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A Study on Environmental Assessment of Residue from Gasification of Polyurethane Waste in E-Waste Recycling Process

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Abstract

With expanding economic growth, the consumption and changing period of electronics products have increased rapidly in last couple of decades in Korea. A refrigerator generally contains 10% of polyurethane. Since the amount of used refrigerators collected at recycling facilities of E-wastes (electronic waste) has increased since 2007, the generation of polyurethane waste has also increased. Polyurethane recycling technologies have been investigated for polyol production and sound-absorbing materials, which are not commercialized yet due to high cost of the technology. However many kinds of plastic wastes are being used as SRF (solid refuse fuel) like RDF (refuse derived fuel), so polyurethane in E-waste could be utilized as valuable fuels, since it has high calorific values and contains low sulfur, low chlorine, and less hazardous substances[Park, C. S. (2013).]. Using a fixed bed reactor, gasification experiment was conducted onpellet type SRF made of polyurethane at 1,000 °C temperature for study purpose. Environmental assessment on gasification residue was also performed byleaching test and the loss on ignition[Kim, C. S., 2008]. The main objective of this experiment was to assess whether polyurethane gasification residue is hazardous for environment or not and also to find out it is recyclable or not.

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1. Introduction

With economic growth, both consumer's demand and the uses of modern equipment have widely spread. This also increases waste generation rates, the management of which has been a major issue. The use of television sets, air conditioners, refrigerators, washing machines, and other home appliances has increased due to improving living standards and the purchasing capacity of consumers. On the other hand, the average lifetime of such products are decreasing. After a certain time they are discarded as waste, which requires treatment. The treatment cost for such equipment involves the fees for collection, transport, crushing, and finally landfilling. In addition, electric home appliances are composed of various materials and their breakup and separation is difficult. However many kinds of plastic wastes are being used as SRF like RDF, so polyurethane in E-waste could be utilized as valuable fuel, since it has high calorific value and contains low sulfur, low chlorine, and less hazardous substances. In gasification experiment, one of the final product is bottom ash, which usually discarded on landfill. Sometime this residue can be hazardous and can pollute the environment. So before discarding it is very important to assess the environmental effects.

2. Materials and Methods

Bottom ash was sampled from lab scale gasifier. Environmental assessment was performed on bottom ash. Korean standard method for leaching test was experimented on bottom ash. Based on the results of the leaching test we can decide whether polyurethane ash is a general waste or a hazardous waste. If the amounts of heavy metals leached from the ash exceed the regulation, the ash is classified as a hazardous waste. Korean waste management law for leaching test is as follows: Ash and DW (distilled water) at a weight/volume ratio of 1/10 (10 g of ash and 100 ml of DW) was mixed and shaken for 6 hours at a pH in the range between 5.8 and 6.3 and then centrifuged for 20 min at 3000 rpm. The supernatant was filtered by using a fiberglass filter of 1.0 μm, and the concentration of heavy metals in the supernatant was analysed by ICP (inductively coupled plasma spectrometer) [Shim, Y. S., et al, 2005]. Figure 1 is showing shaking process of leaching test.

Fig. 1. Heavy metal leaching test

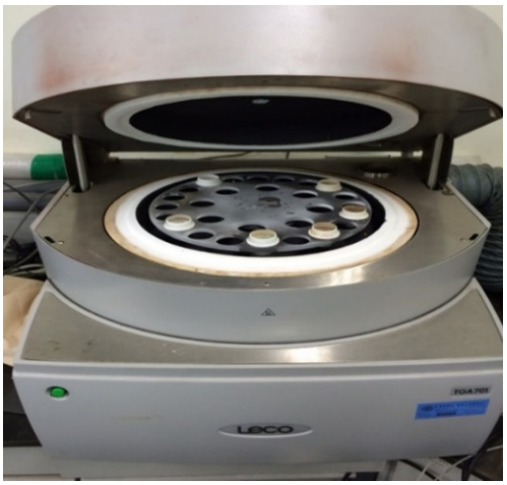

Fig. 2. TGA-701 (LECO Co.)

Loss on ignition was conducted on bottom ash at 600 °C temperature using TGA-701, heating rate was 10 °C/min. It was analysed combustible components of bottom ash. Figure 2 shows instrument conducted loss on ignition.