TREATED WASTE PLASTICS: A SOLUTION FOR ENHANCING THE PERFORMANCE OF CONCRETE CONSTRUCTION

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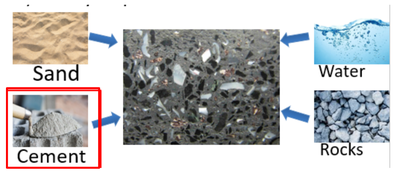
OBJECTIVE

Create a simple and scalable process to treat large volumes of reuse plastics

ABSTRACT

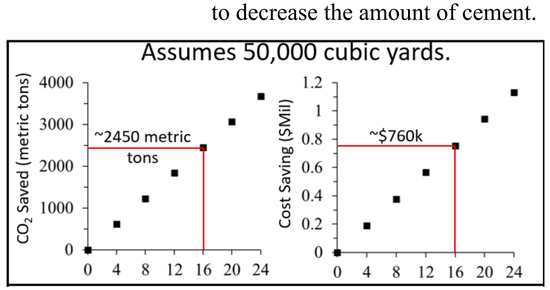
The environment today is facing concerns over accumulation of plastics in landfills as well as excessive CO_2 emissions. Containers and packaging take up approximately 15 million tons each year, and accumulations such as the Great Pacific Garbage Patch are entering the oceans. Work has been done to alter and treat polyethylene plastic to be added to cement mixtures. This is done in an attempt to increase bearing capacity and ductility of concrete in addition to decreasing carbon emissions and plastic waste.

WHAT THIS MEANS FOR THE ENVIRONMENT



The four main ingredients in concrete are sand, water, rocks, and cement. However, for every one ton of cement produced, approximately one ton of CO_2 enters the atmosphere. Our goal is to decrease the amount of cement.

It is predicted that each year that about 35 million tons of plastic is produced in just the United States, and yet only about 9% of this is ever recycled. This is according to a study done by the Argonne National Labs, DOE.

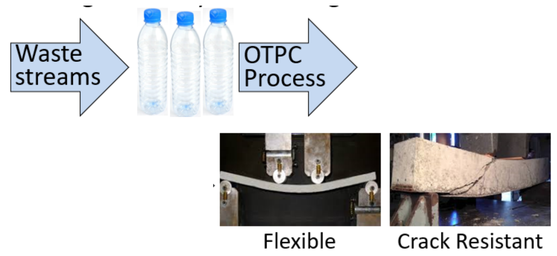


There are many potential benefits of using plastic as a partial replacement for cement in concrete

- Reduction of CO_2 footprint of infrastructure by reducing and preplacing cement.
- Waste diversion and a useful end-of-life for waste plastics.
- Greatly increases energy absorption, durability, ductility, and sustainability of concrete structures.
- Sourcing plastic from landfills and waste and recycling from homes, restaurants, and college campuses.

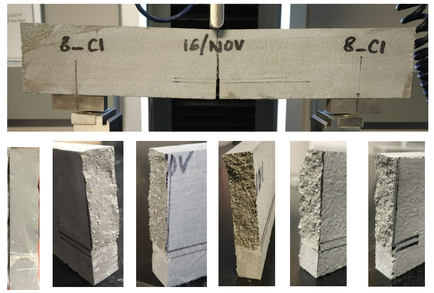
PLASTIC TREATMENT PROCESS

This process starts by taking plastic bottles and containers and grinding them down into small flakes. Next the particles are treated using soy oil and microwaved for two 4-minute increments. This is then followed by grinding down the particles until they are fine enough to add to the cement mixture for testing.



BEAM TESTING

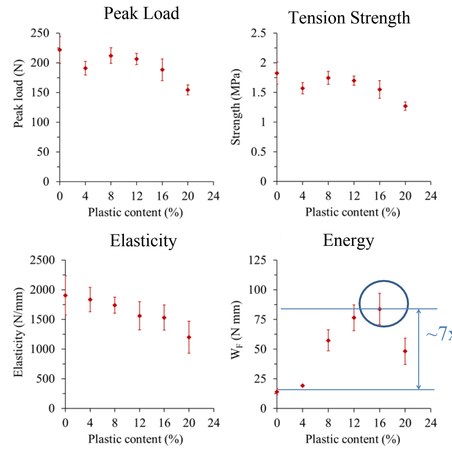
Top picture shows beam under 3 -point testing to test the tensile strength. The pictures below show the cross-sectional view of the broken beams with no added plastic, 4%, 8%, 12%, 16%, and 20% respectively.



WHAT NEXT…

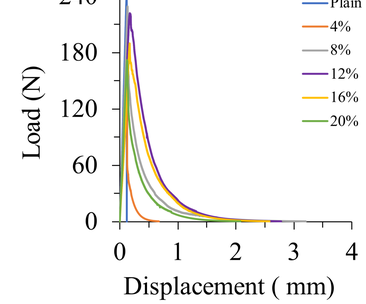
- Continue testing to verify results
- Improve the plastic production process
- Move to a larger scale
- Test fracture properties and scaling effects

MECHANICAL TESTING RESULTS



The most important value taken from these graphs is that of the energy graph in the bottom right of the figure. The circled value is the energy value for 16% plastics. The energy for the beam testing is 7 times more than if there was no plastics in the beam.

The graph to the right shows the load versus displacement based on a three-point test of cement beams. Although the cement without the treated plastic has the highest load, there is no displacement or flexibility.



ACHIEVEMENTS

Discovering relationships between percent plastic and mechanics and performance, CO_2 emissions, and preliminary costs.

NSF I-Corps Training and Findings:

By talking to members of industry, it was found that they had three main goals that this process could help them with.

- The need to reduce CO_2 footprint of concrete
- Finding a balance between value and performance metrics
- Achieving more points on LEED and WELL certifications

FURI

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