Investigating co-pyrolysis of PP and PET with various catalysts
Matthew McAllister, Sean Okonsky and Dr. Hilal Ezgi Toraman
Department of Energy and Mineral Engineering

Abstract
Pyrolysis is the process of thermally decomposing materials at high temperatures. Applying pyrolysis to plastics is being heavily investigated as a method to reduce such waste in the environment. Utilizing properties of catalysts in the process of plastic pyrolysis is known to reduce the temperatures at which these polymers are converted to fuels, chemicals and other materials. By using Thermogravimetric Analysis (TGA), we can analyze how these polymers convert at high temperatures. Our goal is to vary different properties of the catalyst through modifications and study their effects during co-pyrolysis in TGA.

Objectives
- Desilication and cerium loading to parent catalyst
- Conduct co-pyrolysis of PP:PET:Catalyst in 1:1:4 mixture in TGA for all catalysts
- Repeat TGA with used catalyst to gauge sustained activity
- Compare results to determine most efficient catalyst
- Characterize catalysts to assess properties

Materials & Methods

Catalyst Modifications
Catalysts used in this study:
- Parent Catalyst
- Desilicated version
- Desilicated plus 1 wt % cerium version
- Cerium ions
Pores
Larger pores
Larger pores can now support ions

Catalyst
Parent
1 wt % Ce
Desilicated
1 wt % Ce + Desilicated

Pyr TPD (mmol/g catalyst)
0.34
0.34
0.42
0.42

ICP (wt % Ce)
n/a
0.09
n/a
0.36

TGA Results

Fresh Catalyst

Used Catalyst

Conclusions
- Cerium loading by itself had almost no effect on mass loss profile compared to parent catalyst
- Desilication of the catalyst created larger mesopores in the catalyst allowing for increased loading of cerium metal
- Desilication plus cerium loading led to a large decrease in maximum degradation temperature compared to the case when no modification was applied
- Desilication plus cerium loading led to most sustained catalyst activity on the second run
- Pyridine TPD confirmed the acidity of the catalyst to relatively stay the same post-synthesis

References

Acknowledgements
I would like to thank Sean Okonsky for his mentorship and guidance throughout this summer. I would also like to thank Dr. Toraman and the entire Toraman Research Group for their assistance along the way. Finally, I would like to thank the Department of Energy and Mineral Engineering for their support and contributions to make this research possible.