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Thermocatalytic conversion of plastic waste over catalysts synthesized by interzeolitic transformation

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Resumo-Abstract

Plastics are polymeric materials with a wide variety of properties and are very present in everyday life. Although, as useful as they can be, their waste can take centuries to be completely degraded, with the accumulation of plastics in nature causing serious environmental problems such as contamination of the water, the food chain, and even the air, due to microplastic particles (WWF, 2019). A way to reduce this excessive amount of plastics in the environment is through chemical recycling to generate other products, such as chemicals and fuels. This work aimed to study the pyrolysis and the hydrothermal conversion of high density polyethylene (HDPE) waste using zeolites synthetized through interzeolitic conversion, in order to obtain higher economic valuable chemical products, focusing on fuels. The pyrolysis system consisted on a vertical tubular furnace, the triturated plastic waste was deposited over a quartz wool bed inside a small vertical quartz reactor, which was then heated under a 10°C/min heating rate and a 100mL min^{-1} N_2 flow. The temperature was varied, with each product phase's mass being quantified after the tests, to study its influence on the HDPE pyrolysis. That way, it was perceived that increasing the temperature from 400 to 500°C, the amount of gaseous products increased, from 18.1% to 54.2%, as expected since the temperature is a parameter that controls the cracking of the polymeric chains and its degradation rate (Sharuddin et al, 2016). But, at temperatures like 600 and 700°C, an inversion was observed, with a high amount of solid phases being formed, 27.2% and 32.6%, respectively, while the percentage of gases masses decreased to 39.5% for the 600°C test and 34.8 for the 700°C test. It was also noted a difference between the solids below and above 600°C, with that last ones presenting a yellowish color. The pyrolysis products were characterized through ATR, where there was identified the presence of long aliphatic chains and olefin unsaturation related bands. No liquid phases were observed in this system until the test with the zeolite catalyst, where 10% of the plastic mass was of the zeolite gmelinite (GME). It was observed that a higher amount of gases were produced when compared to the test without catalyst at the same temperature. Eventually, other zeolites such as ZSM-5 (MFI), Y (FAU) and Chabazite (CHA) will be added to the thermocatalytic test to study how their properties may alter the proportions of product's phase formation and how to use them to direct to a higher production of a certain phase, since some properties like pore size, pore structure and acidity can have different effects on plastic pyrolysis reaction mechanism.

Palavras-chave: Zeolites, Chemical Reciclyng, Plastic Waste

Referências

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WWF. Brasil é o 4° país do mundo que mais gera lixo plástico, WWF. Disponível em: (https://www.wwf.org.br/?70222/Brasil-e-o-4-pais-do-mundo-que-mais-gera-lixo-plastico). Acesso em: 08/10/2024.

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