ABSTRACT TITLE: DECREASE IN EMISSIONS OF GREENHOUSE GASES THROUGH PRODUCTION WASTE MANAGEMENT

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НАЗВАНИЕ СТАТЬИ: СНИЖЕНИЕ ВЫБРОСОВ ПАРНИКОВЫХ ГАЗОВ ЧЕРЕЗ УПРАВЛЕНИЕ ОТХОДАМИ ПРОИЗВОДСТВА

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Аннотация. *В настоящее время население мира растет очень быстро. Такой рост населения способствует высокому загрязнению окружающей среды. Сжигание углеводородного топлива неизбежно ведет к накоплению в атмосфере углекислого газа и усилению парникового эффекта.*
Цель исследования заключалась в оценке возможности использования в производственном цикле вторичной переработки использованных ПЭТ бутылок как варианта утилизации отходов, который может существенно уменьшить экологические проблемы, связанные с отходами пластиковых бутылок. Количество парниковых газов может быть сокращено за счет отказа от захоронения и сжигания в пользу переработки. Переработка является экологически более предпочтительной для утилизации ПЭТ продуктов.

The combustion of hydrocarbon fuels on scales of planet conducts to an increase in the content of the dioxide of carbon CO_2 in the atmosphere. according to the data of German physical society the content CO_2 it increased in 100 years, beginning from 1850 through 1950 by ~15% and then it rose yearly to 1988 to ~0,3–0,5%. At the beginning of this century it already has to exceed 390 ppmv.

The increase in the maintenance of CO_2 (and also NO_2, CH_4 and some other gases) in the atmosphere conducts to greenhouse effect. It is connected with what the content of carbon dioxide in the atmosphere generally defines a share of the thermal radiation of Earth going to space. With increase in the maintenance of CO_2 in the atmosphere this share decreases. Because of it there is a shift of dynamic balance towards the general warming on Earth. In the recent decades greenhouse effect and its likely consequences are studied in the entire world by many specialized academic institutions and are analyzed by outstanding specialists. Forecasts are not consoling. Grand average warming up to 1–2 K, expected in the next decades, it will cause the completely catastrophic planetary consequences: the melting of the glaciers of the Arctic and Antarctic, a sharp climate change on the Earth.

The production of different forms of polymers has absolutely different energy consumption and a volume of emissions. On this stage it was examined the production of PET bottles for calculating the ecological profile at the stage of the production (Table 1).

Production Stage – Emissions and Energy Requirements for producing a 1L PET bottle.

Table 1

Environmental Profile for PET – PET Production Stage

Raw material	Oil & natural gas	Main Product	1kg PET is produced
Energy	83,8 MJ/kg	Solid waste	0,045130 kg/kg
Transport	0,2 MJ/kg	Emissions	CO_2-2330 g/kg; SO_x-25 g/kg; NO_x -20,2 g/kg; CO-18 g/kg HCs-40 g/kg

Disposal of PET plastic bottle Waste. Plastic waste can be disposed-off using different kinds of methods: recycling, export of waste to the landfill, incineration. Recycling was also one of the improvement methods to be considered in this study. Important to note, that recycling activities will reduce the waste generated to the earth and eventually lessens the risks of environmental burdens caused by the PET bottle [1, 2, 3].

PET Waste Recycle – Emissions and Energy Requirements. Where reuse is not the most environmentally sound way of extracting value from plastic bottle wastes, an alternative is to recycle them into feedstock or into energy recovery so that their intrinsic value is not lost. These two technological methods of plastic waste recovery have been developed in the industrialized countries on a large scale, mechanical recycling and incineration with energy recovery. Once the recyclates have been cleaned and shredded, the process is much the same as for the production of the PET plastic bottles from feedstock. Most plastics are recycled mechanically, but chemical recycling is at a developmental stage. Plastic bottles are the main type of plastics collected and recycled from household waste. During the process of recycling, energy is required and emissions are released to environment.

Global Warming. Table 2 presents the environmental impact for a 1kg PET bottle treated with different waste disposal methods. Global warming is the rising of the global temperature due to emissions of greenhouse gases. The only greenhouse gas emissions of any significance in the manufacture and disposal stages of the PET bottle are carbon dioxide and methane. Based on the results in Table 2, the order of preference is that recycling is better than incineration and landfilling in terms of energy and emissions. The emissions contributing to global warming for incineration of PET bottle is rather similar to the emission for landfilling. This is because all the fossil carbon is released during incineration, as well as during landfilling.

PET can also be co-incinerated with other combustible products from the waste stream which will give even greater contributions to the reduction of greenhouse gases by the prevention of the emission of methane gas from landfills. Methane has a global warming potential of 30 times that of CO_2 [3. This is why the prevention of waste going to landfill is a key measure to reduce the greenhouse gas emissions.

Table 2

Environmental impact for different treatment methods of the PET bottle

Environmental Impact	Waste Recycled	Waste to Landfill	Waste Incinerated
Global Warming (kg CO_2-eq)	3,33	47	4,3

Example of Calculation for Global Warming Value

Process X releases 2.495 kg CO_2 and 0.040016 kg CH_4

The equivalency factors are the 100-year Global Warming Potentials (GWPs):

Q global warming-CO_2 = GWP CO_2 = 1 g CO_2

Q global warming-CH_4 = GWP CH_4 = 21 g CO_2/ g CH_4. The potential contribution to global warming of methane is:

Q global warming-CH_4 =21 g CO_2/ g CH_4 x 40 g = 840 g CO_2-Eq.

The total contribution of Process X to global warming is:

Total global warming = (2,495 + 840) kg CO_2 = **3, 33 kg CO_2-Eq.**

Summary. PET bottle plastics make a valuable contribution to the way we live, but as a society we need to find ways of using these plastics more wisely. The way we make, use and dispose of PET plastic bottles should have a minimal impact on the environment. Some of the methods to reduce the impacts on the environment are:

1) A greener plastics industry

The manufacture of plastic materials is one of the major industries with potential for serious pollution to the surrounding environment. Different types of plastics manufacturing processes and disposal methods will contribute to different effects on the environment. Therefore, government agency must ensure that industry operates in a way that minimises adverse effects on people and the environment, and contributes to the achievement of sustainable development.

2) Reducing the waste generation

As a society, we are generating an increasing amount of waste. As with other materials, more must be done to reduce the amount of PET plastic bottle waste we produce. There has been a shift towards a ‘disposable’ culture, and the lower cost of plastics may have contributed to this and the associated growth in waste.

3) Practicing recycling habit

The attitude of the public in recycling practices should be improved. The public should be well informed of the importance to recycle. Environmental influences appear particularly effective among members of the public who have a “strong belief in personal responsibility and influence, as well as the power of self-determination”. The public would recycle more if they had a greater understanding of the environmental benefits of recycling.

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