Joseph Zeaiter et al., J Fundam Renewable Energy Appl, 5:6
http://dx.doi.org/10.4172/2090-4541.C1.005

OMICS International
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International Conference on
Green Energy & Expo
September 21-23, 2015 Orlando, USA

Design of an automated solar reactor for the pyrolysis of waste rubber to fuel and petrochemicals

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An automated solar reactor system was designed and built to carry out catalytic pyrolysis of waste rubber tires at 550°C. To maximize solar energy concentration, a two degrees-of-freedom automated sun tracking system was developed and implemented. Both the azimuth and zenith angles were controlled via feedback from six photo-resistors positioned on a Fresnel lens. The pyrolysis of waste rubber was tested with the presence of two types of acidic catalysts, H-beta and H-USY. Additionally, a photoactive TiO_2 catalyst was used and the products were compared in terms of gas yields and composition. The catalysts were characterized by BET analysis and the pyrolysis gases and liquids were analyzed using GC-MS. The oil and gas yields were relatively high with the highest gas yield reaching 32.8% with H-beta catalyst while TiO_2 gave the same results as thermal pyrolysis without any catalyst. The dominant gaseous components in the presence of zeolites were propene and cyclobutene. The TiO_2 and non-catalytic experiments produced a gas product of mainly isoprene (76.4% and 88.4% respectively). As for the liquids they were composed of numerous components spread over a wide distribution of C_{10} to C_{29} hydrocarbons of naphthalene and cyclohexane/ene derivatives.

Biography

Joseph Zeaiter received his BE in Chemical Engineering from the University of Sydney in 1998. He then obtained a PhD in process systems engineering from the same university in 2003. After his graduation, he joined the process industry, as an advanced process control lead engineer/senior consultant working on projects in oil and gas, petrochemicals, power plants and mining. He worked for Invensys (now Schneider Electric) in APAC and GCC regions and with Process Systems Enterprise in their London office. In 2010, he returned to academia and joined the department of petroleum and chemical engineering at the American University of Beirut. He is currently an assistant professor at AUB and his research interests are centered on the conversion of municipal solid waste (plastic and rubber) into fuel and chemicals. He has more than twenty publications (journal and conference papers) in the areas of pyrolysis, advanced control, process modeling and optimization of polymerization reactors.

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