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Current Developments and Issues in the Biodegradation Approach to the Sustainable Management of Plastic Trash

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Abstract

Synthetic plastics' adaptability and appealing qualities have significantly influenced how widely they are used. Plastic pollution, on the other hand, is a result of the massive buildup of plastic garbage in the environment due to its very refractory nature. Current methods for reducing the accumulation of plastic wastes are insufficient, and new, sustainable ways for combating plastic pollution are urgently needed. Due to its gentler and less energy-intensive circumstances, plastic biodegradation has become recognised in this context as a sustainable and environmentally beneficial method of treating the accumulation of plastic waste. A lot of study has been done recently with the goal of finding bacteria and enzymes that can break down plastic. With an emphasis on recent developments and an all-encompassing analysis of the state of plastic biodegradation, this paper attempts to advancements in this area. Also, the difficulties facing plastic biodegradation now are examined, and the prospects for plastic biodegradation's continued advancement in the future are highlighted.

Keywords: Plastics; Biodegradation; Enzymes; Biocatalyst; Upcycling

Introduction

China is currently the world's largest manufacturer of plastic, accounting for 32% of all plastic produced globally, and production is expected to reach about 370 million tonnes in 2020. The desirable properties and adaptability of plastics, which enable their use in a variety of applications including packaging, automotive, building and construction, electrical and electronic, and common household products, are primarily responsible for the rising trend in plastic production [1,2]. Also, the coronavirus disease outbreak in 2019 has shown once again how crucial plastics are in the production of personal protective equipment Most personal protective equipment is constructed of plastics including polyurethane, polypropylene, polycarbonate, low-density polyethylene, and polyvinyl chloride, including face masks, gloves, medical gowns, and face shields. Other than PPEs, The demand for plastics used in the packaging industry, including as high-density polyethylene (LDPE), polystyrene, and polyethylene terephthalate, has increased due to the COVID-19's increased demand for packaging materials, notably single-use plastics [3,4]. As of 2015, there were around 6300 tonnes of plastic trash generated as a result of the exponentially rising plastics use. Just 9% of the total plastic garbage was recycled, 12% was burned, and the other 79% was deposited in landfills. A shocking amount of 12,000 tonnes of plastic garbage was predicted to have accumulated in landfills or in the natural environment based on the existing manufacturing and waste management patterns. Plastic pollution has grown to be a significant global problem. The sustainability of the environment has been threatened by the buildup of plastic garbage in the ecosystem. Because of their extremely resistant nature, synthetic plastics are likely to remain in the environment after disposal for hundreds or even thousands of years, adding to environmental damage [5,6].

Discussion

There have been significant investments made in the search for an although there are alternatives to plastic, the issue of the buildup of plastic waste in the environment still urgently needs a workable solution. The biodegradation of plastics is considered to be a greener and more sustainable approach in this context compared to the current strategies of managing plastic wastes, such as landfilling, incineration, and recycling of plastic wastes; the milder operating conditions and absence of harmful chemicals in the degradation process make the biodegradation approach a promising solution for the efficient handling of growing plastic wastes in the environment [7,8]. Since the published literature on the biodegradation of plastics has increased over the past ten years, a lot of research has been focused on finding microorganisms that can break down plastic. Biodegradation of plastic primarily involves the action of microorganism-secreted enzymes to speed up the breakdown of plastic waste into monomers, or smaller molecules. Also, the prevalence of microorganisms in nature suggests that plastic pollution may be reduced by biodegradation. Studies on the biodegradation of plastic have primarily focused on specific him simplest way to handle post-consumer plastic waste is to landfill it, but due to plastics' resilience to disintegration, this approach cannot be used for more productive purposes for a very long time. Further degradation of plastics during recycling results in variations in the quality and composition of recyclates because there are no standards for recycled polymer grades[9,10].

Conclusion

These secondary environmental pollutants, benzene, toluene, and xylene, are formed from plastic debris and released as gases and leachates from landfills. This also explains why mechanically recycled plastics have a lower economic worth. Chemical recycling is a method for turning plastic waste into products with value-added in order to create a circular economy for plastics. Products that are typically

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recovered through chemical recycling hydrogen, syngas, carbon-based materials, liquid oils with high heating values, and polymers. The procedures used for chemical plastic recycling are shown in Table 2. Although chemical recycling is thought to be a promising strategy for the efficient management of plastic wastes, there are still a number of issues that need to be resolved. More research is needed on the tolerance, recovery, and reusability of catalysts in large-scale systems. Also, the harsh conditions required in these chemical reactions add to the environment's exposure to dangerous substances including sulphur, carbon, and other volatile gases. As a result of exposure to heat, moisture, and UV light in the environment, plastic wastes degrade abiotically, releasing extremely hazardous substances such persistent organic pollutants from the plastic surfaces and chemical additives seeping out of the plastic wastes. Furthermore, there is growing worry over the abiotic decomposition of plastic wastes into micro- or nanoplastics, which are easily absorbed by water bodies and pose a threat to human health as well as marine life.

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Conflict of Interest

None

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