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Dependence of Biofuel Bio-refineries on Polymer Applications: The Outlook of Profitable Biofuel Opportunities

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The strategies for production and processing of Bio-based non-petroleum fuels from a variety of biomass is actively exploited in the recent years. Bio-polymers like cellulose, starch, xylan, pectin etc. are renewables obtained from plants, algae and other biological sources that are being exploited for variety of applications in biofuels. Technologies for biological/chemical processing of these polysaccharides to form fuels, platform chemicals and other value added byproducts to enhance process profitability can be the next breakthrough in biofuel commercialization.

In the early stages of biofuel revolution, plant polymers were promising targets for alcoholic fuel production. Difficulties prevailed with lignin processing were overcome by third generation algal biomass and customized biopolymer production through algae attained global interest. Delipidized algal strains are expected to have atleast 30% cellulose in the residue that could be used for production of cellulose based bioplastics. Polyethylene, poly-lactic acid are other polymer products of algae that can be mixed with the petro-based bioplastics for improved biodegradability characteristics. Nanostructured scaffolds in polyhydroxyalkanoates obtained from spirulina like microalgae finds application in development of extracellular matrices for tissue and organ culture.

The developments of algae compatible resins like polymethacrylate, polystyrene etc. for immobilized biomass cultivation eliminates the need for expensive biomass harvesting procedures due to high water content and biomass dilution in cultivation systems. Specialized hydrophilic resins are developed for oil binding that leaves the biomass with no solvent contamination for further processing. Solvent treatment of these resins can result in biodiesel formation as high as yield in conventional oil extraction-conversion methodologies and also ensures resin recovery for further use. These advancements would make a positive impact on the quality of residual biomass that can be possibly used for making high valued polymer products by utilizing the residual polysaccharides using appropriate technologies. On the other end, addition of waste synthetic polymers like polystyrene to biodiesel fuel can reduce viscosity and density but increase flash point for enhanced energy recovery and combustion features. The glycerol byproduct can be catalytically dehydrated to form acrolein which later can be polymers of acrylic acid and its polymeric esters that are already known as billion-dollar plastic business in petro-chemical industries. The technological advancements in biofuel manufacture fueled by the science of polymer applications for improved energy balance on the process opens up a new dimension of economical fuel processing. Henceforth, the science of polymer making and breaking in a biofuel biorefinery is inevitably decisive for a profitable business in next generation biomass bioprocessing.