RESEARCH

Dry slag granulation turns waste into value

A NOVEL dry method for slag granulation could help the cement, iron and steel industries develop sustainable practices and derive value from waste.

About 300 kilograms of slag is generated for every tonne of iron produced. Slag wastes are usually air-cooled in large pits or water-granulated, and then sent to landfills or used in low-level applications such as road base materials.

Some blast furnace operations water-quench discharged slags to produce glassy granules, which can be used in cement.

"The new, dry way of treating slags offers a number of benefits over the traditional wet method," says CSIRO Minerals Project Leader Dongsheng Xie.

CSIRO'S DRY GRANULATION PROCESS: MOLTEN SLAG POURS ON TO A ROTARY DISC. PHOTO: STEVE SANETSIS

The process involves feeding molten slag on to a rotary disc. This disc spins at high speed, breaking the slag into small droplets and rapidly solidifying them to produce glassy granules with similar properties to those produced by wet granulation.

With these properties, the granules can be used in Portland cement, which is a key constituent of concrete – the most consumed mineral product on earth (at about 1.7 billion tonnes annually).

Producing one tonne of Portland cement consumes about 3000MJ of electrical and thermal energy and emits about 900kg of carbon dioxide, mainly due to the decomposition of limestone in the cement kiln.

Granulated slag can substitute for up to 70 per cent of the Portland cement, leading to significant energy savings and reduction in greenhouse gas emissions.

"The wet granulation method involves high capital costs," says Dr Xie. "And it doesn't contribute to sustainable practices because it consumes excessive amounts of water, doesn't recover heat, and generates environmental problems such as acid mist.

"With a lower capital cost and benefits in heat recovery and reduced air pollution, dry granulation is an attractive alternative to conventional wet granulation."

The CSIRO team has built a pilot-scale facility and tested the dry method with several slags from ferrous and non-ferrous industries.

"With a good understanding of how slag properties influence the granulation process, we can tailor-design processes for a variety of slag wastes," says Dr Xie.

"This process is likely to become part of our future work at the Centre for Sustainable Resource Processing [see page 6].

"We've had growing interest from several overseas and Australian companies and we'll work with them to turn the dream of zero-waste processing into a reality."

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Waste not, smelt lots

Forestry and mineral processing scientists are proposing an ambitious project to replace coal in metallurgical processes with char produced from a wide range of wastes.

With its high reactivity and low sulfur content, char from the pyrolysis of carbon-containing wastes – such as those from forestry practices, agriculture, sawmilling, paper, cardboard, biosolids and possibly old tyres – could be used in operations such as slag fuming, bath smelting, synthetic rutile production and iron ore sintering.

Regional centres such as Port Pirie, Werribee and Newcastle would be suitable locations for such an operation, as agricultural and forestry industries exist in these regions and local smelters could directly use the char.

"It's an attractive proposal for many reasons," points out CSIRO Minerals Project Scientist Michael Somerville, whose team has begun discussions with the Port Pirie Regional Development Board.

"The main benefits are environmental, through re-using waste, and drastically shortening the carbon dioxide cycle, reducing net greenhouse gas emissions."

There are also processing benefits from using a more reactive reductant and economic benefits for both smelters and councils.

The proposal is based on a technique developed by CSIRO Forestry & Forest Products (CFFP), in which carbonaceous wastes are heated under a controlled atmosphere to produce char, gas, bio-oil and an aqueous phase.

"Similar pyrolyis operations form the basis of Brazil's iron and steel industry," explains CFFP's Project Leader Dr Paul Fung. "There the gas is burnt to further fuel pyrolysis and the bio-oil is used as fuel oil substitute for heating."

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