collecting the packaging waste, types of symbols for marking the packaging depending on the type of material, method of processing and disposal of packaging waste, and the amounts of fines for failing to comply with the provisions of the Regulations.

The producer, legal or physical person who packs the products in the packaging material or imports products in the packaging material has to cover the costs for the collection, disposal and recycling of waste of the primary packaging from the products they have marketed on the territory of the Republic of Croatia, and to provide designation of the product packaging, i.e. marketing of the product with adequate barcode in compliance with the international system of coding and identifying the product by EAN (European Article Numbering). All the producers are obliged to submit to the Environmental Protection and Energy Efficiency Fund until 1 March of the current year a report on the types and quantities of packaging material they placed on the market on the territory of the Republic of Croatia.

A salesperson whose sale area is greater than 200 m² has to allow setting of and manipulation of containers or other equipment for the collection of waste packaging. Besides, the salesperson has to organise the transport of the collected waste packaging from their sales premises and temporary warehouses to an authorised person for the disposal and recycling or to the temporary warehouse for waste packaging. The salesperson also has to pay a fee to the consumers of 0.5 kuna per unit of every returned disposable waste packaging. The fees received by the consumers are paid back to the salesperson by the Environmental Protection and Energy Efficiency Fund.

The fee and the deposit system include several fees for the disposal and return of the disposable packaging, as a kind of “incentive fee”.

All this is contained in the European Union guidelines. By adopting the EU directives about the packaging and the waste packaging – Directive 94/62/EC, and with modifications and amendments 2004/12/EC the European Union has brought the Act for more efficient recovery of the used packaging and reduction of the impact of packaging on the environment [6].

3 Glass waste packaging collection system in RH

Glass packaging waste has been collected since 1 January 2009 in green bags (40 items in a bag) with a safety string and a label with an adequate barcode. Glass packaging is not delivered to Waste Management Centres but rather transported to the temporary warehouses of the authorised collectors, i.e. directly to the recycler [7].

A lifecycle of a glass bottle for the beverages on the Croatian market is presented in Figure 1.



Fig. 1. Life cycle of glass packaging

Like the two other types of beverage packaging, glass packaging marks also very high return percentage, which is delivered via Waste packaging management centre or directly from the collectors to the authorised recycler of glass packaging. The

recycling of glass packaging completely closes the cycle of return into the product of the same type – glass container.

4 Recycling of glass packaging

The collected glass packaging waste is delivered to the recycling factories where immediately upon entry the waste is sorted according to colour and according to quality categories, if the glass waste is delivered that does not need to be processed before use (glass cullet for instance from the bottling plants during packaging replacement).

Regardless of whether it is pure or impure glass waste, it needs to be stored on a plateau designed in such a manner that there is no danger of impurities emissions into soil, water and air.

Impure glass packaging waste is usually delivered packed in specified bags of the Environmental Protection and Energy Efficiency Fund, so that the first step is debagging. The waste glass packaging is transported by means of a conveyor belt to the dose bunker. While passing through the sorting area, the glass waste passes

through various levels of purification and separation of glass from other materials in the recycling factory.

The track magnet is used to remove magnetic waste from glass, and solid big waste (china, brick, plastics) is separated manually on the sorting belt conveyors. Glass cullet is then downsized by a crusher to optimal size. The sieves are used to separate big pieces of glass and foreign material, and for fine fraction. Special devices are used to separate non-magnetic waste (aluminium, Pluto cork), stone, china and ceramics [3], whereas paper waste is separated by exhaust devices. The separation of single colours of glass – flint, amber, green, blue – from the mixed cullet is done by selecting the required program on a special device – colour separator.

This is followed by one more quality control after which the pure glass cullet is stored in the storage plateau and waits for transport to a glass factory where it will be used for the production of glass packaging. The entire procedure of obtaining glass cullet from the collected waste glass packaging is presented in Figure 2.

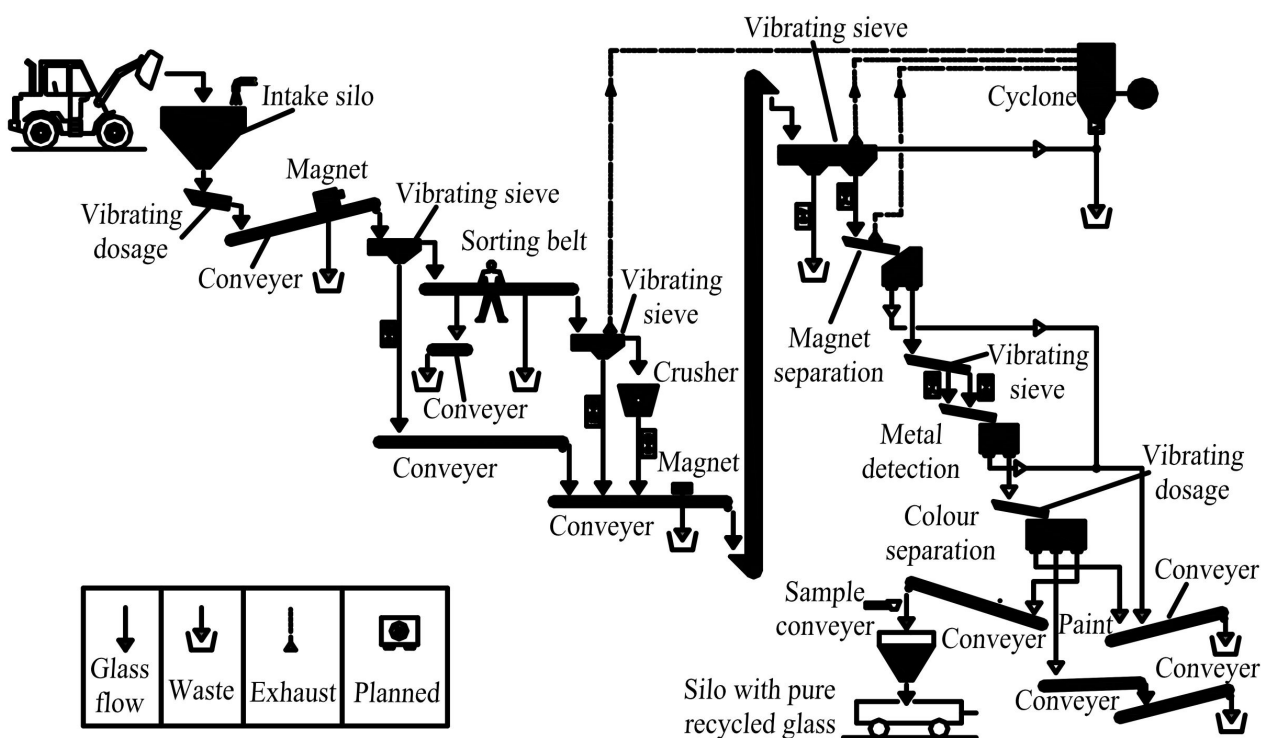


Fig. 2. Recycling of glass packaging

Waste that is generated during the recycling of waste glass packaging, according to the Regulations on the Categories, Types and Classification of

Waste with the Waste Catalogue and the List of Dangerous Waste (NN 50/05), belongs in greater part to non-hazardous waste. The total waste is

collected in containers, weighed and disposed in the regulated manner. The waste that cannot be recycled (labels, cork and plastic stoppers), according to the Waste Catalogue (NN 50/05) belongs to municipal waste (KB: 20 03 01) and delivered to the municipal landfill. Waste that can be recycled (bags (KB: 15 01 02), metal stoppers (KB: 19 12 02) are delivered to authorised concessionaires.

According to the Regulations (NN 50/05) minute glass fraction, and minute pieces of stone, china, and ceramics together with glass sludge are classified as inert waste which is deposited at inert waste landfills.

While performing the activities of recycling of waste glass packaging no dangerous waste is generated.

5 Conclusion

It is precisely because of the high share of the glass packaging on the market, that it has to be collected as much as possible, and then recycled.

Glass recycling reduces the need for raw materials (silica sand, soda, dolomite, feldspar) [3, 8], and they need not be exploited from the environment. Each ton of recycled glass preserves 1.17 tons of raw materials and a large amount of energy which is necessary to heat the raw materials to the temperature higher than 1,600 °C in order to obtain glass melt from which glass containers are made.

The recycling of waste glass packaging is thus claimed to preserve the environment, since the raw materials are not exploited, energy is saved, the emission of CO₂, NO_x, SO₂ particles is reduced because less heat energy which is usually obtained from land gas and electrical energy is needed for the melting of glass cullet than for obtaining of glass melt from raw materials. New workplaces have been opened for the needs of recycling old glass waste. In

the future the activities regarding the education of the public should be intensified so that the recycling rate of the glass packaging would be even higher than the current 60 %.

ACKNOWLEDGMENT

The authors express their gratitude to the *Vetropack Straža – glass factory Ltd.* company for the assistance in understanding the glass containers recycling system.

References:

- [1] Patrascu, R., Minciuc, E., Darie, G., Complex analysis and evaluation of processes from the glass industry, *Proceedings of the 4th IASME / WSEAS International Conference on Energy & Environment (EE'09)*.
- [2] Ruth, M., Dell'Anno, P., An industrial ecology of the US glass industry, *Resources Policy*, Vol. 23, No. 3, pp. 109-1024, Elsevier Science Ltd 1997.
- [3] Vellini, M., Savioli, M., Energy and environmental analysis of glass container production and recycling, *Energy* 34 (2009) 2137–2143.
- [4] http://www.vetropack.hr/html/glasrecycling_6.htm
- [5] Pravilnik o ambalaži i ambalažnom otpadu, Narodne novine, broj 178/04.
- [6] http://ec.europa.eu/environment/waste/packagin/index_en.htm
- [7] <http://www.fzoeu.hr/hrv/index.asp?s=propisi>
- [8] Kovačec, M., Pilipović, A., Štefanić, N., Improving the quality of glass containers production with plunger process control, *CIRP Journal of Manufacturing Science and Technology* 3 (2010), 4; 304-310.