

The Management of Plastic: The 3Rs are Not Enough

Plastic is one of the most significant innovations of the modern age. The first fully synthetic plastic, Bakelite, was commercially produced in 1907 from coal tar. The next big plastic product, nylon, was first produced in 1938 from petroleum. The production of plastics grew more than twenty times between 1964 and 2015 and this is projected to double by 2035 (Barra *et al.* 2018). Unfortunately, the ubiquity and low cost of plastic have resulted in the generation of large amounts of waste and widespread plastic pollution.

The environmental movement in the United States in the 1970s popularized the 3Rs – reduce, reuse, recycle – and this has been adopted worldwide. However, despite its wide use, the 3Rs approach has failed to curb the problem of plastic waste, especially in less developed countries. An analysis of the 3Rs reveals its inadequacy in solving the problem of plastic waste.

Reduce. In a modern society that has become increasingly consumption-driven, a reduction in the use of plastic is illogical. Industry and commerce need to increase output to survive and grow, while consumers are constantly urged to consume more. Plastics have now replaced many natural materials such as cotton, wood, and leather. The growth in plastic products means that the strategy to reduce will not work.

Reuse. The reuse of plastic products can only postpone the increase in plastic. Plastic products are rarely durable and often rendered obsolete by newer products. For example, the useful life of computers, which contain a significant amount of plastic, is limited by capacity. Also, the reuse of many plastic products is limited by the presence of additives such as plasticizers and flame-retardants, which leach out of the plastic and pose hazards for reuse (Halden 2010).

Recycle. Many plastics are not meant to be recycled. Plastics can be divided into two general types: thermoplastics, which can be recycled; and thermosets, which cannot be recycled. There are over 20 types of thermoplastics but only six are identified for recycling: 1, PET (polyethylene terephthalate); 2, HDPE (high-density polyethylene); 3, PVC (polyvinyl chloride); 4, LDPE (low-density polyethylene); 5, PP (polypropylene); and 6, PS (polystyrene). The other types of recyclable plastics are classified as 7, OTHER. Clearly, the system for the recycling of thermoplastics leaves much to be desired. On the other hand, thermoset plastics, which account for a large group of important industrial and consumer plastics, are not recyclable. In addition, the use of additives makes it difficult to recycle plastics. It is, therefore, not surprising that less than 9% of plastic waste is recycled globally (d’Ambrières 2019).

Before plastic waste can be recycled, it must first be recovered. However, the recovery of plastic waste requires an efficient waste management system and most developing countries are unable to do this. In the Philippines, there is an informal sector that collects plastic waste to resell. While recovery may work for plastic waste that retains some value, it does not work for those that do not have any value such as sachets and thin plastic bags. These materials have been identified as the major plastic pollutants and have placed the Philippines as the third highest in the world in the mismanagement of plastic waste (Jambeck *et al.* 2015). Finally, the processing of recycled plastic into new products is generally more difficult and expensive to do compared to the use of virgin petroleum feedstocks (Nkwachukwu *et al.* 2013). The recent announcement that the San Miguel Corporation is piloting the use of recycled plastic for roads is a welcome initiative (GMA News Online 2019).

The failure of the 3Rs to address plastic waste can be attributed to two things: first, this strategy requires an efficient recovery of plastic waste, a system that is not present in most developing countries; and second, many plastics are not designed to be recycled. The inadequacies of the 3Rs can be addressed by the 5Rs: *redesign, reduce, reuse, recover, and recycle*. The 5Rs capture the key aspects of the Circular Economy, a strategy that is being promoted by the European Commission (Eur-Lex 2018).

Given the wide range of applications of plastics, a considerable amount of research and development is needed for the redesign of plastics to make them inherently recyclable, and for the efficient recycling of all types of plastics, including

new and old types. In March 2019, the 4th UN Environment Assembly committed to “significantly reduce single-use plastic products by 2030” (UNEP 2019). This is just the beginning. Single-use plastic accounts for only about 36% of total plastic production. We must already invest in research and development to address the challenges posed by the remaining 64% of the plastic that we produce.

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