



Biomass better

BIOMASS IS EMERGING AS AN ALTERNATIVE CARBON SOURCE IN A VARIETY OF HIGH-TEMPERATURE METALLURGICAL PROCESSES. BY MARINA JOHNSON OF CSIRO MINERALS.

Early research into the use of biomass as an alternative carbon source in a variety of high-temperature metallurgical processes has found it reduces environmental impact and improves efficiency and productivity.

Researchers from CSIRO Minerals, the Centre for Sustainable Resource Processing and the Light Metals Flagship are examining the potential of biomass to help close the carbon loop, recycle carbon dioxide (CO₂) and improve environmental outcomes. As a replacement for coal in metallurgical processes, the renewable resource is greenhouse-neutral: CO₂ liberated during smelting is absorbed by the successive growing of trees.

Carbon-containing wastes – such as those from forestry practices, agriculture, sawmilling, paper, cardboard and sewage plant biosolids – are transformed using pyrolysis to produce char suitable for use in metallurgical operations.

Pyrolysis is the thermal decomposition of biomass without oxygen. Volatile components are driven off as a gas, leaving a charcoal shell. The gases can be condensed to produce an organic phase called bio-oil, which can be substituted for fuel oil in stationary equipment.

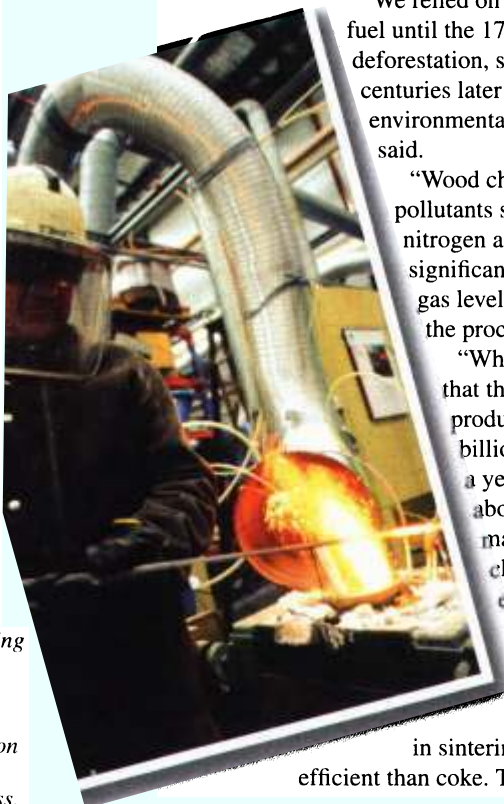
CSIRO researcher Roy Lovel has been testing char produced from trees – grown to ameliorate salinity in the Western Australian Wheatbelt – for use in iron- and steelmaking processes.

“We relied on wood char as blast furnace fuel until the 1700s, resulting in widespread deforestation, so it’s interesting that three centuries later we’re looking at biomass for environmental reasons,” he said.

“Wood char is low in pollutants such as sulfur, nitrogen and ash, which significantly reduces acid gas levels associated with the process.

“When you consider that the steel industry produces more than one billion tonnes of steel a year, and generates about 6% of the world’s man-made greenhouse gases, using char in the process to reduce emission levels – and improve productivity – simply makes sense.

“Our research has shown that char can be used directly in sintering iron ore and can be more efficient than coke. The productivity of the process



Sampling molten iron during injection of biomass.

“The productivity of the process improved by between 10 and 19% and when we used char with a narrower size distribution, the productivity improved by up to 40%.”



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In smelting processes, biomass dissolves as rapidly as high-rank coals. But Lovel said using biomass instead of coal substantially reduced net CO₂ and acid gas emissions, as well as reducing slag volume and process waste.

“Our research has also shown it reduces the demand for fluxing agents, resulting in cost savings and decreased bath volume,” he said. “Improved carburisation rates and increased product quality are also achieved as a result of reduced sulfur levels in hot metal.”



Further study required

Meanwhile, CSIRO researchers under the Centre for Sustainable Resource Processing (CSRP) are conducting a biomass pilot study at Port Pirie, South Australia to confirm their initial findings. The Spencer Gulf industrial town has agricultural and forestry industries and a local smelter that could directly use the char produced.

According to pilot study leader Michael Somerville, biomass benefits the initial waste provider and the end user.

“For instance, in mid-north South Australia there is a small but sustainable forestry industry, which generates waste during tree thinning, harvesting and wood milling,” he said.

“If we use this waste as biomass, there will be no need to burn it in windrows. We also reduce the fuel load on the forest floor and therefore reduce the fire risk. By using this char in local sintering or smelting processes, the environment benefits from reduced CO₂ emissions and the smelter operator may benefit from improved productivity and efficiency.”

The study involves characterising the different biomass materials and their behaviour during pyrolysis. Researchers will also conduct bench-scale metallurgical test work using char produced from local biomass

When this phase finishes, the work will move to demonstration scale, with completion of the study anticipated in 2009.

In a related project, a CSIRO team – through the Light Metals Flagship – is investigating biomass for use in carbon anodes.

The aluminium industry currently relies on coke and coal tar pitch to produce high-quality, dense carbon anodes. However, declining coke quality, security of supply and environmental concerns threaten the quality of aluminium production and are driving the development of alternative carbon sources.

Biomass offers an attractive alternative as it is renewable and has low sulfur and ash content. However, its low density and oxygen content means extra processing is required, so researchers are blending charcoal with biopitch to make a coke-like material to overcome this issue.

If it proves successful, aluminium producers would ideally develop and maintain tree plantations to use for biomass production. LHO

Photos: (top) Mark Fergus, CSIRO; (bottom) Christian Pearson, misheye