Ex-situ catalytic pyrolysis of citrus fruit peels over mesoporous MFI and Al-MCM-41

Y-M. Kim, J. Jae, H.W. Lee, T.U. Han, H. Lee, S.H. Park, S. Kim, C. Watanabe, Y-K. Park

Energ. Convers. Manage. 125 (2016) 277–289

Abstract:

The thermal and ex-situ catalytic pyrolysis of different citrus peels, Citrus paradisi peel, Citrus sinensis peel, Citrus unshiu peel, and Citrus limon peel, were studied by thermogravimetric, evolved gas analysis–mass spectrometry and tandem micro-reactor–gas chromatograph/mass spectrometry analyses. Kinetic analysis revealed more complicated reaction steps and a wider range of activation energies of citrus peels than those of wood powder due to the presence of pectin in the citrus peels. Large amounts of methanol formation from each citrus peel were also recorded by evolved gas analysis–mass spectrometry and fast pyrolysis–gas chromatograph/mass spectrometry analyses at the main decomposition temperature of pectin, between 150 and 250ºC. Mesoporous MFI was found to be a more effective catalyst for the production of mono aromatic compounds (benzene, toluene, ethylbenzene, and xylene; 3.06–4.17 C%) and light olefins (ethene, propene, butene, and butadiene; 8.13–9.13 C%) than Al-MCM-41 (mono aromatic compounds 0.67–0.93 C% and light olefins 3.61–4.58 C%) because of its higher catalytic activity in deoxygenation and aromatization due to the stronger acidity of mesoporous MFI. The yield of mono aromatic compounds over mesoporous MFI was highest from C. paradisi peel (4.17 C%), followed in order by C. sinensis peel (3.83 C%), C. unshiu peel (3.61 C%), and C. limon peel (3.06 C%), due mainly to the different contents and properties of pectin in each citrus peel. The higher activities of mesoporous MFI than Al-MCM-41 were also maintained during the 7 times sequential catalytic pyrolysis of C. paradisi peel, demonstrating the stability of mesoporous MFI catalyst.

* Excerpted from online journal website (Click the title)

Frontier Labs Products used:

Multi-Shot Pyrolyzer (EGA/PY-3030D), Tandem micro-Reactor (RX-3050TR), F-Search, UA^{+}-5