Sugar cane waste use as component of hydraulic concrete

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Hydraulic concrete is one of the most-used construction materials around the world. Portland cement is its principal component, but during its production a lot of energy is needed, and big volumes of greenhouse gases like CO_2 are released.

As an alternative, the Mexican National Polytechnic Institute (IPN) proposes the reduction of the amount of cement in the concrete and its replacement with industrial byproducts such as flying ash, agricultural waste and ash from sugar cane waste.

This research is being performed at the Interdisciplinary Research Center for Integral Regional Development (CIIDIR), at Oaxaca, in the south of Mexico. The research is lead by Pedro Montes García, who explains that Mexico is fifth in sugar cane production worldwide. During the extraction of the juice from sugar cane, 30% of the cane is transformed in waste that could be used for this purpose.

According to the researcher, previous work performed at the CIIDIR partially substituted the waste in the cement. "In the chemical composition of the waste's ash, we find silicon oxide with contents of alumina and iron oxide, which can react with calcium hydroxide in the hydration of the cement and produce materials that improve the mechanical and durability properties of the concrete".

For the study, the experimental program was divided in three stages. The first one consisted in the characterization of the ingredients and how they could work with the material; researchers found that the morphology, size and mineral composition of the cane waste ash are hard to process in the concrete mixtures, although this can be solved by adding a superplasticizer.

In the second stage, after the evaluation of the microstructural properties of the material, researchers found that the use of cane waste ash has no detrimental effects.

The third stage, explained by Montes García, consists of lab and field tests to evaluate the durability properties of concrete. The results of chloride diffusion and electric resistivity suggest that the concrete made with cane waste ash can be much more durable than that made with other complementary materials.

"Additional tests in reinforced concrete are required to corroborate these results, which is why we performed the test at the CIIDIR-Oaxaca, in samples submerged in a simulated marine environment using electrochemical resistance tests. There's been an important advance in

the monitoring, which started over 1,700 days ago and we'll soon have the results," says the IPN specialist.

The material has been employed in the lab to partially substitute Portland cement. To launch it in the market, further research must guarantee that its characteristics comply with the current normativity requirements, especially regarding durability.

Currently, the research at CIIDIR-Oaxaca recommends under 15 percent of cement substitution by cane waste ash, because there is no adequate control of the burning system. Therefore, the resulting ash has a high content of uncalcined matter, which can negatively affect the final properties of the concrete.

Cane waste has several applications, one of which is as a base for the manufacture of compound materials. iIt has even been called "the compound material of the future."

Montes García points that another successful application at CIIDIR-Oaxaca has been the stabilization of compacted soil blocks, as the addition of ash significantly improves the properties of resistance and durability of the blocks.

He concludes that the cane waste ash seems like a great option for the manufacturing of several materials used in construction. That is why further research is required, focused in elucidating whether it can be used as a partial or a total substitute of Portland cement.

"Focusing on this, and with the collaboration of Iván Escalante from the CINVESTAV, we have open a new line of research regarding the study of alkaline activated cements that only contain cane waste ash".

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