General Study for Manufacturing Low Carbon Footprint Plastic Parts

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General Study for Manufacturing Low Carbon Footprint Plastic Parts: *Increasing international interest over the climate change has brought up a very controversial problem: the long-term trend of global warming. Since the mid-20th century, global average temperature has increased most likely due to the increasing concentrations of anthropogenic gases. Manufacturing accounts for 19% of greenhouse gases emissions. A particular attention is paid to carbon dioxide. Estimation of the total amount of GHG emitted during various stages of the product life cycle has led in obtaining carbon footprint products.*

Key words: *Global warming potential, Greenhouse gases, Carbon footprint, Manufacture, Plastics.*

INTRODUCTION

The mitigation of carbon emissions is an important topic for any government's agenda, and nations are trying their best to reduce its carbon footprint to the maximum possible extent. Many companies would like to reduce the carbon footprint of their products, and consumers have become more aware of the environmental problems that the world is facing and are looking for products that emit lower carbon emissions in their entire life cycle. Assessment of the carbon footprint for different products, processes, and services, as well as the carbon labelling of products, have become familiar topics recently in various industrial sectors. Every industry has unique assessment and modelling techniques, allocation procedures, mitigation methods, and labelling strategies for its carbon emissions.

In the present paperwork, we review the available scientific literature on the concept and calculation of carbon footprint and we evaluate different methods for calculations for plastic products, especially blowmoulded parts that are used as air conditioning and heating systems in the automotive business.

The car is the symbol of our individual mobility. At the same time, a significant amount of emissions with a harmful effect on the climate is given off by individual, motorised mobility. The ecological footprint of every individual is determined by this aspect to a considerable extent. For this reason, it is important to travel by car as little as possible, to drive energy-efficient vehicles and to offset the unavoidable CO_2 emissions in a carbon offset project. There were made several calcutors that determines the CO2 emissions that arise during a car journey. It not only takes into account the direct emissions arising from fuel combustion but also so-called grey emissions. These arise from the production of the vehicle, the provision of road infrastructure and the extraction, transportation and processing of the crude oil.

Existing approaches to reducing environmental impacts along the plastic product production are focused largely at the scale of the plant (primary production), rather than considering the whole cycle of the product (including consumption chain).

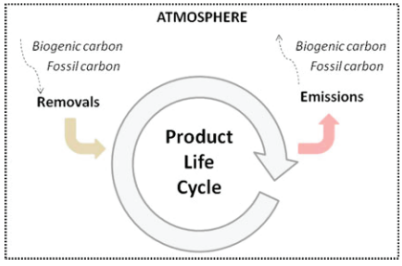

Fig.1. Flows considered in the product carbon footprint [1]

Among different quantitative indicators, the carbon footprint has gained popularity and widespread application. The concept of carbon footprint has been widely used to communicate about the climate responsibility, by its easy methodology of conveying information about the GHG intensity of variety of products and activities among the general public. Because of its encreased use, scientific analyses of carbon footprint have been conducted for consumer products and industrial processes in then last years.

Carbon footprint is the total set of GHGs emission caused by a product. It is often expressed in terms of carbon dioxide equivalent of all GHGs emitted. A product's carbon footprint can be measured by undertaking a GHG emissions assessment. Once the size of a carbon footprint is known, a strategy can be devised to reduce it by technological developments, better process and product management and alternate consumption strategies.

METHODOLOGY

1. Types of plastic

In recent years the plastics deal an important place in the automotive industry. New types of materials used in extrusion blow molding technology such as: PA, PA glass fiber, along with the usual PE and PP has brought significant advantages to these types of benchmarks compared to previously used materials. Thanks to the technology of processing complex shapes can be obtained with low cost of plastic residues is recycled and enhancing the life of the car. It is easy to explain that this technology is on an upward trend, all of it is developing several methods.

There are three types of plastics: high-density polyethylene (HDPE), low-density polyethylene (LDPE) and polyethylene terephthalate (PET).

HDPE is used for a wide variety of products, including milk jugs, automobile fuel tanks, toys and household goods. It is also used for packaging many household and industrial chemicals such as detergents and bleach and can be added into articles such as crates, pallets or packaging containers. (ICIS, 2009)

LDPE is used mainly for film applications in packaging, such as poultry wrapping, and in non-packaging, such as trash bags. It is also used in cable sheathing. (ICIS,2010a).

The largest use for PET is for synthetic fibers, in which case it is referred to as polyester. PET's next largest application is as bottles for beverages, including water and other products.(ICIS, 2010b)

The carbon footprint is a globally accepted tool for quantifying the environmental burdens of products. This indicator can be obtained through the implementation of an Life Cycle Assessment (LCA) analysis, like other environmental business activities. The goal of the method is to quantify the global GHG emissions related to the entire life cycle of a product, process or service. This quantification is expressed in CO_2 equivalent (a unit for expressing the irradiative forcing of a GHG to carbon dioxide) and has become a common indicator for environmental assessment.

Carbon footprint, being a quantitative expression of GHG emissions from an activity helps in emission management, but also in evaluation of measures to reduce the impact over the environment. As a basic knowledge to calculate the carbon footprint is the calculation of Global Warming Potential (GWP).

In the automotive industry HDPE is the main material used for obtaining blowmoulded parts. The main parts that are obtained through extrusion are air ducts for air conditioning and air supply to the engine and various tanks as well, for fuel, coolant, windshield washer fluid.

Fig.2. Air Duct made in Subansamble Factory

2. Raw Materials acquisition and manufacturing

Plastic resins are made from derivatives of petroleum and natural gas. The first step in plastic manufacture is the acquisition of derivatives from refined petroleum and natural gas, which results in process energy and non-energy GHG emissions from the extraction and refining of petroleum and natural gas. The petroleum and/or natural gas are then transported to plastic manufacturers, which results in transportation GHG emissions. Once the manufacturers have the appropriate inputs, the two main processes in plastic manufacture are cracking and processing.

In the process of cracking, hydrocarbons from refined petroleum and natural gas are heated to extremely high temperatures during the cracking process to break down the larger molecules into smaller hydrocarbons such as ethylene and propylene.

During the processing phase, the simpler hydrocarbon molecules are made into chains called polymers, which are then combined in different variations to make plastic resins with different characteristics.

Plastics can be manufactured from 100 percent virgin inputs but are often manufactured from a combination of virgin and recycled materials.

In the process of blowmoulding we have the concept of mixing material. The utilisation of a mixture of materials is carried out in order to obtain certain characteristics of the product. The choice of material is based on the characteristics of the finished product. Temperatures working extruder and head is dependent on the material (or mixture). Observe the proportions set out in mixing because the characteristics and quality of the product. It requires proper handling of materials that are used in the mixture (recepturii) and prevent contamination of the material, in all stages mixture (waste recovery, grinding, mixing-dosing).

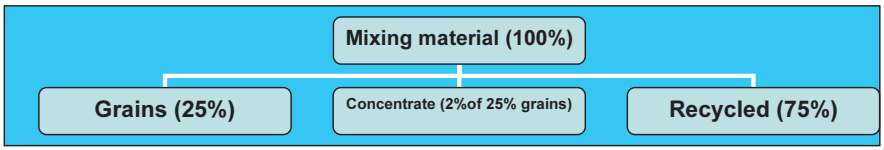

Fig.3. General schematics of material used in Subansamble for blowmoulded parts

3. General description of blowmoulding process

Blowmoulding technological process is a process by which the plastic extruded has form of a sock (hollow) and a clearly determined by "inflating" its breathalyser within a

mold, followed by cooling.

By this process can be obtained relatively thin-walled parts (0,5-5mm) hollow as: bottles, barrels, air or water pipelines, reservoirs.

Extrusion - blowing is a process that can be used to produce hollow articles such as bottles for various liquids or pipes for the automotive industry. In the process of extrusion blow molding, plastic material is plasticized inside a cylinder fitted with a variable pitch screw and pushed by the extruder head that gives a blank hollow cylindrical shape (known as parison-English, French or trousers paraison- or stocking the Romanian industrial practice); it is either transferred to mold or mold over. Once in the mold, the preform is inflated, either by a blowing mandrel or by means of a needle inserted in it. Compressed air pressure makes the plasticized material to be "bonded" to the cavity wall; by transferring heat to the mold it was cooled by allowing opening of the mold and removal of the preform thus obtained. The process of extrusion-blowing can be used to produce both simple symmetrical parts and parts which have three-dimensional curves.

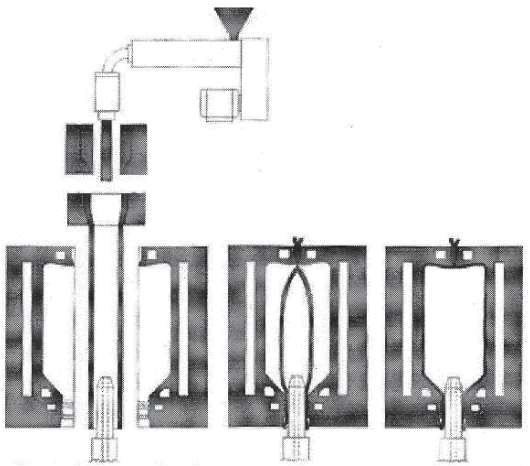

Fig.4. General description of the blowmoulding process

4. General calculations

Currently, there is no single methodology and no international agreement on methods for calculating carbon footprints for the blowmoulded parts. At least, the generalised standard three-tier approach of the GHG protocol must be followed in the generalised standard three-tier approach of the GHG protocol must be followed in order to maintain uniformity among different studies. The selection of the boundary depends on the level up to which carbon footprints are to be calculated. GWP of all the tiers is calculated individually using the conversion factors of IPCC [7] corresponding to a 100-year time horizon. The formula for the calculation of GWP of tier i (i=1,2 or 3) is given by [8]:

$$GWP(tier_i) = \frac{emission}{removal} CH_4 x25 + \frac{emission}{removal} N_2 Ox298 + \frac{emission}{removal} CO_2 \left[kgCO_2 / kgplastic\right] \quad (1)$$

Emissions are taken as positive while removal as negative. Values are given in kg/m2. Carbon footprint is calculated by adding the GWP of all tiers.

$$CF = \sum_{i=1}^{3} \left[GWP(tier_i)\right]\left[kgCO_2 / kgplastic\right] \quad (2)$$

These calculation are to be used in order to make a complete study of the environmental responsibility of automotive industry and reciclying of solid wastes into new value-added products that can lead to improvements of life cycle assessment, by creating

close loops in terms of sustainable utilisation, increasing the eco-effciency and economic efficiency.

CONCLUSIONS AND FUTURE WORK

Carbon footprinting has become a strong and popular indicator of the GHG intensity of any activity or organization. Due to its important role in raising awareness regarding responsibility toward global warming, scientists and policy makers are trying to use it as a management tool. However, its application over the blowmoulded plastic parts sector is still limited. A standard methodology is required to address the emissions associated with the blowmoulded process, where there is a strong need of evaluation in order to evaluate and action towards the reduction of impact over the environment.

The lack of sector and region specific methods adds some uncertainity in the current studies on carbon footprint.

According to latest directions of European Community, there is a strong desire that by 2020 every part that is mounted on a car must have calculated the carbon footprint.

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This paper has been reviewed.