



Lummus New Hope Plastics Pyrolysis Technology

Modern day plastics are durable, lightweight and inexpensive. They are found in many of our everyday items, including electronics, cars, home goods and appliances, medical supplies, and have drastically improved our quality of life, safety, mobility. The end of life issues we are facing from plastics stem from their success. Green Circle is glad to provide safe and reliable circular solutions to the end of life issue without compromising the benefits derived for modern life which are expansive, touching all aspects of it.

With over 1 billion people expected to move into the middle class by 2030, plastics consumption growth remains robust. By 2050, an estimated 12 billion metric tons of plastics will reside in landfills with continued risk of leakage into our rivers and oceans. Additionally, with more companies pledging to introduce recycled plastic feedstock into their facilities, projections show that over 100 million metric tons annually will be chemically recycled using pyrolysis based technology by 2050.

To address this market trend, Lummus' Green Circle business provides sustainable technologies for the circular economy and the energy transition, including solutions for plastics recycling; decarbonisation of existing assets; and green chemicals from renewable feedstocks. Part of Green Circle is Lummus New Hope Plastic Pyrolysis Technology, which transforms post-consumer and post-industrial plastic waste into valuable pyrolysis oil that can be fed into suitable existing steam or catalytic crackers for a full circular solution or blended to make sustainable fuels. By creating pyrolysis oil from plastic waste and feeding this oil into crackers for eventual plastics production, we move toward creating the circular economy and improving our environment by reducing plastic waste sent to landfills, leaked into the environment or incinerated.

Leveraging New Hope Energy's plastics recycling production experience and Lummus extensive ability to commercialize, scale-up and improve process technology, Green Circle can provide comprehensive solutions to integrate the product obtained from plastic waste conversion with existing assets. Green Circle can also support end-users who wish to produce circular fuels/polymers by reliably and effectively introducing the pyrolysis oil product from New Hope Energy's recycling plants into their existing cracker or refining facilities.

Currently, New Hope Energy is operating a proven plastic waste conversion facility in Tyler, Texas, that is producing high-quality, scalable pyrolysis oil. Green Circle and New Hope Energy are jointly working on the significant expansion of the facility using the combined knowledge and expertise of both companies. Lummus' Green Circle is the exclusive global licensing party for this process technology and supports projects by providing basic engineering design packages, proprietary equipment, technical services and modular execution strategies.

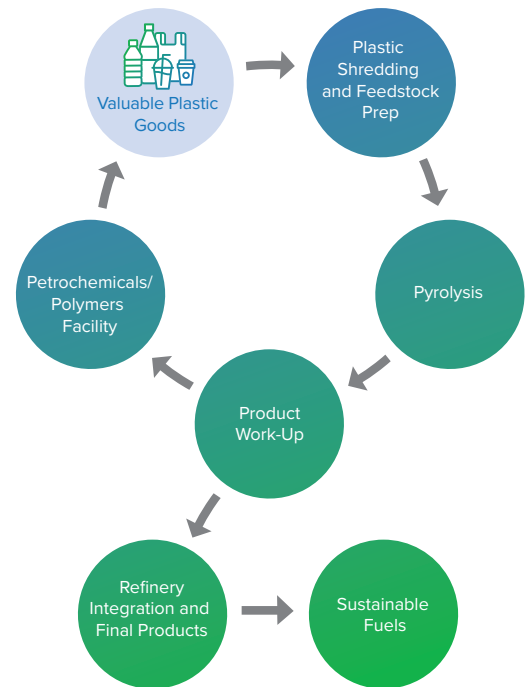


Advantages

Technology Features	Technology Benefits
Optimized Flow Sheet and Critical Equipment Design, Operating Parameters	Minimized Capital Investment and Operating Costs, Higher Return on Investments
Proprietary Feedstock Preparation, Contaminants Removal and Reactor Section Design	Feedstock Flexibility with Minimal Contamination Issues, Robust and Reliable Operations, increased Run Length.
Product Flexibility, including Asphalt production instead of char	Higher revenues generated from all products
Downstream hydroprocessing and refinery/ petrochemicals integration options	Increased revenues from marketable products

Performance Characteristics

Plastic Type Acceptable
LDPE - preferred
HDPE - preferred
PP - preferred
PVC, Nylon - minimized, avoided
PS - Acceptable, High Volume
PET - Higher value for mechanical recycling
Typical Yields
Hydrocarbons for further processing – 70%
Asphalt like material– 5%
Lighter gas for fuel to heat system – 25%



Process

The Lummus New Hope Plastic Pyrolysis Technology utilizes pyrolysis to chemically upgrade waste plastics to be either fed into existing petrochemical facilities or blended with fuel at the refinery.

Depending on the full range waste stream composition and project strategy, the derived plastic waste mix is sorted and shredded using processes designed by Green Circle, and then directed to a proprietary feedstock preparation

section which includes contaminants removal. The properly conditioned feedstock is sent to the conversion reactor where the pyrolysis takes place. The technology includes useful heat integration and the final liquid pyrolysis oil is sent to a product finishing section for separation. Additional processing of the liquid pyrolysis oil can be addressed based on project strategy and final product requirements using Lummus Technology's hydroprocessing and cracking platforms of technologies.

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