Hydrogen and steam injected tandem μ-reactor GC/FID system: phenol recovery from bisphenol A and alkylphenols using Ni/Y zeolite

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Abstract:

A tandem μ-reactor-gas chromatograph/flame ionisation detector (TR-GC/FID) system that allows hydrogen and steam injection, called H_2/steam-TR-GC/FID, was newly developed to quantitatively evaluate phenol recovery from the pyrolysis of bisphenol A (BPA), isopropyl phenol (iPrP), and isopropenyl phenol (IPP). Ni-Loaded Y-zeolite (Ni/Y) was selected to simultaneously catalyse BPA decomposition into phenol and IPP, IPP hydrogenation to iPrP, and iPrP dealkylation to phenol and propylene. These substrates were evaporated in the 1st μ-reactor, and then converted into phenol using Ni/Y-zeolite under H_2/steam flow in the 2nd μ-reactor. The products were directly introduced into GC/FID and quantified using naphthalene as the internal standard. Although the steam injection caused degradation of product peaks, this drawback was overcome by using two-step ice- and cryo-traps. The phenol yield was negligible when the three substrates were pyrolysed alone at 350 ºC, but became substantially enhanced by the combination of H_2, steam, and Ni/Y, reaching the maximum of 89 %, 46 %, and 62 % from iPrP, IPP, and BPA, respectively. Hence, these results indicate the possibility to obtain phenol-rich products from the pyrolysis of polymeric wastes with BPA macro skeleton. In addition, the developed high-throughput analytical technique can accelerate the development of other gas–solid reaction systems under H_2/steam atmosphere.

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Frontier Labs Products used:

Tandem μ-Reactor Rx-3050 TR, Ultra ALLOY+-1, UADTM