LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coach	Supervisors	Funding
Ir. Oguzhan Akin	Dr. Ir. Robin John Varghese Prof. Dr. Ir. Kevin Van Geem	-

Catalytic Upgrading of Polyethylene and Ethylene-Vinyl Alcohol (EVOH) Co-Pyrolysis Vapors: Impact of EVOH on Product Selectivity and Catalyst Stability

Aim

Investigating the influence of EVOH on product selectivity and catalyst stability during the catalytic cracking of PE-EVOH co-pyrolysis vapors.

Justification

Ethylene-vinyl alcohol (EVOH) is a widely used copolymer in packaging for its exceptional gas barrier properties, which helps extend the shelf life of packaged products . It is often combined with polyethylene (PE) and/or polypropylene (PP) in multi-layer packaging to improve functionality. However, this combination complicates its recycling. EVOH content above 5 wt.% in PE or PP waste streams renders them unsuitable for mechanical recycling by diminishing the mechanical properties of recycled material. In recent years, pyrolysis has gained attention for converting plastic waste into valuable base chemicals like light olefins (C_2-C_4) and mono-aromatics. However, EVOH in PE/PP streams increases the oxygen content of pyrolysis oil, degrading its quality when EVOH exceeds 5 wt.%. Catalytic deoxygenation using zeolites like HZSM-5, modified with Ga or Zn, has shown promise in mitigating this issue. Given the frequent co-occurrence of EVOH and polyolefins in packaging waste, direct catalytic upgrading of PE-EVOH co-pyrolysis vapors may allow higher EVOH tolerances while producing high-quality products. This thesis will investigate the effects of EVOH on product selectivity and catalyst stability during the catalytic cracking of PE-EVOH co-pyrolysis vapors over HZSM-5, with a focus on Ga and Zn modifications. Experiments will involve pyrolysis of PE-EVOH mixtures with varying ratios (wt./wt.) using a tandem micro-pyrolyzer coupled with comprehensive two-dimensional gas chromatography (GC×GC-FID/TOF MS), enabling real-time, qualitative, and quantitative analysis of pyrolysis products, providing insights into cracking mechanisms and potential synergistic effects between EVOH and PE. The proposed research seeks to address the limitations of EVOH-contaminated PE/PP streams in chemical recycling by exploring a novel catalytic approach. Insights gained from this study could advance sustainable end-of-life recycling technologies for multi-layer packaging waste, contributing to circular economy goals and reducing environmental impact.

Program

1. Literature review on thermochemical recycling of EVOH and multilayer packaging materials.
2. Experimental investigation of the pyrolysis characteristics of EVOH and PE mixtures with varying compositions.
3. Synthesis of Ga- and Zn- modified HZSM-5 and performing catalyst characterization techniques.