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Treated Plastic Granules (TPGs) for Sustainable Enhancement of Asphalt and Concrete

Background

Incorporating recycled plastic in concrete and asphalt has been shown to improve their properties in construction applications and may also be a viable solution for managing and reducing waste plastic. The use of waste plastic can decrease the thermal conductivity in cement concrete by 50%. An optimization study found that the concrete samples containing 30% low-density polyethylene (LDPE) fibers by volume had lower thermal conductivity than the control (Poonyakan et al., 2018). Another study found that by adding 5 wt% and 10 wt% of plastic and rubber solid-ash residues to ordinary Portland cement clinker, a higher rate of setting was observed, which in turn accelerated the hydration process and improved the compressive strength (Hashem et al., 2019). Furthermore, asphalt containing surface-activated rubber (SAR) showed an 86% reduction in segregation index compared to conventional rubberized asphalt. Hence, shifting developmental focus to similar surface treatments for waste plastics can likewise advance commercial concrete and asphalt.

Invention Description

Researchers at Arizona State University have developed low-cost treated plastic granules (TPGs) produced from mixed plastic rejects for use in construction applications. These applications include concrete and asphalt production as a partial replacement for fillers, aggregates, and cement. In addition to diverting plastic waste from landfills, the TPG production method also utilizes waste bio-oils in a microwave treatment process.

With TPG use in concrete, enhanced toughness is expected, as well as reduced shrinkage cracking while retaining moisture for improved internal curing. In asphalt, TPG use can improve fatigue life and the self-healing capacity of pavements.

Potential Applications

- Asphalt matrix filler
- Partial replacement of cement in concrete manufacturing

- Waste bio-oil processing
- Waste plastic processing

Benefits and Advantages

- Cost effective
- Highly compatible granules for improved construction properties of concrete and asphalt
- Reduces waste plastics and bio-oils

Faculty Profile of Professor Elham Fini