

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

Part 1: Screening of zeolite catalysts

[Background] The use of carbon fiber reinforced plastic (CFRP) is increasing in the aviation and automobile industries due to its light weight and high rigidity. The highly stable property of CFRP makes recycling processes difficult and its recycling has attracted great concern. Thermal decomposition of CFRP has been used to recover CFs, while the problem with thermal decomposition is the release of harmful gases from plastics of CFRP. In this report, gases generated when CFRP is pyrolyzed were reformed using several zeolite catalysts. Aromatics formed were identified using GC/MS.

[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. The CFRP was Toray's prepreg, T700SC/259 (about 40 % epoxy resin content). Various zeolites (MOR, MFI, FAU, and BEA) 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 heated at 500 °C. Products formed during the flash pyrolysis and catalytic process were separated and detected by GC/MS.

[Results] Fig. 1 shows the pyrogram of the gases generated by the pyrolysis of the CFRP and the chromatograms of the products obtained by the catalytic reformation of the gases. In the pyrogram without catalyst, bisphenol-based and phenol-based compounds derived from the epoxy resin are observed; however, in the chromatograms obtained by a catalytic reaction, the peak intensities of the bisphenol-based compounds decrease, while peaks for benzene, toluene, naphthalene, and some of the basic chemicals, are observed. It was found that the BEA catalysis promoted the decomposition of bisphenol compounds most efficiently.

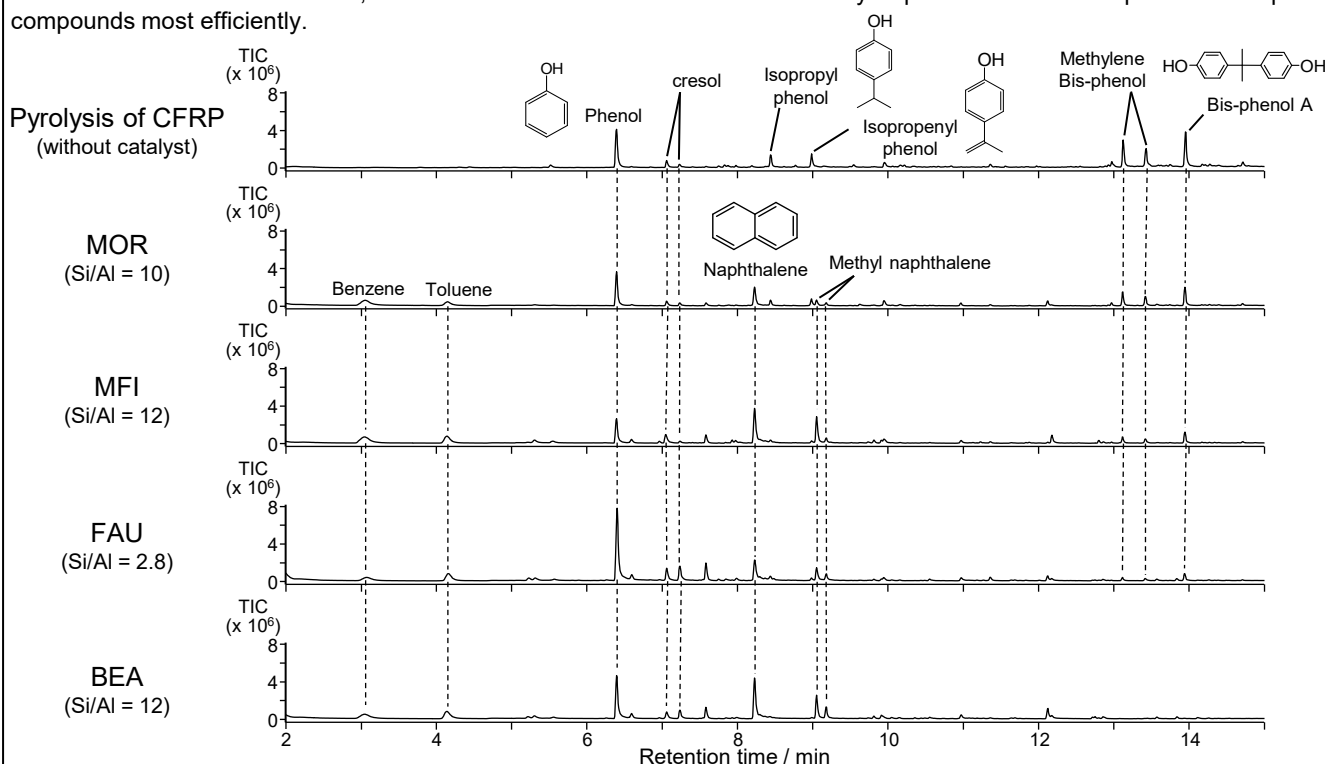


Fig. 1 Pyrogram of CFRP and chromatograms of catalytic reaction products

Pyrolysis/catalytic 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: MOR, MFI, FAU, and BEA 3.0 mg

Ref. K. Oshima et al., *Ind. Eng. Chem. Res.* 59 (2020) 13460–13466

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 : [PYA1-117E \(Part 2\)](#), [RXA-008E \(Part 3\)](#)

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