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Tyre Recycling with Thermal Solvolysis Method Using Microwave Radiation

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EXTENDED ABSTRACT

Used tyres are one of the most widespread types of waste and one of the polymer materials which are most difficult to recycle.

There are many different applications for used tyres today. Part of the tyres can be retreated and re-used, but most of the used tyres are recycled. Every year, around 2.5 millions tons of tyres wear out only in Europe, and their recycling rate reaches 90%. Most of the tyres (about 40%) are burned for energy. Slightly lower proportion of used tyres (about 30%) are shredded for further use either in shredded form or as raw material for pyrolysis or thermal solvolysis. 20% of used tyres are restored in order to be reused.

By dissolving the tyres it is possible to filter out various chemical substances. These substances coming from the used tyres can be used for creating a new material or improving an existing one. One of the technologies involves adding chemically recycled tyres to the bitumens used in road pavement construction. It could result in possible reduction of binder price and improvement of its properties, which generally will improve road surface quality. The substances obtained from the recycled tyres can be used in the water proofing of bitumen. Adding these substances not only can reduce the costs for water proofing but also improve its properties.

Methods of pyrolysis and solvolysis are used for recycling tyres into raw materials. Thermal solvolysis has several advantages over pyrolysis: recycling conditions are softer due to solvent used and lowered temperature to 200-400°C in the process (Амосова И.С., 2005); possibility to use bigger pieces of tyres; gas emission reduction to 1% at a temperature of 300°C; possibility to change the properties of the final product obtained with solvolysis by changing the solvent and temperature.

In this research tyre recycling with thermal solvolysis is studied by using a conventional oven and microwave oven in order to obtain waterproofing materials with improved exploitation properties. Promising results are obtained in the pre-studies on the tyre recycling in the microwave allowing to reduce energy consumption before thermal processing of tyres as well as during the thermal processing process compared with methods involving heating in traditional furnace (Алексеенко, В.В., 2010).

Dissolving time of the recycled tyre pieces depending on the size of the pieces as well as energy consumption depending on furnace type, operating temperature and time have been assessed during the experimental part.

Adhesive properties of the rubber-bitumen composite obtained during the experiments were tested.

Results of the experiment showed that the dissolving time of used tyres in the microwave oven is on average 22 times shorter than in a traditional furnace. Recycling time for the pieces with fractions 5-12 mm is 9% longer than for the pieces with fractions 0.1-1.0 mm heating in a traditional furnace and 27% longer heating in a microwave oven.

After testing the adhesive properties on the concrete surfaces it can be concluded that rubber-asphalt composite obtained in a microwave oven has the best adhesion because no waterproofing peeling has been found.

Keywords: *thermal solvolysis, rubber-bitumen composite, waterproofing.*

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