

Pyrolysis of CFRP and reforming of gases by zeolite catalysts in CFRP recycling

Part 2: Evaluation of catalysts with varied Si/Al ratios

[Background] In Part 1 ([PYA1-116E](#)), four types of zeolite catalysts, called as MOR, MFI, FAU and BEA, were evaluated for the thermal decomposition of CFRP. Among these catalysts, BEA was found to effectively promote the decomposition of bisphenol compounds. In this report, three BEAs with different acid amounts (Si/Al ratio) were tested using pyrolysis followed by catalytic conversion.

[Experimental] A pyrolysis (Py)-GC/MS system with a Multi-Shot Pyrolyzer (EGA/PY-3030D) directly interfaced to the GC injector was used for the measurements. Toray's prepreg (T700SC/2592) was used as CFRP. Three types of BEAs with different Si/Al ratios (Si/Al = 12, 18.5, and 92.5) were used as catalysts. A mixture of 0.3 mg of CFRP and 3.0 mg of catalyst was placed in an Eco-Cup and dropped into the pyrolyzer furnace at 500 °C. Flash pyrolysis formed pyrolyzates which flowed directly through the catalytic bed. The products were separated and detected by GC/MS.

[Results] The three chromatograms are shown in Fig. 1 for the products obtained by reforming the gases from the pyrolysis of CFRP with the BEA catalysts. The relationship between the acid amount and the phenol yield is shown in Fig. 2 for each BEA whose acidity was measured by the ammonia temperature-programmed desorption (NH₃-TPD) experiments. Although there was no correlation between the acid amount and phenol yield, it was found that the formation of byproducts such as naphthalene and other compounds was suppressed at high Si/Al ratios, and the BEA catalyst with Si/Al=92.5 was found to be an effective catalyst for reforming of the CFRP decomposition gas.

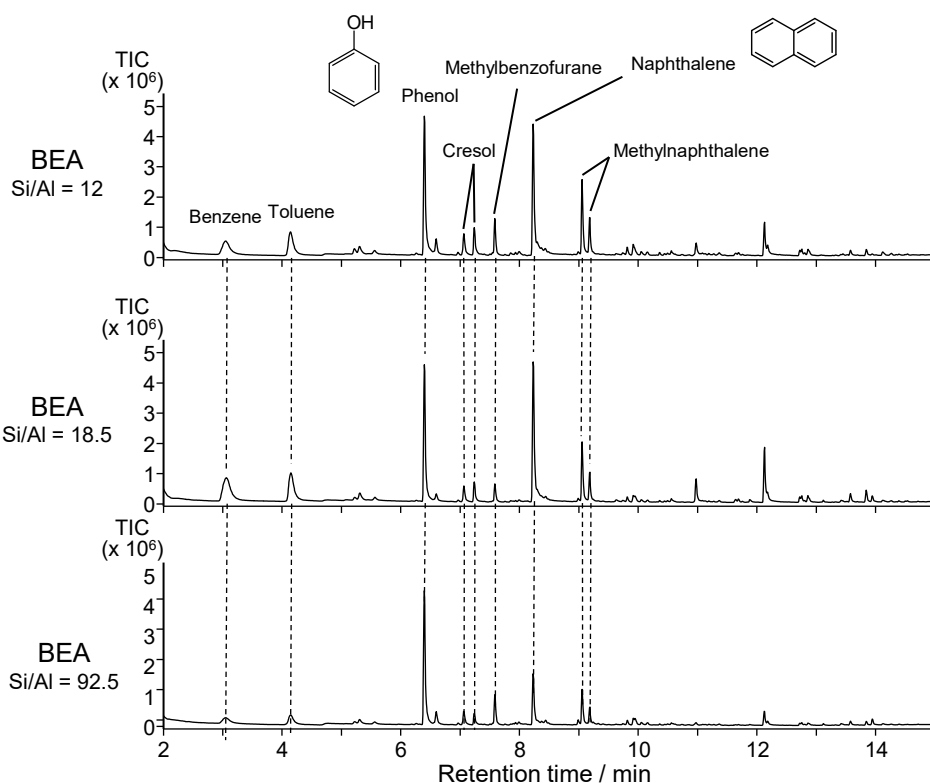


Fig. 1 Chromatograms of catalytic reaction products

Pyrolysis/catalyst reaction temp.: 500 °C, GC inj. temp.: 300 °C, GC oven: 40 (2 min hold) - 320 °C (20 °C/min), Split ratio: 1/100, Separation column: UA⁺-5 (5 % diphenyl 95 % dimethylpolysiloxane), L=30 m, i.d.=0.25 mm, df=0.25 μm, Column flow rate: 1 mL/min, MS scan range: *m/z* 29 - 550, Sample: CFRP 0.3 mg, Catalysts: BEA-12, BEA-18.5, and BEA-92.5 3.0 mg

Ref. [K. Oshima et al., Ind. Eng. Chem. Res. 59 \(2020\) 13460–13466](#)

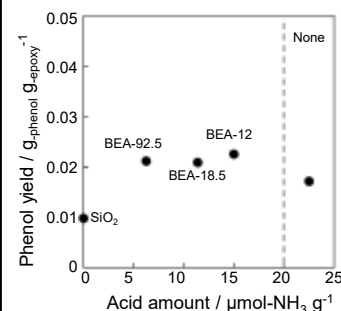


Fig. 2 Plots of phenol yield versus acid amount

Keywords : Plastic recycles, CFRP, Zeolite catalyst

Products used : Multi-Shot Pyrolyzer, UA⁺-5, Vent-free GC/MS adapter

Applications : Plastic recycles, Catalyst screening

Related technical notes : [PYA1-116E \(Part 1\)](#), [RXA-008E \(Part 3\)](#)

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