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Experimental study of ex-situ catalytic pyrolysis of ground tire rubber (GTR) and devulcanized ground tire rubber (dGTR)

Aim

To investigate ex-situ catalytic fast pyrolysis of GTR and dGTR with a micro-pyrolyzer unit to produce valuable products with minimal polar aromatics.

Justification

Many tires are discarded every year, and no significant action has been taken towards full recycling. The current recycling of tires is limited, and most of the used tires are either incinerated or landfilled/stockpiled. On the other hand, the ability to collect tires more easily due to their large size compared to plastics and the relative homogeneity of the waste tires can be an advantage in recycling. However, the various components present in tires, e.g., rubbers, carbon black (CB), steel wire, textile fibers, etc., complicate the recycling process. Pyrolysis can deal with used tires environmentally friendly. Pyrolytic products, including light olefins and dienes, naphthenes (limonene), single-aromatics, tar, and polar aromatics, are impacted by process and experimental parameters. The promoted zeolite and silica/alumina catalysts can reduce the treatment cost to some extent by lowering tar and polar aromatics. At least 5 to 25% of the pyrolysis oil components have one or more heterogeneous atoms (O, N, S). Due to high char, ex-situ catalytic pyrolysis is a promising method to increase the yields of targeted products. Furthermore, tire devulcanization has an influential role in reducing energy consumption, residence time and improving the quality of final products.

At LCT, using micro-pyrolyzer combined with comprehensive two-dimensional gas chromatography with flame ionization detector and time-of-flight mass spectrometer (GC x GC-FID/TOF MS), the qualitative and quantitative information of ex-situ catalytic pyrolysis products can be obtained online. Thus, this work mainly aims to investigate ex-situ pyrolysis of GTR and dGTR in micro-pyrolyzer combined with GC x GC-FID/TOF MS.

Program

1. The pyrolysis characteristic of GTR and dGTR will be studied via micro-pyrolyzer setup at various experimental conditions, such as devulcanization degree, temperatures, and residence time.
2. Ex-situ catalytic pyrolysis experiments will be carried out to evaluate and compare the performance of catalysts (such as NiMo/silica, NiMo/zeolite, and CoMo/zeolite).