J Adv Chem Eng 2018, Volume: 8
DOI: 10.4172/2090-4568-C4-015

Biodegradation of plastic waste by using microalgae and their toxins

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Today the use of plastic wastes (high density and low-density polyethylene) have become an unavoidable entity of human life, these wastes continuously accumulating in the environment and becoming a worldwide ecological threat. This accumulation can be hazardous and may cause some environmental disturbances. The conventional methods used for polymer degradation including landfill, incineration, and chemical treatment are causing a harmful effect to the surrounding environment and living things due to their non-degrading nature. A better idea for the complete degradation of plastic has not yet been identified; so their complete disposal is still a major problem. Although to solve this tremendously growing issue, biological mode of polythene degradation protocol may be discovered and expanded in the future. Biodegradation is an effective option for eco-friendly degradation of plastic waste because biodegradable plastics are environment-friendly; they have an expanding range of potential application and are driven by the growing use of plastics in packaging. In recent years considerable attention has been focused on biodegradability of polymeric materials mainly due to the pollution in the environment created by plastic waste and no protocol has yet been developed to feasibly degrade polyethylene by biodegradation on a commercial scale. Polyethylenes are carbon and hydrogen polymers, exceptionally resistant to biological decay. It is estimated that polythene would degrade less than 0.5% over 100 years, degradation mainly depends on temperature, light exposure, oxygen, and moisture availability. The two possible approaches to reduce the 'plastic waste' are: (1) to develop biodegradable commodity plastics from fossil fuel and/or renewable resources building blocks (hydro-biodegradable) or re-engineering of full carbon backbone commodity polymers (Oxo-biodegradable), (2) to identify potential micro-algae and its toxins to develop protocol to effectively biodegrade the polymeric materials. The present study is an attempt to assess algal diversity in the plastic contaminated area using a molecular approach and to isolate potential indigenous microalgae and its toxins for the efficient degradation of plastics. Biodegradation is promoted by various microalgae and simple or multiple toxin systems, with the enzymes being synthesized by microalgae involving a reduction in the energy of activation and weaken the chemical bonds in the polymer, thereby decreasing the energy required for degradation. Our main goal is to the conversion of these plastics by microalgae into metabolites such as CO_2, H_2O and new cell biomass (i.e. mineralization).

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