Incorporating Zeolite Desilication for the Catalytic Co-Pyrolysis of PP and PET Using HZSM-5

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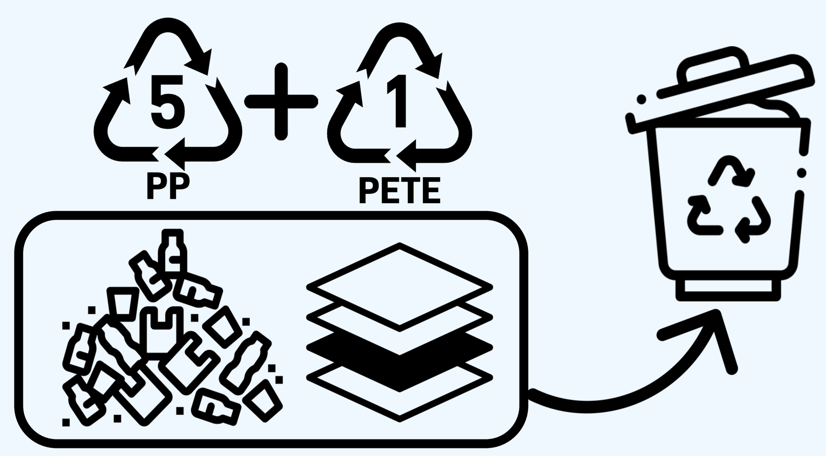
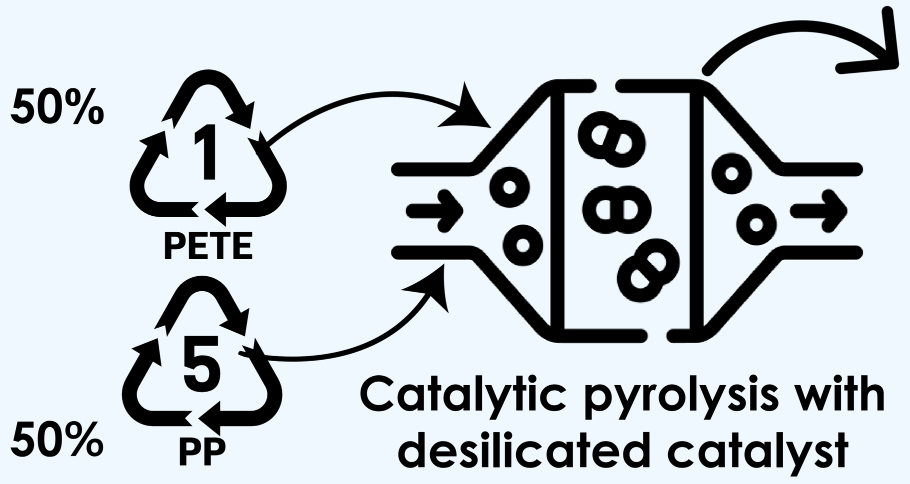
Intorduction



- PP and PET can coexist as unsorted or mixed in multilayer packaging in a waste stream [1].
- PET can cause coke formation during catalytic pyrolysis [2,3].

Objective

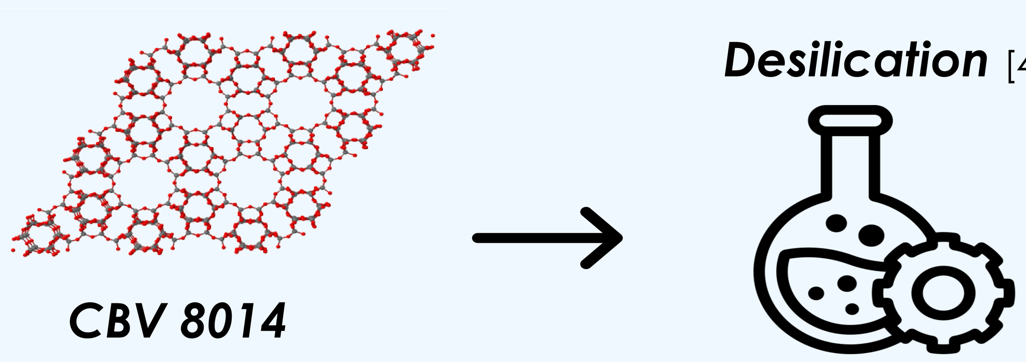


- Investigate catalyst properties
- Study deactivation

MATERIALS & METHODS

Catalyst modification

Desilication [4]

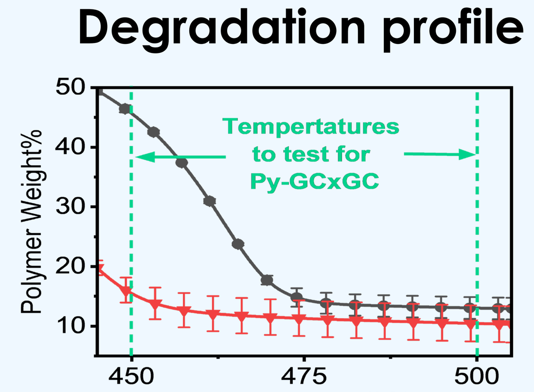


1. *Stirring with 0.3M NaOH at 65 °C*
2. *Wash solutions & dry catalysts*
3. *Mixed with 0.05M HCl to remove extra framework at 65 °C*
4. *Ammonium exchange with 0.1M NH_4NO_3*
5. *Calcination at 550 °C*

Catalyst characterization

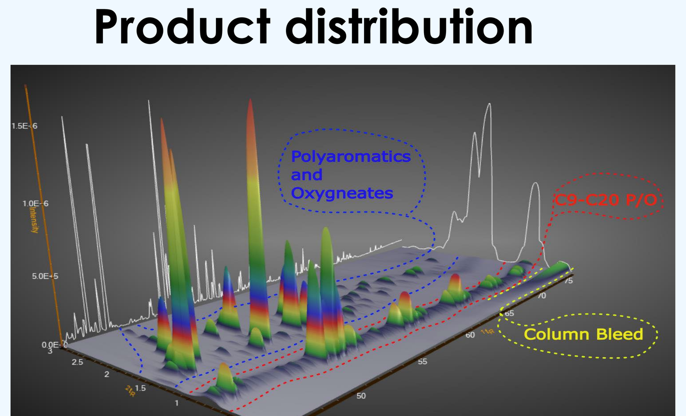
- ✓ *Pyridine-TPD: Total acidity measurement*
- ✓ *Collidine-TPD: External acidity measurement*
- ✓ *N_2-Physisorption: Surface analysis*
- ✓ *ICP-AES: SI/Al ratio determination*

Degradation profile



Thermogravimetric analyzer (TGA)

Product distribution

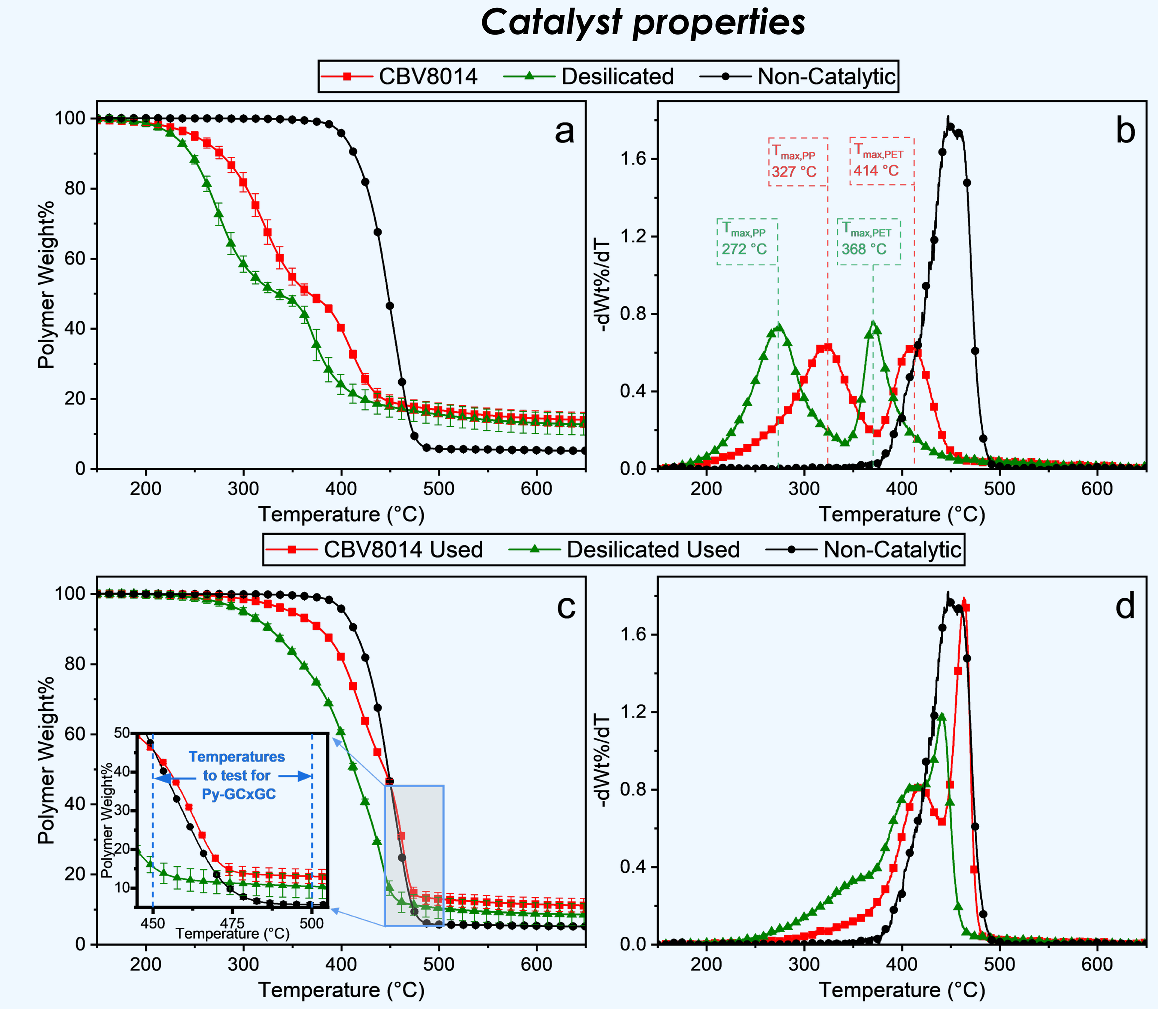


Py- GCxGC – FID/MS

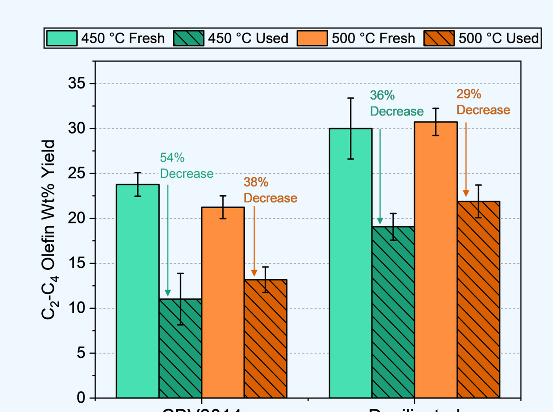
RESULTS

Catalyst	Micropore volume	Mesopore volume	Si:Al ratio	Pyridine/ gcat (mmol)	Bronsted: Lewis ratio	Collidine/ gcat (mmol)
CBV 8014	0.140 ± 0.004	0.085 ± 0.002	42	0.39	67	0.046
Desilicated	0.114 ± 0.005	0.212 ± 0.023	31	0.49	61	0.062

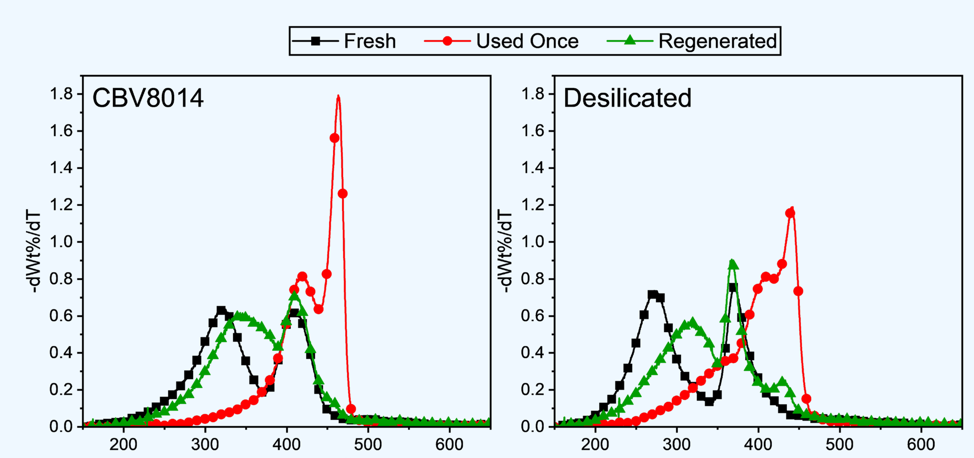
Catalyst properties



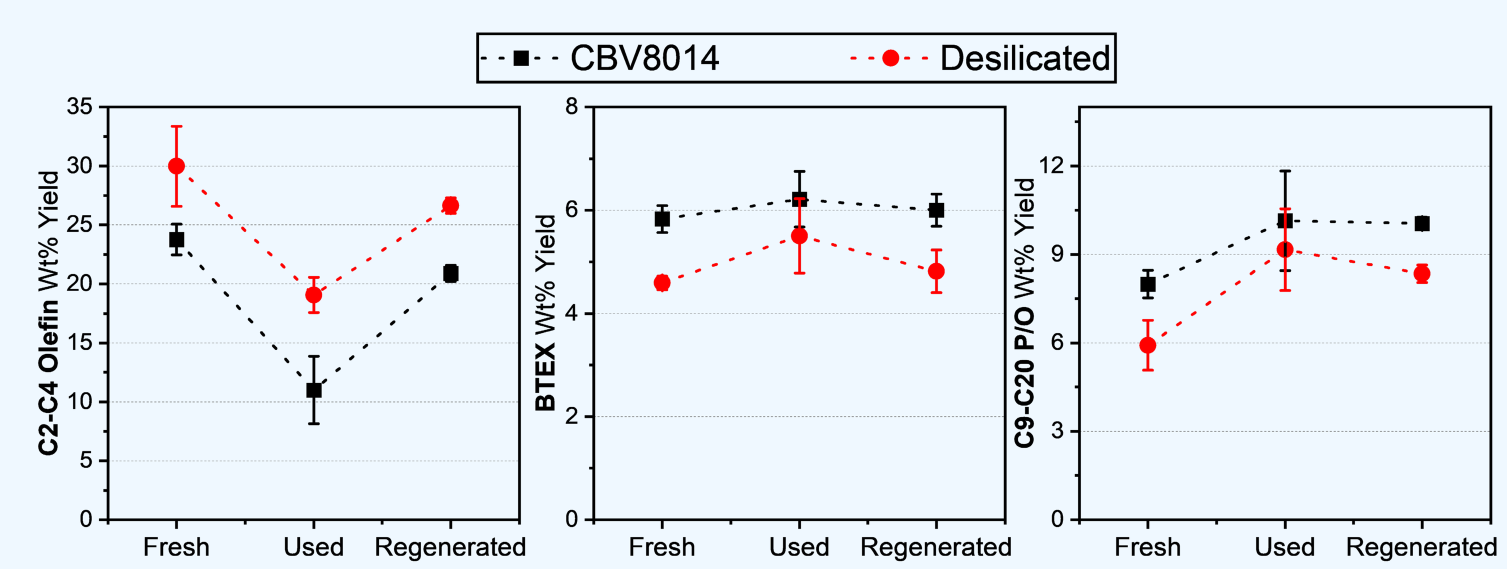
Polymer weight percent (a, c) and derivative weight percent (b, d) curves for PP and PET with CBV8014 and Desilicated HZSM-5 catalysts, in their fresh (a, b) and used once (c, d) states



C_2-C_4 olefin yield for catalytic pyrolysis at 450 °C and 500 °C with fresh and used CBV8014 and Desilicated catalysts.



Derivative weight percent curves for the catalytic co-pyrolysis of PP and PET with CBV8014 (left) and Desilicated (right) HZSM-5 in fresh, used, and regenerated state for each catalyst



Percent yields of C_2-C_4 olefins (left), BTEX (middle), and C_9-C_{20} paraffins and olefins (right) for CBV8014 and Desilicated catalysts in their fresh, used, and regenerated state at 450 °C

CONCLUSIONS

- The desilicated CBV 8014 increased the acidity and mesopore volume, compared to parent catalyst.
- The desilicated CBV 8014 catalyst decreases the degradation temperature of PP and PET.
- Desilicated fresh CBV 8014 showed a higher yield of C_2-C_4 olefins (30.0 – 30.7 wt%), compared to CBV 8014 (21.2 – 23.8 wt%).
- The desilicated catalyst showed a lower decrease of C_2-C_4 olefin yield at 450 °C and 500 °C, compared to CBV8014.
- Catalyst regeneration increased the yield of C_2-C_4 olefins in comparison with the catalyst in their used state.
- This research demonstrated that desilicated catalyst could enhance C_2-C_4 olefin yield and be durable in in-situ catalytic co-pyrolysis of PP and PET as feedstock.

REFERENCES

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AKNOWLEDGEMENTS

현대차 정몽구 재단
Chung Mong-Koo Foundation

REMADE INSTITUTE

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

"This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Advanced Manufacturing Office Award Number DE-EE0007897" awarded to the REMADE Institute, a division of Sustainable Manufacturing Innovation Alliance Corp".

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