SLATT UNDERGRADUATE RESEARCH FELLOWSHIP
FINAL REPORT

SCHOLAR NAME:	Peter Halloran
FACULTY ADVISOR:	Dr. Jason Hicks
PROJECT PERIOD:	06/01/2021-07/23/2021
PROJECT TITLE:	Catalytic Hydrocracking of Low-Density Polyethylene
CONNECTION TO ONE OR MORE ENERGY-RELATED RESEARCH AREAS (CHECK ALL THAT APPLY):	**(x) Energy Conversion and Efficiency ( ) Sustainable and Secure Nuclear** **( ) Smart Storage and Distribution ( ) Transformation Solar** **(x) Sustainable Bio/Fossil Fuels ( ) Transformative Wind**

MAJOR GOALS AND ACCOMPLISHMENTS

Summarize your research goals and provide a brief statement of your accomplishments (no more than 1-2 sentences). Indicate whether you were able to accomplish your goals by estimating the percentage completed for each one. Use the next page for your written report.

RESEARCH GOALS	ACTUAL PERFORMANCE AND ACCOMPLISHMENTS	% OF GOAL COMPLETED
Develop an understanding of lab techniques	I was able to learn and use the tube reactor, chemisorption, physisorption, batch reactor, GC, GC-MS machines.	100
Become better acquainted with current polymer literature	I read dozens of recent publications on the methodology and purpose of polymer degradation.	90
Collect data on specific catalytic hydrocracking reactions	I was able to run three trials, each of which required around 20 hours of prep and experimental time, to test the effects of Pt/Al2O3 and Ru/Al2O3	75
Communicate the impact of research in polymer fuel techniques	I prepared and presented a poster to many observers at the Summer Research Undergraduate Symposium.	100

RESEARCH OUTPUT

Please provide any output that may have resulted from your research project. You may leave any and all categories blank or check with your faculty advisor if you are unsure how to respond.

CATEGORY	INFORMATION
EXTERNAL PROPOSALS SUBMITTED	
EXTERNAL AWARDS RECEIVED	
JOURNAL ARTICLES IN PROCESS OR PUBLISHED	
BOOKS AND CHAPTERS RELATED TO YOUR RESEARCH	
PUBLIC PRESENTATIONS YOU MADE ABOUT YOUR RESEARCH	2021 Summer Undergraduate Research Symposium. July 21, 2021. Jordan Hall of Science. Catalytic Hydrocracking of Low-Density Polyethylene.
AWARDS OR RECOGNITIONS YOU RECEIVED FOR YOUR RESEARCH PROJECT	
INTERNAL COLLABORATIONS FOSTERED	
EXTERNAL COLLABORATIONS FOSTERED	
WEBSITE(S) FEATURING RESEARCH PROJECT	
OTHER PRODUCTS AND SERVICES (e.g., media reports, databases, software, models, curricula, instruments, education programs, outreach for ND Energy and other groups)	(Please describe each item in detail)

RESEARCH EXPERIENCE

Please let us know what you thought of your research experience: Did this experience meet your expectations? Were lab personnel helpful and responsive to your needs? What else could have been done to improve your experience or achieve additional results?

FINAL WRITTEN REPORT

(Please use the space below to describe your research project and objectives, any findings and results you can share, and graphs, charts, and other visuals to help us understand what you achieved as a result of this research experience.)

Mid-range hydrocarbon fuel, derived from waste plastic degradation, is a promising source of modern-day alternative fuel. However, selective catalysts and more efficient processes are needed to recycle waste plastics into fuels. In this study, we used low density (0.91-0.94 g/cm^3) polyethylene (LDPE) as a well-defined polymer to represent a waste plastic. We subjected the LDPE to distinct environments in which the solvent and catalyst was varied. All trials were run in a Parr 4848 250ml batch reactor with an initial H_2 pressure of ~3450 kPa. The temperature was raised to 598K and held for two hours. Qualitative analysis of gas products using a GC with TCD and FID suggested the formation of low carbon number gases in all conditions (C1-C8). Without n-hexanes as a solvent, no liquid product was formed, while with a solvent, the liquid phase was analyzed in a GC-MS. Results suggested the lack of formation of mid-range hydrocarbons present in the liquid phase using Pt/Al_2O_3. Taken cumulatively, the outcome suggests the conditions tested favor chain-end scission, a useful approach to maximize gas production. Due to the limited research investigating the solvent relationship with catalytic hydrocracking of polymers, future research in this area will investigate the effects of the solvent on the liquid and gas yields.