

Environmentally Friendly Manufacturing Process

—Ferronickel Manufacturing Process—

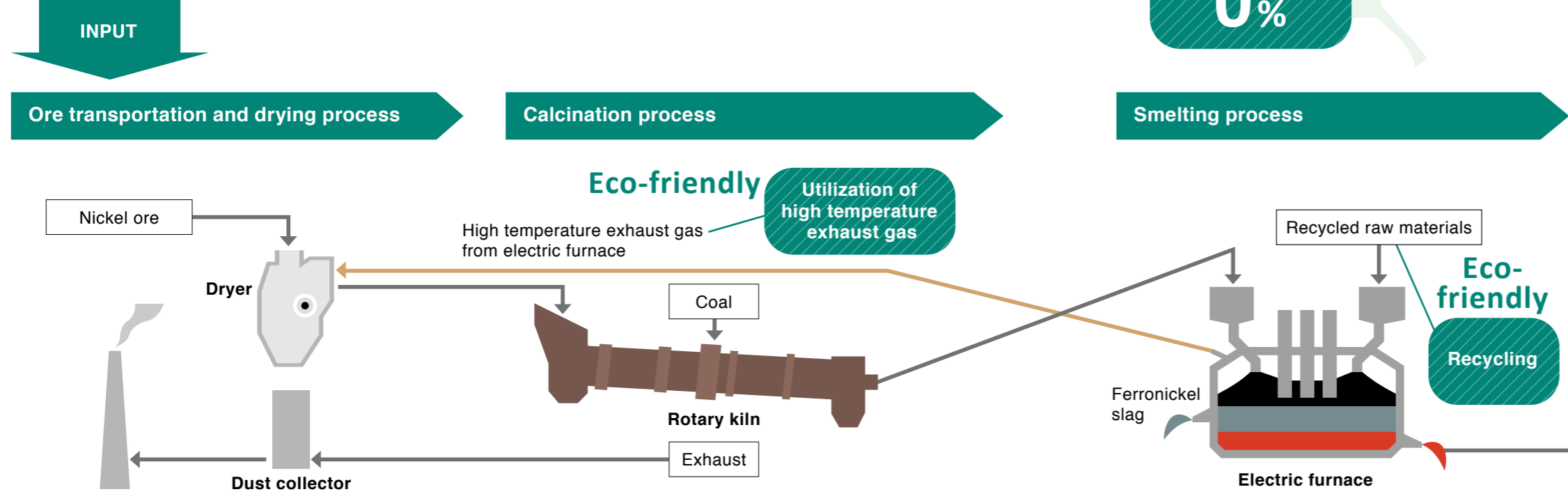


Ferronickel, which is the main raw material for stainless steel, and we are the number one domestic producer of ferronickel. Utilizing the world's top level smelting technology, we carry out efficient manufacturing with the world's largest electric furnace.

Ingenuity to reduce environmental impact, we apply many technologies such as reducing energy consumption by using high-temperature exhaust gas from electric furnaces into the ore drying process, and recycling by smelting recycled resources containing nickel together with nickel ore.

Ferronickel manufacturing process

Main raw materials		Total energy	Industrial water	
Nickel ore (wet)	2,550,000 t	Secondary ingredients 310,000 t	18,420,000 GJ	6,470,000 m ³



Imported nickel ore and coal will be initially stocked at off-site stock yard, and then transported to an on-site stockpile by a conveyor. The conveyed nickel ore is brought into an impact dryer or rotary dryer.



Raw material conveyor: Raw material conveyor is total around 2.4km length.

The preliminary dried ore will be heated in a rotary kiln to remove almost all the remaining and crystallization water.



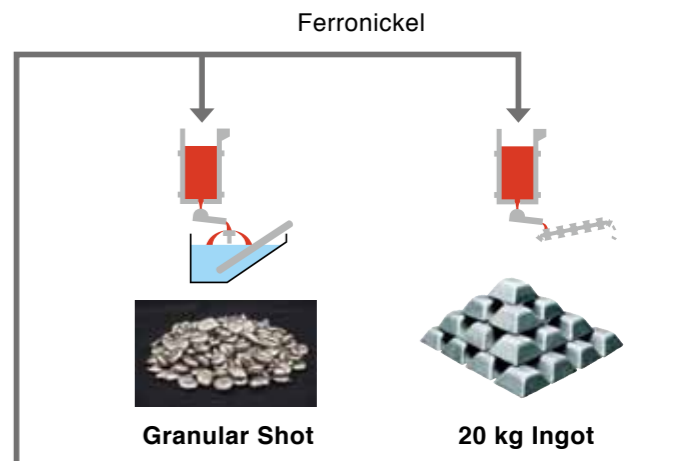
Rotary kiln: A calcining equipment, over 100m in total length that thermally processes dried ore by heating it to approximately 1,000 degrees Celsius.

Recycling rate
100%

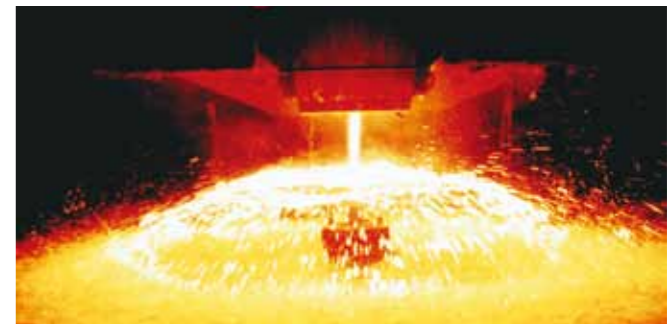
Final waste disposal rate
0%

Products		Atmospheric release	
Ferronickel (gross)	225,000 t	CO ₂	1,390,000 t
Resource recycling		SO _x	1,389 t
Ferronickel slag	1,390,000 t	NO _x	2,384 t
Drain water		Soot and dust	38 t
Discharged water	4,520,000 m ³		

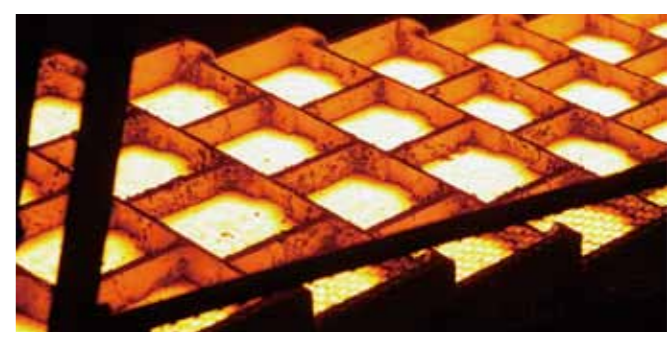
Casting process



Smelted ferronickel (molten metal) is molded into 20kg ingots and granular shots.



Shot casting: Molten metal is rapidly cooled with water in a water tank and finished into small particles.



Ingot casting: Molten metal is poured into molds and finished into 20 kg ingots.

The calcined ore is heated further in an electric furnace. The high temperature exhaust gases from the electric furnaces are used as a heat source in the drying process of nickel ore to reduce energy consumption.



Electric furnace: These are the world's largest electric furnaces that is heated by using electric resistance, and used for smelting ferronickel from ore.

Eco Products That Contribute to Reduced Environmental Impact



Effective use of by-products

Ferronickel slag obtained as a by-product of the ferronickel manufacturing process is cooled by the slow cooling method, and then the entire product is recycled according to the intended use and sold as an attractive product that can be used in a wide range of applications.

The slag's constituent components are stable, environmentally friendly, and have the same quality as natural resources and thus contribute to energy saving by conserving natural resources, and to the formation of a recycling-oriented society.



Used as a civil engineering material in earthquake disaster reconstruction areas

Ferronickel slag (Product name: PAMCO Crushed Stone)

After cooling, ferronickel slag is crushed by crushing equipment to particle sizes of 5 mm or less, 5 to 20 mm, or 20 to 40 mm, which thus allows for a wide range of particle size adjustments when combined according to customer requests.

The slag is characterized by the fact that it is environmentally friendly, highly safe, and does not contain harmful substances, and because it has high roadbed bearing capacity after compaction, it is easy to install, and has excellent frost heaving suppression. In the Tohoku area, it is used mainly as a substitute civil engineering material for mountain sand and crushed stone (for roads, embankments, and land development).



Ferronickel slag of 5 mm or less

Ferronickel slag of 0 to 40 mm

LCA for ferronickel slag products

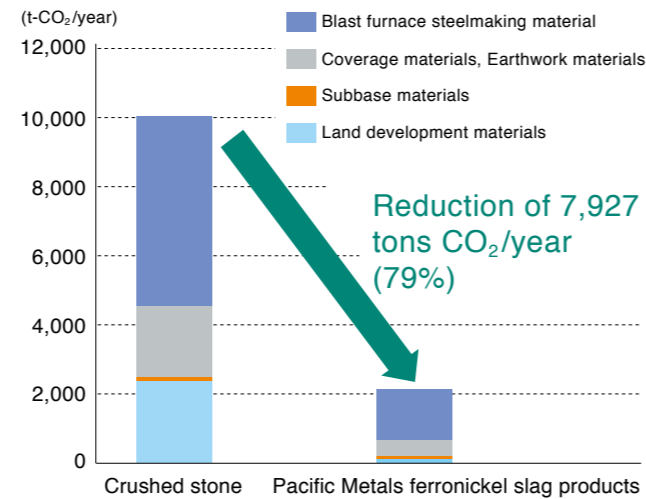
Our ferronickel slag products meet all the elution amount and content standards notified by the Ministry of the Environment, are free from harmful substances, are environmentally friendly and boast high safety, and crushed stones the reduction of environmental load.

The figure below is an LCA (*1) evaluation comparing ferronickel slag products and quarry products (*2), confirming a reduction in CO₂ emissions (*3).

*1: Abbreviation for Life Cycle Assessment. A method of quantifying the environmental impact of a product during its lifetime (resource extraction, manufacturing, use, disposal). *2: Products manufactured by collecting and mining natural stones *3: Evaluation results for ferronickel slag products manufactured in FY2018

Environmental contribution of ferronickel slag products

Applications of ferronickel slag products	CO ₂ emissions (t-CO ₂ /year)		CO ₂ reduction rate
	Crushed stone	Pacific Metals ferronickel slag products	
Slow cooling - Land development materials	2,360	44	98%
Slow cooling - Subbase materials	115	32	72%
Slow cooling - Coverage materials, Earthwork materials	2,059	571	72%
Slow cooling - Blast furnace steelmaking materials	5,518	1,477	73%
Total	10,052	2,124	79%



[Click here for product information](https://www.pacific-metals.co.jp/products/kras.html) https://www.pacific-metals.co.jp/products/kras.html

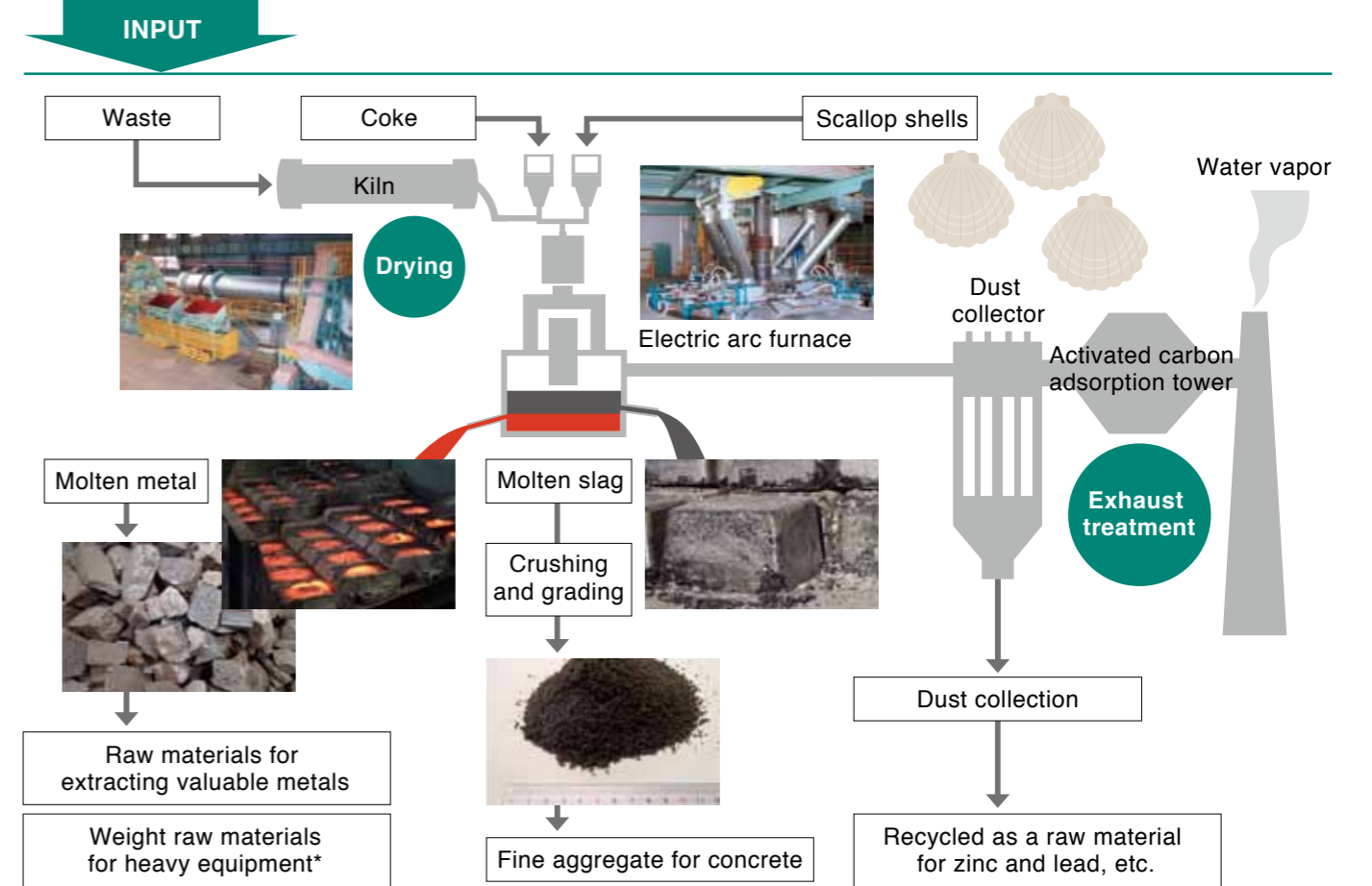
Services That Contribute to the Environment –Waste Recycling Business–



We are engaged in the waste recycling business by utilizing the advanced technology cultivated in ferronickel smelting. At the incineration ash / scallop shell recycling facility, incineration ash from general waste and industrial waste together with scallop shells in Aomori Prefecture are melted in a DC electric furnace and recycled into metal raw materials and fine aggregate for concrete (artificial aggregate).

Incineration ash/scallop shell recycling process

Main raw materials		Total energy		Industrial water	
Waste	2,040 t	Waste generated in-house	1,750 t	70,000 GJ	1,329 m ³
Scallop shells	512 t	Collateral raw materials	1,150 t		



*: Used for weight in vehicles such as excavators and forklifts

Product	Drain water	Atmospheric release			
Molten metal	138 t	Discharged water	0 m ³	CO ₂	1,093 t
Molten slag	4,595 t			SOx	0.03 t
Waste				NOx	0.57 t
Soot and dust, etc.		186 t		Soot and dust	0.047 t

As a waste disposal company, we comply with laws and regulations and we properly recycle. We sell the molten metal produced after processing to metal refining companies for use as weight raw material for heavy equipment and as raw material for valuable metal extraction. We also collect the soot and dust discharged in the processing process and recycle it as raw material for zinc and lead, etc.

We sell the molten slag produced in the same way as fine aggregate for concrete, etc. Secondary concrete products using molten slag and asphalt mixtures have been certified by Aomori Prefecture as recycled products. We are also actively promoting consideration of expanded uses for molten slag products, such as in gabion products for revetment and landscaping material, or in fishing reefs for breeding marine biological resources.

[Click here for information on industrial waste disposal](https://www.pacific-metals.co.jp/environment/waste.html) https://www.pacific-metals.co.jp/environment/waste.html