Chemical recycling of plastics: A circular economy approach.

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Introduction

Plastics have become an integral part of our modern lives, but their widespread use has led to a growing environmental concern due to their persistence in the environment. To tackle the plastic waste problem and reduce our dependence on fossil resources, there's a growing interest in chemical recycling as a part of a circular economy approach. In this article, we will delve into the concept of chemical recycling of plastics, its significance, methods, challenges, and its potential to transform the plastic industry [1].

The Plastic Predicament

Plastics have revolutionized industries, from packaging to healthcare, thanks to their durability and versatility. However, their durability is a double-edged sword. Traditional plastics can persist in the environment for hundreds of years, contributing to pollution and harming ecosystems. This problem has motivated researchers and industry leaders to seek sustainable alternatives and develop strategies to manage plastic waste [2].

Understanding Chemical Recycling

Chemical recycling, also known as advanced recycling or molecular recycling, represents a paradigm shift in plastic waste management. Unlike mechanical recycling, which involves melting and reusing plastics, chemical recycling focuses on breaking down plastics into their molecular building blocks. This process allows us to create new plastics or other valuable chemicals without compromising on quality [3, 4].

Methods of Chemical Recycling

There are several methods of chemical recycling, each with its advantages and challenges:

Pyrolysis: Pyrolysis involves heating plastics in the absence of oxygen to break them down into gases, liquids, and solids. These can then be used as feedstock for new plastics or other chemicals.

Gasification: Gasification converts plastics into syngas, which can be used to produce fuels or chemicals.

Depolymerization: This method involves breaking the polymer chains of plastics to obtain monomers that can be used to make new plastics.

Solvolysis: Solvolysis uses solvents to break down plastics into their constituent parts. This method is particularly useful for certain types of plastics.

Hydrogenation: In hydrogenation, plastics are reacted with hydrogen to convert them into valuable chemicals.

Each of these methods has its unique advantages and is suitable for different types of plastics, making them promising for various applications within the circular economy.

Advantages of Chemical Recycling

High-Quality Output: Chemical recycling can produce high-quality feedstock, comparable to virgin materials, allowing for the creation of new plastics with desirable properties.

Diverse Plastic Types: Unlike mechanical recycling, chemical recycling can process mixed or contaminated plastics, making it more versatile.

Reduced Environmental Impact: By preventing plastics from ending up in landfills or incineration, chemical recycling reduces environmental pollution and greenhouse gas emissions.

Resource Efficiency: It reduces the reliance on fossil resources by creating a closed loop where plastics can be endlessly recycled [5].

Challenges and Hurdles

While chemical recycling offers immense promise, it faces several challenges:

Technological Maturity: Many chemical recycling processes are still in the experimental or pilot stage and need further development and scaling up to become economically viable.

Cost: The initial cost of establishing chemical recycling facilities can be high, although economies of scale can bring costs down over time.

Regulatory Framework: The regulatory framework for chemical recycling needs to be developed and standardized to ensure safety and environmental compliance.

Feedstock Collection: Effective collection and sorting systems for plastics must be in place to ensure a steady supply of feedstock for chemical recycling.

The Future of Chemical Recycling

Despite these challenges, the future of chemical recycling looks promising. Many companies and research institutions

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***Received:** 21-Aug-2023, Manuscript No. AACTA-23-113089; **Editor assigned:** 22-Aug-2023, PreQC No. AACTA-23-113089(PQ); **Reviewed:** 31-Aug-2023, QC No. AACTA-23-113089; **Revised:** 04-Sep-2023, Manuscript No. AACTA-23-113089(R); **Published:** 25-Sep-2023, DOI: 10.35841/aacta-6.3.155*

***Citation:** Smith H. Chemical recycling of plastics: A circular economy approach. J Chem Tech App. 2023;6(3):155*

are investing in this technology to develop more efficient and economically viable processes. As governments and consumers become increasingly aware of the plastic waste problem, there is growing support for initiatives that promote a circular economy approach.

Conclusion

Chemical recycling of plastics is a transformative approach that holds the key to mitigating the plastic waste crisis and reducing our dependence on fossil resources. While challenges exist, ongoing research, development, and investments in this field are bringing us closer to a sustainable and circular plastic economy. By embracing chemical recycling, we can reduce environmental pollution, conserve resources, and pave the way for a more sustainable future.

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Citation: *Smith H. Chemical recycling of plastics: A circular economy approach. J Chem Tech App. 2023;6(3):155*