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ORIGINAL PAPER

Sulphur distribution in the products of waste tire pyrolysis

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The aim of the presented work was to investigate the distribution of sulphur in tire pyrolysis products as well as the influence of process parameters (temperature and residence time) on sulphur distribution due to environmental concerns. Among modern methods used for waste tire recycling, pyrolysis is one of the most reasonable alternatives meeting current environmental standards. However, waste tire sulphur content can be a potential drawback for pyrolysis products utilisation as fuels. Sulphur is present in tires in different concentrations, depending on the type and age of the tires. Typical sulphur content in tires is about 1.6 mass %. In this paper, the distribution of sulphur in tire pyrolysis products was investigated. Tire pyrolysis yields three different products: liquid, gaseous, and solid residue composed mostly of carbon black (chars). Temperature and residence time are the two most important parameters affecting the yield and composition of the volatile fraction and they are therefore expected to affect the sulphur content in residues. Pyrolysis experiments were carried out in a laboratory pyrolysis reaction unit in the temperature range of 650 °C to 750 °C at different residence times: 88.6 s, 80.2 s, and 73.9 s. Liquid and solid products were analysed by elemental analysis and the distribution of total sulphur in tire pyrolysis products was calculated.

Keywords: waste tire, pyrolysis, sulphur distribution, pyrolysis products

Introduction

The disposal of organic non-degradable waste is one of the most crucial environmental problems nowadays. The waste tire stream is a major waste stream in today's urban environment and its disposal is receiving increasing attention. The total world production of waste tires increases annually with the main producers of waste tires being: North America (2.5 million tonnes per year), Japan and China (6.2 million tonnes), and European Union which produces more than 2.5 million tonnes of used tires each year (Williams & Brindle, 2003). Different recycling methods were used in the past but all of them have significant drawbacks when considered for this type of process and material. Some of the drawbacks are: low efficiency, unacceptability by environmental standards, or economic unprofitability. One common method of disposal is landfilling which is, however, accompanied by several limitations; a significant amount of space is needed resulting in massive stockpiles, where accidental fires with high emissions of dangerous gases can occur, it is also a potential ground for diseases that can be spread by vermin like mosquitoes, etc. Other alternatives, like reclaiming, retreading, or grinding, were proven to be insufficient in a similar way (de Marco Rodriguez et al., 2001). One of the ways of assessing waste tires energy potential is incineration, where waste tires are used as a fuel especially in cement kilns, power stations, and paper mills (Juma et al., 2007). However, there are some disadvantages of incineration considered for power applications: large capital investment, need of flue gas depuration, and relatively high operating costs (Sharma et al., 2000). Pyrolysis is another method of waste tire recycling. It is considered as a non-conventional method of waste tire recycling

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