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SUPPLEMENTARY MATERIAL TO

Study of pyrolysis of high density polyethylene in the open system and estimation of its capability for co-pyrolysis with lignite

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ADDITIONAL INTRODUCTORY CONSIDERATIONS

Seo *et al.* (2003)¹ reported similar or even higher yield of the liquid product obtained by the thermal cracking than by the thermo-catalytic cracking (ZSM-5 and Zeolite Y) of HDPE at 450 °C. However, the composition of liquid products was quite different. The liquid product obtained by the non-catalytic cracking contained 56 % of light hydrocarbons (C₆–C₁₂), whereas the liquid products from the thermo-catalytic cracking comprised more than 90 % of light hydrocarbons. Miskolczi *et al.* (2004)² studied the thermal and thermo-catalytic cracking behaviour of a commercial HDPE waste in the temperature range of 400–450 °C. The fluid catalytic cracking catalyst (FCC), HZSM-5 and a clinoptilolite, containing rhyolitic tuff, were used as catalysts. The yield of gases increased in the following order: non-thermo-catalytic cracking < clinoptilolite < FCC < HZSM-5 catalysed cracking, while the yields of liquid products increased in the sequence of non-thermo-catalytic cracking < clinoptilolite < HZSM-5 < FCC catalysed cracking. Barbarias *et al.* (2015)³ used the spent FCC catalysts regenerated with air at 550 °C for 1 h and then agglomerated by the wet extrusion with bentonite (50 wt. %) in the two-step system (flash pyrolysis at 500 °C and catalytic cracking in the temperature range from 450 to 550 °C). It was observed that an increase in the catalytic cracking temperature from 450 to 550 °C resulted in the

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significant increase of the yield of light olefins (from 12 to 28 wt. %) and non-aromatic C₅–C₁₁ compounds (from 34 to 52 wt. %). Almustapha and Andresen (2011)⁴ used two sulphate modified zirconium catalysts (CAT) in the catalytic degradation of HDPE. Heating of HDPE with catalysts to 400 °C at heating rate of approximately 20 °C min⁻¹ resulted in the extremely high conversion of HDPE (about 99.8 %) into gaseous and liquid products. Garcia *et al.* (2005)⁵ demonstrated the advantage of utilisation of hybrid zeolitic-mesoporous material (ZSM-5/MCM-41) for the catalytic degradation of HDPE. By the heating of HDPE:catalyst mixture (mass ratio, 100:1) at 380 °C for 2 h, the conversion of HDPE of about 70 % was achieved. The light hydrocarbons (C₂–C₆) rich in olefins were the main degradation products, while the production of heavy fractions was negligible.

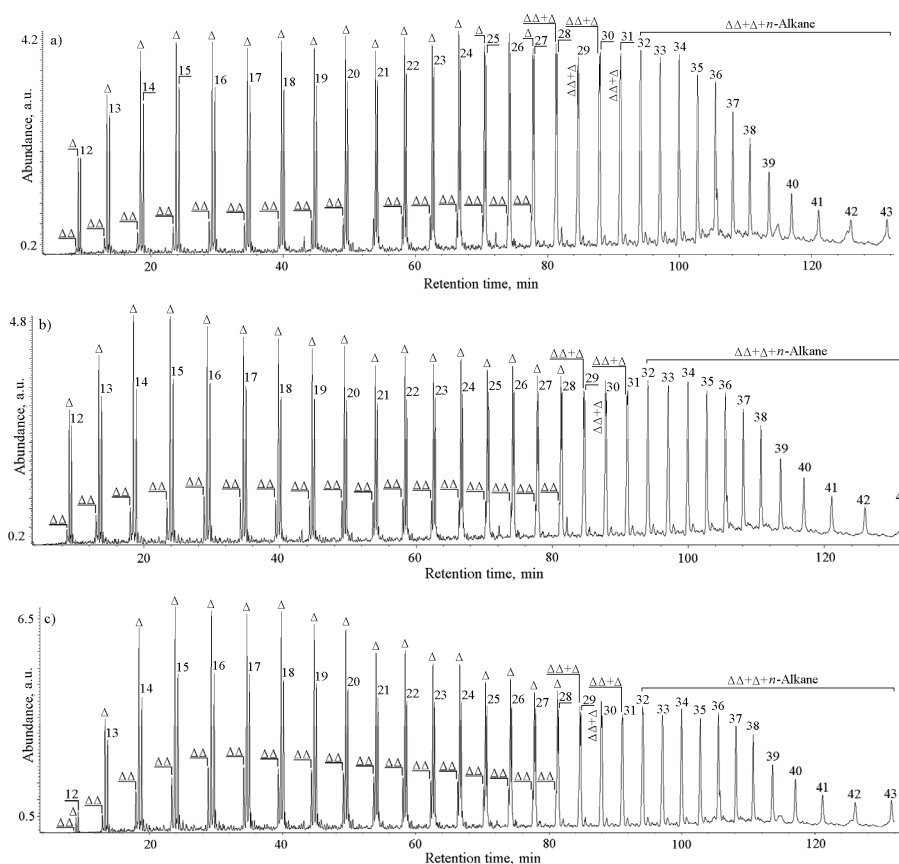


Fig. S-1. TIC (Total Ion Current) of liquid pyrolysates obtained at 400 °C (a), 450 °C (b) and 500 °C (c). *n*-Alkanes are labelled according to their carbon number; Δ – 1-*n*-alkenes with same number of carbon atoms as *n*-alkanes; ΔΔ – Terminal dienes with same number of carbon atoms as *n*-alkanes.

REFERENCES

1. Y.-H. Seo, K.-H. Lee, D.-H. Shin, *J. Anal. Appl. Pyrolysis* **70** (2003) 383
2. N. Miskolczi, L. Bartha, G. Deák, B. Jóver, D. Kalló, *J. Anal. Appl. Pyrolysis* **72** (2004) 235
3. I. Barbarias, M. Artetxe, A. Arregi, J. Alvarez, G. Lopez, M. Amutio, M. Olazar, *Chem. Eng. Trans.* **43** (2015) 2029
4. M. N. Almustapha, J. M. Andresen, *Int. Proc. Chem. Biol. Environ. Eng.* **26** (2011) 21
5. R. A. García, D. P. Serrano, D. Otero, *J. Anal. Appl. Pyrolysis* **74** (2005) 379.