

Introduction of Practical Technologies for Reduction of Micro Plastic Pollution by Injection Molded Products Made of Biodegradable Plastic Resin, Poly Lactic Acid (PLA)



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Marine litter from petroleum-based plastic product causes micro plastic pollution in the world. To reduce its pollution, plant-based biodegradable plastic product is considered as one of the practical solution. By the way of replacing petroleum-based plastic products with PLA, we could reduce the total volume of waste changing to micro plastic. Biodegradation is a chemical process during which microorganisms that are available in the environment convert materials into natural substances such as water, CO₂, and compost. The process of biodegradation depends on the surrounding environmental conditions, on the material and on the products. According to several estimates, about 80 % of the litters found in the marine environment comes from land-based activities. The source of marine litter is not necessarily limited to human activities along the seashore. Even when disposed of on land, rivers, floods and wind carry the litter to the sea. The original materials of PLA are just starch and lactobacillus. Lactobacillus change starch to lactic acid by fermentation. Lactic acid is changed to PLA thermoplastic resin by chemical synthetic process. PLA is available for injection molding, blow molding or sheet process. The waste of PLA product may bury in the ground, then PLA is biodegraded by microbe. Also in the ocean, PLA is biodegraded by microbe in seawater too. By biodegradation, PLA changes into just CO₂ and H₂O. By photosynthesis of plant, CO₂ and H₂O changes into starch again. By composting process, PLA will be biodegraded around 2 weeks to 6 month depends on the product shape. Biodegradation in seawater is so slower than land filling as composting due to smaller number of microbe, or lower temperature than land. But, Biodegradable plastic resin will be composed in seawater finally. PLA had 3 weak points, high material cost, poor heat resistance, up to around 70 °C and bad fluidity by injection molding. Caused by these reasons, PLA products were limited as thin sheet products by vacuum molding. They didn't have enough rigidity so that deforms easily. For promotion of wider adoption of PLA products, I have developed 4 injection molding technologies. The products doesn't deform easily, with high value and quality and possible to match the market cost. 1st technology is for heat resistant PLA injection molding method. 2nd technology is for heat resistant PLA heat insulated product by nitrogen super critical micro cellular injection molding method. 3rd technology is thin wall PLA cup CO₂ super critical micro cellular injection molding method for mass production. 4th technology is PLA product containing natural cellulose fiber by nitrogen super critical micro cellular injection molding method. These technologies are expected for application of single-use tableware, cutlery, food package, medical package and fisheries, also durable tableware, toy, agriculture, gardening and civil engineering. In conclusion, injection molding is brand new way to produce PLA application products. PLA products are effective to reduce micro plastics, but biodegrading process should be in compost or landfill. It is necessary to cooperate all field, science, government, engineering, media and consumers for reducing micro plastic in the world.