

# V Iron and Steel Slag as an Environmentally Friendly Material

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## Contribution to Resource and Energy Saving as well as CO<sub>2</sub> Emission Reduction

Amid growing awareness of environmental issues, iron and steel slag products are highly valued as materials that reduce environmental impact, particularly from the perspectives of resource conservation, energy savings, and CO<sub>2</sub> reduction.

For example, compared to ordinary Portland cement, blast-furnace slag cement containing 45% granulated blast furnace slag offers four key advantages in terms of reducing environmental impact.

(1) The use of ordinary Portland cement is reduced by an amount equivalent to the granulated blast furnace slag content, resulting in approximately 40% savings in limestone, which contributes to resource saving and environmental preservation.

(2) Granulated blast furnace slag, which does not require the calcination process, can reduce coal and electricity consumption by approximately 40% during cement production, thereby enhancing the energy saving effect.

(3) Due to its lower consumption of limestone and energy, blast-furnace slag cement can reduce CO<sub>2</sub> emissions by approximately 320 kg per ton of cement, resulting in a reduction of about 3.2 million tons of CO<sub>2</sub> per year for the production of 10 million tons of blast-furnace slag cement.

(4) Blast-furnace slag cement excels in chemical resistance, with a low chloride ion diffusion coefficient and permeability coefficient, and also has an alkali-aggregate reaction suppressing effect, making it suitable for constructing durable structures.

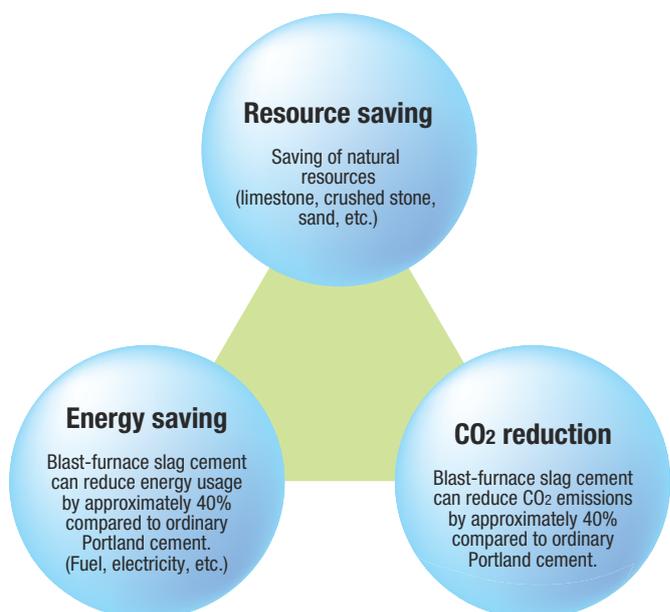
Utilizing iron and steel slag as an alternative to natural resources can contribute to environmental conservation by saving natural resources and reducing energy consumption during extraction. In fact, extracting natural rocks and sand consumes large amounts of energy and emits CO<sub>2</sub> through the heavy machinery used to excavate mountains, sea beds, and riverbeds, leading to significant environmental issues such as the destruction of ecosystems and natural habitats.

Iron and steel slag products are already recognized as

materials that contribute to environmental preservation, and many of these products have been selected as designated procurement items under the Act on Promoting Green Procurement for public projects.

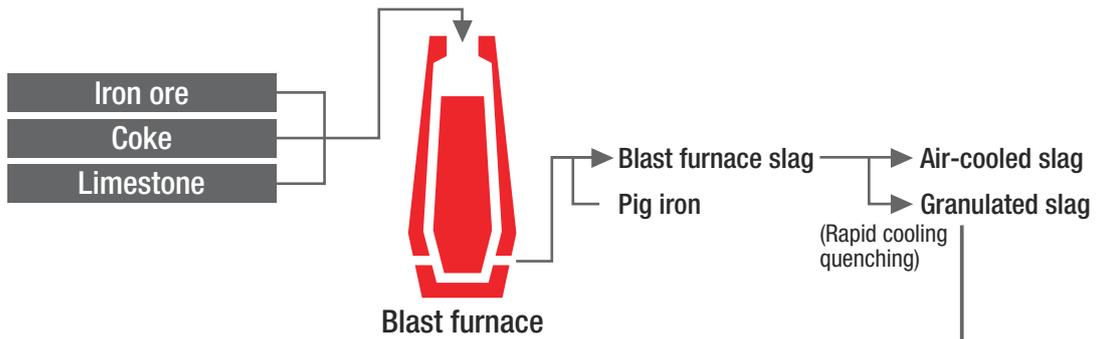
Green procurement refers to an initiative aimed at promoting environmental considerations in procured goods, which was initiated by the United Nations and public organizations in various countries. In Japan, the “Act on the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities” (Act on Promoting Green Procurement) was enacted in April 2001. The government and independent administrative institutions are required to engage in green procurement, and local governments are also expected to promote the procurement of environmentally friendly goods. Furthermore, for companies, the requirements of the ISO 14001 environmental management system include green procurement, thereby encouraging organizations certified with ISO 14001 to promote green procurement.

### Characteristics of “Resource and Energy Saving as well as CO<sub>2</sub> Emission Reduction”

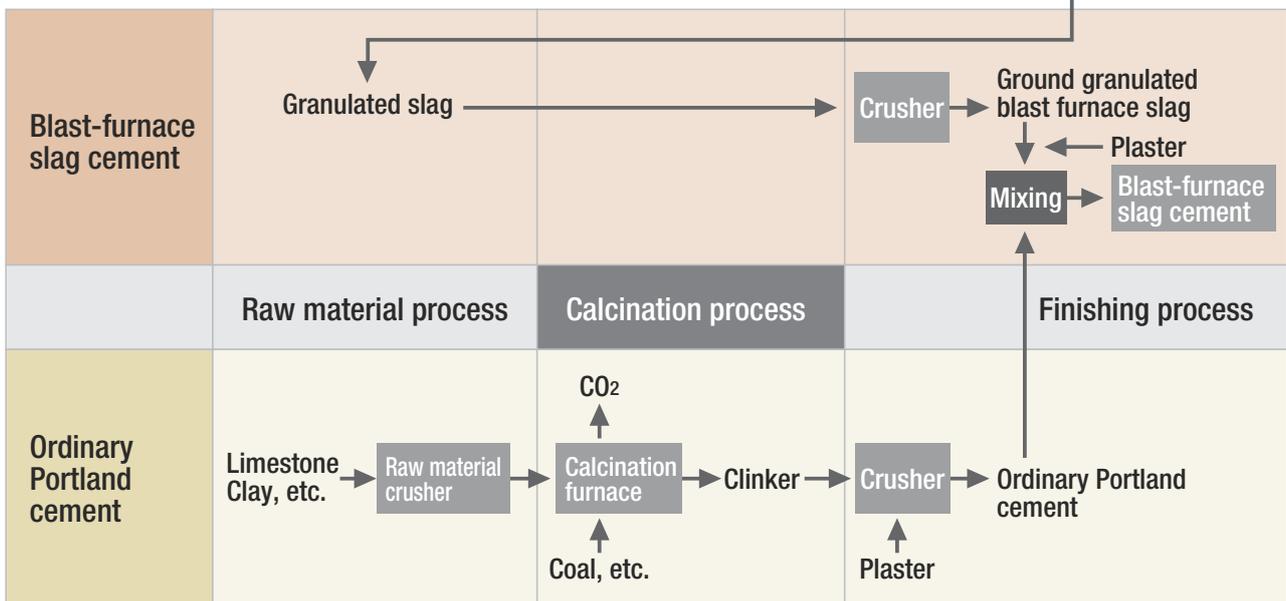


This estimation is based on a 45% ratio of blast furnace slag in blast-furnace slag cement.

Comparison of Production Processes and CO<sub>2</sub> Emissions Between Blast-Furnace Slag Cement and Ordinary Portland Cement



Comparison of Production Processes Between Blast-Furnace Slag Cement and Ordinary Portland Cement



CO<sub>2</sub> Emission Per Ton of Cement (Unit: kg)

CO <sub>2</sub> emission source	Portland cement CO <sub>2</sub> emission (1)	Blast-furnace slag cement Type B CO <sub>2</sub> emission (2)	CO <sub>2</sub> emission reduction (1) – (2)	CO <sub>2</sub> reduction rate (%)
Limestone	476	270	206	43
Electricity and energy	283	170	113	40
Total	759	440	319	42

(Data published by the Japan Cement Association in 2022)

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## Designated Procurement Products under the Act on Promoting Green Procurement

Many iron and steel slag products are highly regarded for their environmental advantages and long track record of use, and have been selected as designated procurement items (products contributing to the reduction of environmental impact) in public works projects under the Act on the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (commonly known as the

Act on Promoting Green Procurement), which came into effect in 2001.

Under the Act on Promoting Green Procurement, the national and local governments are actively promoting procurement, leading to the widespread and effective use of iron and steel slag products as civil engineering materials throughout the country.

Designated procurement items	Condition	Environmental advantage
Blast-furnace slag cement (Designated in FY 2001)	Blast-furnace slag cement containing more than 30% blast furnace slag	<ul style="list-style-type: none"> <li>• Conservation of limestone resources</li> <li>• Energy saving effect</li> <li>• Reduction in CO<sub>2</sub> emissions</li> </ul>
Blast furnace slag aggregate (Designated in FY 2002)	Blast furnace slag aggregate used as a substitute for natural sand (including sea sand and mountain sand), natural gravel, crushed sand, and crushed stone	<ul style="list-style-type: none"> <li>• Preservation of natural environment</li> <li>• Reductions in fossil fuel consumption and CO<sub>2</sub> emissions during crushing process</li> </ul>
Base course material mixed with iron and steel slag (Designated in FY 2002)	Iron and steel slag as base course materials in road construction	<ul style="list-style-type: none"> <li>• Preservation of natural environment</li> </ul>
Asphalt mixture containing iron and steel slag (Designated in FY 2002)	Iron and steel slag aggregate for heated asphalt in road construction	<ul style="list-style-type: none"> <li>• Preservation of natural environment</li> <li>• Reductions in fossil fuel consumption and CO<sub>2</sub> emissions during crushing process</li> </ul>
Granulated slag for civil engineering works (Designated in FY 2003)	Granulated slag for civil engineering works used as a substitute for natural sand (including sea sand and mountain sand), natural gravel, crushed sand, and crushed stone	<ul style="list-style-type: none"> <li>• Preservation of natural environment</li> <li>• Reductions in fossil fuel consumption and CO<sub>2</sub> emissions during crushing process</li> </ul>
Iron and steel slag for ground improvement (Designated in FY 2004)	Steelmaking slag used as a substitute for natural sand (including sea sand and mountain sand) when applying the sand compaction pile method	<ul style="list-style-type: none"> <li>• Preservation of natural environment</li> <li>• Reductions in fossil fuel consumption and CO<sub>2</sub> emissions during crushing process</li> </ul>
Electric arc furnace oxidizing slag aggregate for concrete (Designated in FY 2005)	Electric arc furnace oxidizing slag aggregate used as a substitute for natural sand (including sea sand and mountain sand), natural gravel, crushed sand, and crushed stone	<ul style="list-style-type: none"> <li>• Preservation of natural environment</li> <li>• Reductions in fossil fuel consumption and CO<sub>2</sub> emissions during aggregate transportation and heavyweight concrete work</li> </ul>
Iron and steel slag block (Designated in FY 2008)	Blocks and stone materials made of hydrated matrix, using steelmaking slag as aggregate at a weight ratio of 50% or more and ground granulated blast furnace slag as a binder	<ul style="list-style-type: none"> <li>• Preservation of natural environment and conservation of limestone resources</li> <li>• Reduction in CO<sub>2</sub> emissions during concrete production</li> <li>• Good biofouling properties when used in marine environments</li> </ul>