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**Text 1**

# Upgrading of Blast Furnace Sludge and Recycling of the Low-Zinc Fraction via Cold-bonded Briquettes

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## Abstract

Depending on the operation of the blast furnace (BF), the main outlet of zinc from the furnace is more or less via the BF dust and sludge. As the dust is recycled to the BF, the sludge has to be de-zinced prior to recycling to prevent the accumulation of zinc in the BF. De-zincing and recycling of the low-zinc fraction via sinter have been reported. However, no research concerning recycling of upgraded BF sludge via cold-bonded briquettes has been performed. In the present study, a fine-grained BF sludge with low zinc content, generated by a BF operating on a ferrous burden of 100% pellets, was upgraded using the tornado process. The process simultaneously dried and separated the BF sludge into a high-zinc and a low-zinc fraction. The feasibility of recycling the low-zinc fraction to the BF using cold-bonded briquettes was studied on a laboratory-scale BF shaft simulator. On comparison with a reference briquette, the experiments indicated that 10 wt% of the upgraded BF sludge can be added to the briquette without negatively affecting the reducibility. Higher additions were found to render the briquette less reduced compared to the reference under test conditions corresponding to the central part of the BF. The strength of the briquettes was not compromised with the addition of the upgraded BF sludge, and a decision to study the briquettes in the LKAB experimental blast furnace was made in order to evaluate the behavior under actual BF conditions.

Text 2

https://www.britannica.com/science/metallurgy/Refining#ref622633

Iron, [copper](https://www.britannica.com/science/copper), and lead are fire-refined by selective oxidation. In this [process](https://www.britannica.com/technology/basic-oxygen-process), oxygen or air is added to the impure liquid metal; the impurities oxidize before the [metal](https://www.britannica.com/science/metal-chemistry) and are removed as an [oxide](https://www.britannica.com/science/oxide) slag or a volatile oxide gas.

The [basic oxygen furnace](https://www.britannica.com/technology/basic-oxygen-furnace) (BOF) is a vessel used to convert [pig iron](https://www.britannica.com/technology/pig-iron), of about 94 percent [iron](https://www.britannica.com/science/iron-chemical-element) and 6 percent combined impurities such as carbon, manganese, and silicon, into [steel](https://www.britannica.com/technology/steel) with as little as 1 percent combined impurities. The BOF is a large pear-shaped unit that can be tilted to charge and pour. Molten blast-furnace iron and steel scrap are charged into the furnace; then it is turned to an upright position and a lance inserted to blow high-tonnage oxygen gas into the bath. Oxidation reactions occur rapidly, with silicon and manganese oxidizing first and combining to form an oxide slag, then carbon oxidizing to [carbon monoxide](https://www.britannica.com/science/carbon-monoxide) gas and burning to [carbon dioxide](https://www.britannica.com/science/carbon-dioxide) as it leaves the furnace mouth. These reactions are strongly exothermic and keep the vessel up to its reaction [temperature](https://www.britannica.com/science/temperature) without any external heat or fuel being added.

Text 3

https://www.britannica.com/technology/steel/Electric-arc-steelmaking

The electric-[arc furnace](https://www.britannica.com/technology/arc-furnace) (EAF) is a squat, cylindrical vessel made of heavy steel plates. It has a dish-shaped refractory hearth and three vertical electrodes that reach down through a dome-shaped, removable roof (see figure). The shell diameter of a 10-, 100-, and 300-ton EAF is approximately 2.5, 6, and 9 metres. The shell sits on a hydraulically operated rocker that tilts the furnace forward for tapping and backward for [slag](https://www.britannica.com/technology/slag) removal. The bottom—i.e., the hearth—is lined with tar-bonded magnesite bricks and has on one side a slightly inclined taphole and a spout or, as shown in the figure, an oval hearth and a vertical taphole. With this latter arrangement, a furnace needs be tilted only 10° for tapping, producing a tight and short tap stream that decreases heat loss and reoxidation of the liquid steel. Before charging, the vertical taphole is closed from the outside by a movable bottom plate and is filled with refractory sand.