

Sustainable Upcycling of Scrap Tires for Civil Engineering Projects

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Almost one billion scrap tires are generated and recycled, creating almost \$8 billion of revenue worldwide. With stricter regulations, the market for the recovery and recycling of scrap tires is increasing at the rate of 4.5% annually. The three largest segments are fuel, civil engineering applications, and ground rubber markets. Tire-derived aggregate (TDA) has been widely used for civil engineering applications. Ten major properties of TDAs will be discussed along with successful full-scale application examples for the past 30 years. The rubber used in manufacturing tires were found to adsorb toxic organic compounds and heavy metals. Steel wires in tires are also capable of removing phosphorus present in the environment. Various sizes of scrap tires can be used for the removal of pesticides and fertilizers. A 20-cm thick tire rubber layer was found to be capable of removing $\geq 90\%$ for 37 out of 51 pesticides evaluated. Scrap tires can be upcycled to remove phosphorus, heavy metals, and organic contaminants in stormwater. It was found that stormwater treatment systems filled with TDA can remove 60~80% of phosphorus present in the runoff. TDA can hold twice more water and provide a 75% lower cost than stone when used as underground water storage. TDA can also be upcycled as an eco-friendly zone by treating roadway runoff in the bioswale. As recommended by ASTM in Propelling Green Construction into the Mainstream (2017), scrap tires should be upcycled further as a substitute for stone aggregate in construction applications.