Abstract Book of the 2nd International Conference on Recycling and Reuse
June 4-6, 2014 - Istanbul / TÜRKİYE

Comparison of Solids Product Obtained from Waste Tyre Rubber via Chemical Degradation with Pyrolysis Solid Product *(Chars)*

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Keywords: Chemical Degradation, Pyrolysis, Waste Rubber, Recycling, Chars

With the rapid development of automobile industry, an enormous number of waste tires cause a series of environmental problems. How to deal with these waste tires is common challenge for human beings (Gao N.,2009) The aim of this work is to compare the solids product (char) obtained from waste tyre rubber via chemical degradation in our laboratory experiments with pyrolysis solid product (chars) given in literature. Chemical reclaiming process is a possible method for devulcanizing the vulcanized network through the use of chemical agents that attack the C–S or S–S bonds(Sadaka, F.,2010; Dubkov, K.A.,2012). A large number of studies have been conducted on pyrolysis of waste tyre in the literature. The pyrolysis of waste tires proves to be a high value-added and environmentally friendly technology in numerous technologies of disposing waste tires. During the pyrolyzing process, pyrolytic waste tire char as one of the main products is obtained. It possesses similar structure of carbon black, owning general properties of carbonous materials such as high thermal stability, great corrosion resistance in acid/base. In this study, the chemical degradation experiments of waste tire rubbers crumb were carried out in the reaction vessel by using inorganic and organic chemicals to decompose easily on account of cross linking and stabilizers at three reaction temperatures and time in the range of 130 – 150 ^{0}C and 10 – 30 min. under atmospheric pressure. The experiments were carried out in three series. Firstly, three different quantities (3g, 6g and 9 g) of waste tire rubbers crumb samples were studied at 1400C reaction temperature and 20 minute reaction time to define the optimum quantity samples for the best cleaving carbon-carbon or other stronger cross links in this experimental study. After that, the experiments have been performed three different reaction temperatures and time in the range of 130 – 150 0C and 10 – 30 minute, respectively. Each experiment was carried out three times. Experimental studies showed that the reaction time, the reaction temperature, acid/waste tyres rubber ratio, can be used to control the break down. The products selected for analysis in this study were obtained in the maximum yield at 140 ^{0}C reaction temperature and 20 minute reaction time conditions. The solid products were analyzed to determine their elemental composition, and also the chemical compositions were investigated by spectroscopic techniques. Elemental analysis of the waste tyre rubbers crumb and solid products was performed on a LECO CHNS 628 model (LECO Corporation, U.S.A) elemental analyzer. The HHV values were calculated by Beckman's Formula HHV (MJ/kg) = 0.352C + 0.944H + 0.105(S–O). C, H, S, O represent carbon, hydrogen, sulphur and oxygen content of material, respectively, expressed in % by mass on dry basis. Determination of ash, moisture and volatile matter was performed according to ASTM Standards. The proximate and ultimate analysis of waste tyre rubbers crumb are shown in Table 1 and Table2

Table 1. Proximate and ultimate analyses of waste tyre rubbers crumb.

Proximate analysis (as received, wt. %)	
Moisture	0
Volatile matter	63,03
Fixed carbon	28,99
Ash	7,98
Ultimate analysis (dry, %)	
C	86,89
H	8,34
N	-
O[a]	3,65
S	1,12
HHV[b] (MJ kg^{-1})	38,20
[a] Calculated from weight difference. [b] Higher Heating Value.	

Table 2. Proximate and ultimate analyses of solid product

Proximate analysis (as received, wt.%)	
Moisture	4,57
Volatile matter	53,37
Fixed carbon	39,84
Ash	2,22
Ultimate analysis (dry, %)	
C	72,41
H	4,55
N	0,57
O[a]	18,79
S	3,68
HHV[b] (MJ kg^{-1})	15,1
[a] Calculated from weight difference. [b] Higher Heating Value.	

The new method seems to be applicable to the recycling of waste tires. The findings of laboratory-scale studies are encouraging and warrant larger applications of recycling of waste tire rubbers crumb for the production of active carbon.

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R&R, 2014

2nd International Conference on Recycling and Reuse

Book of Abstracts
Poster Presentations

June 4-6, 2014
İstanbul - Türkiye

RECYCLING AND REUSE, 2014

2nd INTERNATIONAL CONFERENCE ON RECYCLING AND REUSE

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İstanbul / TÜRKİYE

June 4-6, 2014

2nd International Conference on Recycling and Reuse, R&R 2014 (İstanbul, Türkiye)

İstanbul : **İstanbul University Environmental Engineering Department**
Boğaziçi University Institute of Environmental Sciences

344 p.
ISBN 978-975-518-364-0

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