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COMBINED THERMAL AND CATALYTIC CRACKING OF WASTE PLASTICS IN THE PRESENCE OF CLINOPTILOLITE

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What to do with spent plastics? It is the most important question at present. Their decomposition is long term process because of their durability and the result is their accumulation on landfills. There exist some approaches how to solve this problem. The commonly used method is incineration (energy recovery), but the problem with toxic gases in the air is the result. The other recycling methods as material and feedstock recycling are used also. Feedstock recycling seems to be very promising thanks to the reuse of spent plastics on monomers or valuable fuels.

Experimental

Input materials

Polypropylene

Clinopitolite (original, acid modified)

Apparatus of two stage cracking process

All experiments (thermal and catalytic cracking) were carried out at the same experimental conditions:

- temperature of 450°C
- nitrogen flow of 50 ml/min
- mass ratio of feedstock/catalyst (7:1)

Products

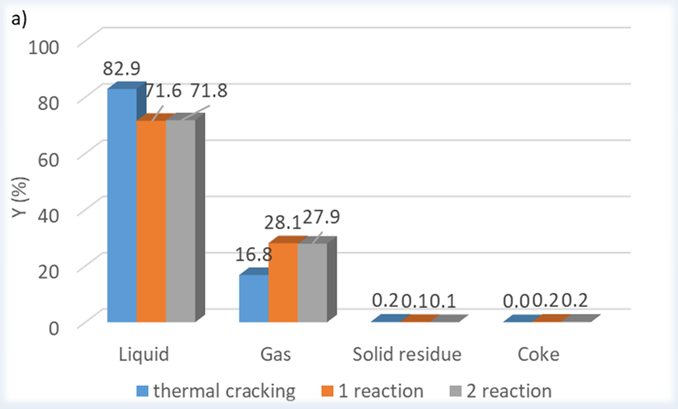
- Gas
- Liquid
- Solid residue
- Coke on the catalyst surface (for catalytic cracking)

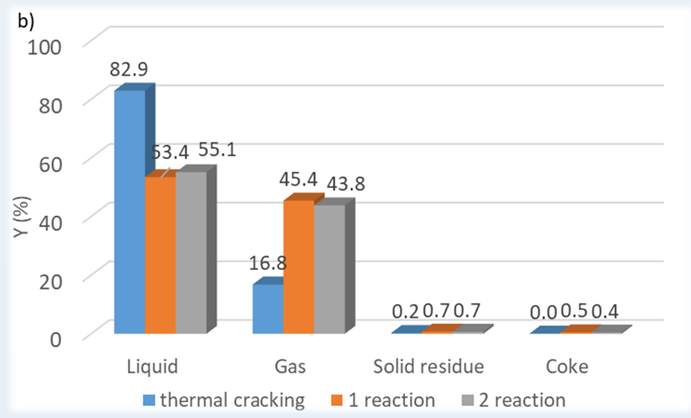
The goal of the work

- to study the process of PP thermal cracking
- to study catalytic crakcing- the influence of original and acid modified by 0.1M solution of HCl clinoptilolite catalysts
- to analyse the composition of obtained products (gas and liquid) by gas chromatography (Hewlet Packard HP 6890+ equipment and Hewlett Packard HP 7890A equipment).
- to compare results obtained from catalytic cracking with results obtained from thermal cracking

Results and discussion

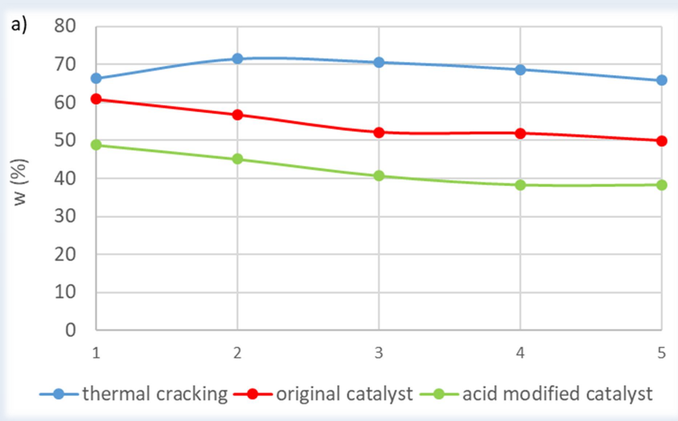
Material balance

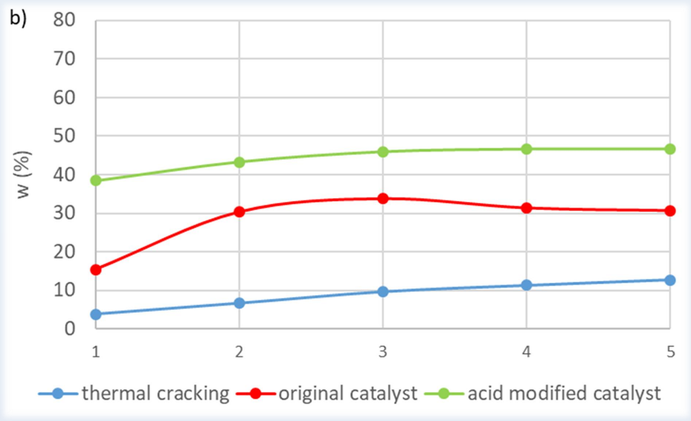




Yields of individual fractions for thermal and catalytic cracking of polypropene with fresh (1 reaction) and regenerated (2 reaction) catalyst – a) original, b) acid modified

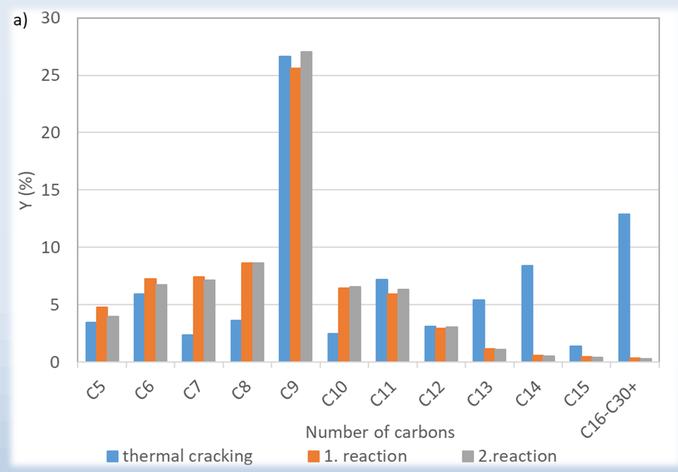
Gas fraction composition

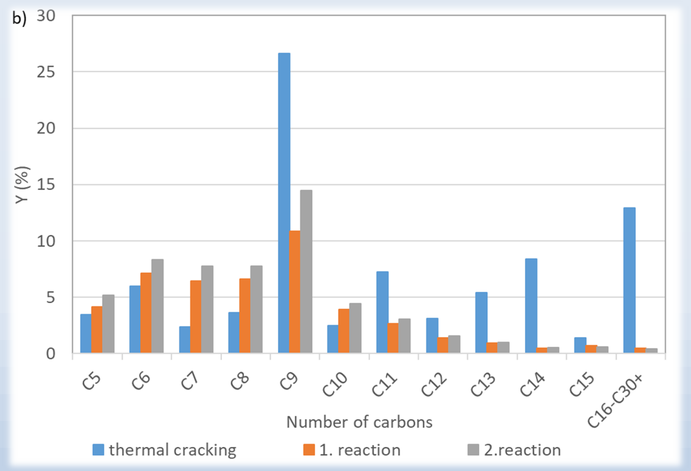




Influence of fresh catalyst on the production of a) C3 and b) C4 hydrocarbons for original and acid modified catalyst during the experiment in comparison with thermal cracking

Liquid fraction





Yields of liquid hydrocarbons obtained from thermal and catalytic cracking of polypropene for a) original and b) acid modified clinoptilolite

Conlusion

If the catalyst used in the experiment is fresh (original or acid modified), the production of gas fraction is slightly higher as after regeneration of catalyst. The catalyst modification by acid solution has positive influence on the pore structure and strenght of acid sites. The result is the highest amount of gas in all reactions.

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