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ORIGINAL PAPER

Catalytic gasification of pyrolytic oil from tire pyrolysis process

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The present work deals with thermo-catalytic decomposition of pyrolytic oil from the scrap tire pyrolysis process. Such oil can be used as a model tar in an experimental study of tar removal from pyrolysis or gasification process gas. Several experiments under different conditions were carried out in order to determine conditions of the gasification and pyrolysis processes. Influence of the oil to steam ratio, temperature, and of the presence of dolomite catalyst was studied. Addition of water steam has positive effect on the hydrogen content in the outgoing process gas as well as on the conversion of the injected oil. The catalytic gasification experiment in a quasi steady state produced process gas with the composition: 61 mole % of H_2, 6.4 mole % of CO, and 11.7 mole % of CH_4. At temperatures lower than 800 ℃, the amount of process gas decreased resulting also in a decrease of the oil conversion. A comparison of gasification experiments using fresh calcined dolomite with experiments proceeding with regenerated dolomite was done under the same conditions. There was a decrease in the process gas volumetric flow when regenerated catalyst was used.

Keywords: tire oil, gasification, pyrolysis, dolomite, catalyst

Introduction

One of the main interests in the field of energy production is the replacement of standard fossil fuel reserves utilization by new alternative resources connected with the decrease of green house gases emissions, specifically of carbon dioxide. Therefore, large effort has been made in waste conversion to energy research concerning thermal processes. Thermal decomposition processes such as gasification or pyrolysis offer an environmentally attractive method of the decomposition of a wide range of wastes, including scrap tires. There are three main products of the scrap tire pyrolysis process: combustible gas (5–20 mass %), liquid (tar) (40–60 mass %), and solid char (30–40 mass %). Their relative ratio depends mainly on the process conditions (Juma et al., 2007). The amount of condensable vapors, called tars contained in the gaseous phase plays a crucial role in the further processing of process gas. The composition and amount of tars are strongly dependent on the process conditions, such as temperature, residence time, addition of oxygen or steam water (García et al., 1999; Hosoya et al., 2008; Gilbert et al., 2009; Zhang et al., 2009), etc., and on the origin of the tar sample (Milne et al., 1998; García et al., 1999). Since tars are often regarded as catalyst poisons (Zhang et al., 2004; Schmidt et al., 2011) or cause problems in process gas burning (Schmidt et al., 2011), several ways of tar removal have been proposed (Anis & Zainal, 2011). The basic and simplest way of tar removal from process gas is their condensation followed by a mechanical wet-low temperature washing process (Han & Kim, 2008). A disadvantage of this gas cleaning method is the loss of the energy potential of cleaned gas by its cooling. Moreover, if condensed tars are not directly processed, they have to be stored. Open reservoirs which represent environmental threat are often used. If process gas is needed at high temperature for further processing, the most often used method of tar removal is its thermo-catalytic destruction in a thermo-catalytic reactor. Dolomite is one of the most frequently used catalysts for its good

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