

# Environmentally Friendly Manufacturing Process

## — Ferronickel Manufacturing Process —

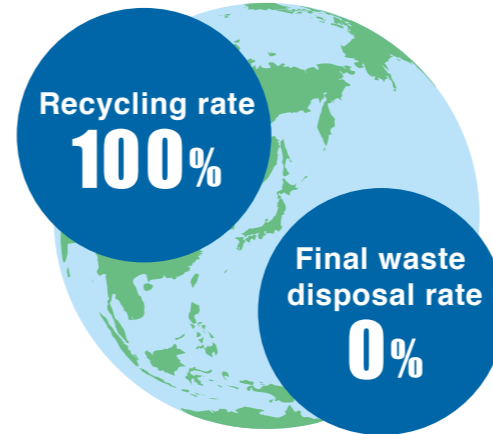


Ferronickel, which is the main raw material for stainless steel, and we are the number one domestic producer of ferronickel. Utilizing the world's top level smelting technology, we carry out efficient manufacturing with the world's largest electric furnace.

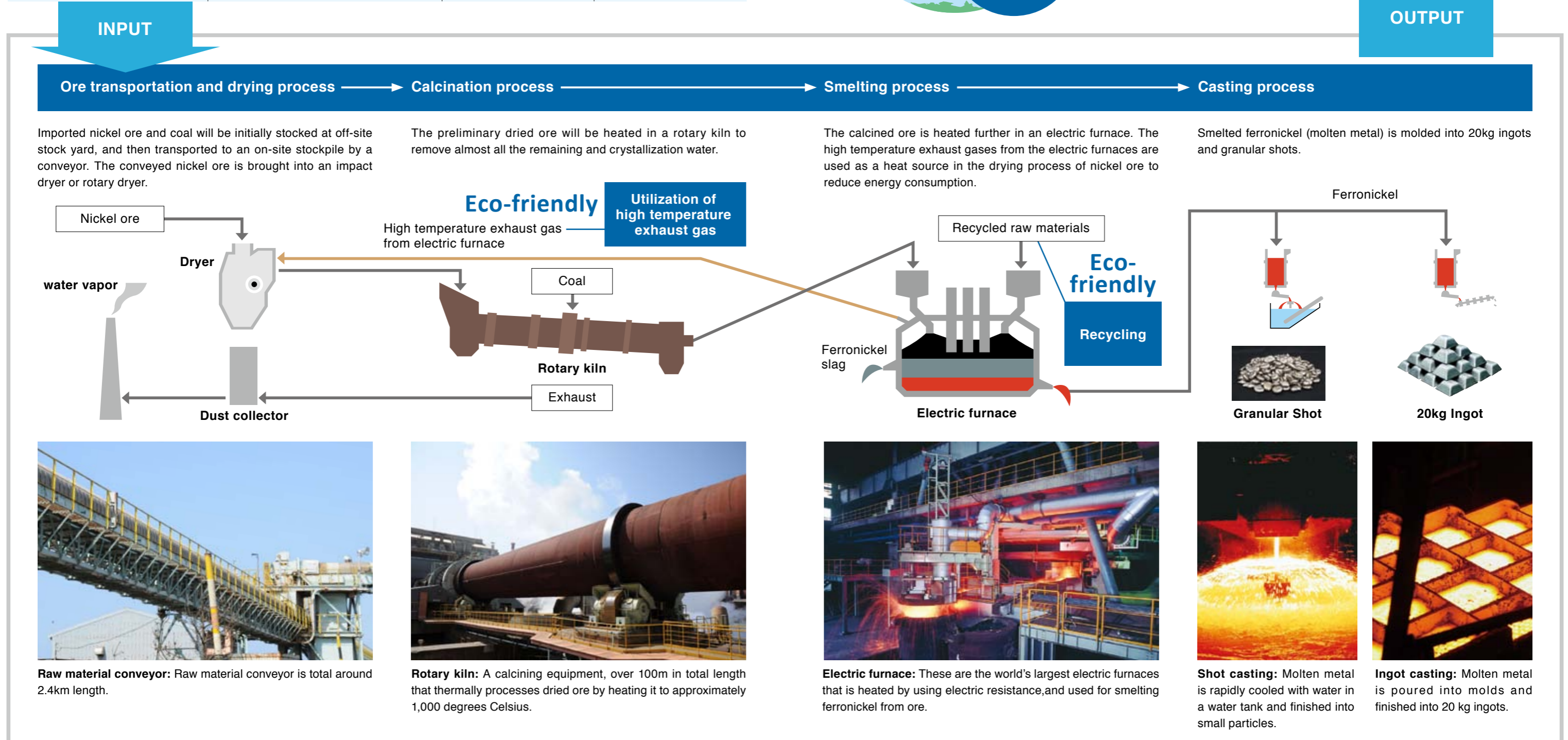
Ingenuity to reduce environmental impact, we apply many technologies such as reducing energy consumption by using high-temperature exhaust gas from electric furnaces into the ore drying process, and recycling by smelting recycled resources containing nickel together with nickel ore.

### ■ Ferronickel manufacturing process

Main raw materials		Total energy	Industrial water
Nickel ore (wet)	1,510,000 t	6,670,000 GJ	6,680,000 m <sup>3</sup>
Secondary ingredients	190,000 t		



Products		Atmospheric release	
Ferronickel (gross)	126,000 t	CO <sub>2</sub>	730,000 t
<b>Resource recycling</b>		SO <sub>x</sub>	831 t
Ferronickel slag	890,000 t	NO <sub>x</sub>	1,647 t
<b>Drain water</b>		Soot and dust	22 t
Discharged water	5,720,000 m <sup>3</sup>		



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



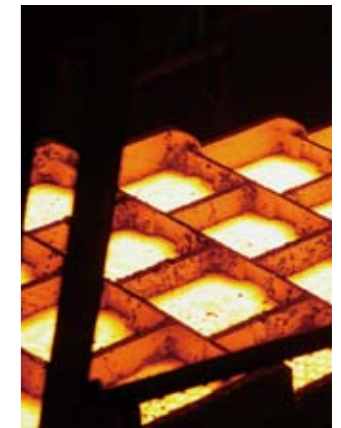
**Rotary kiln:** A calcining equipment, over 100m in total length that thermally processes dried ore by heating it to approximately 1,000 degrees Celsius.



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



**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.

# Eco Products That Contribute to Reducing 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 crustone)

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).

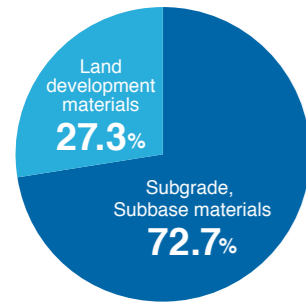


Ferronickel slag, 5 mm or less



Ferronickel slag of 0 to 40 mm

## Percentage of ferronickel slag product by application (period ending March 2021) \*No sales recorded for (3) and (4)



Application	Main Features and Effects
(1) Land development materials	Suitable as soft ground improvement soil
(2) Subgrade, Subbase materials	Excellent roadbed material strength and low freeze-thaw resistance
(3) Coverage materials, Earthwork materials	Suitable for embankments etc. because it compacts well to form firm ground
(4) Blast furnace steelmaking materials	Used as an auxiliary material for adjusting blast furnace slag components

## LCA for ferronickel slag products

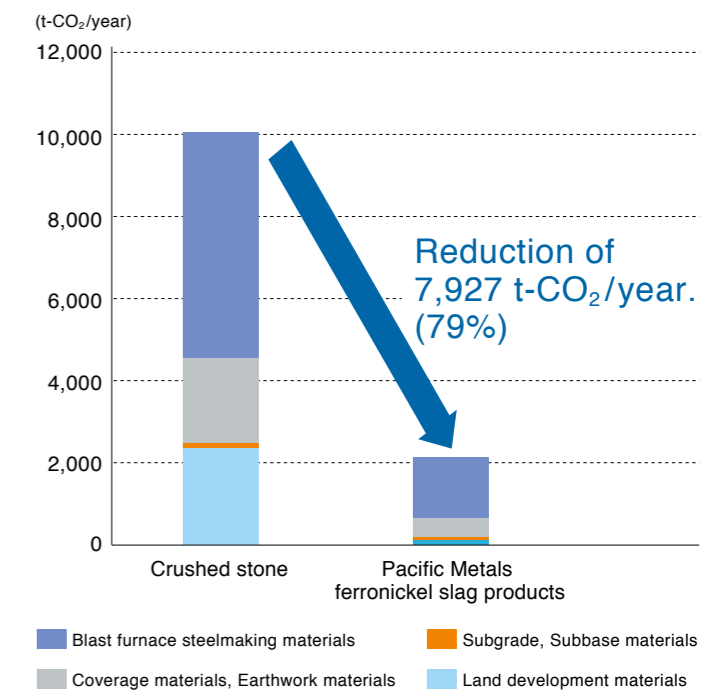
Our ferronickel slag products meet all the elution amount and content standards notified by the Ministry of the Environment, are free from harmful substances, are environmentally friendly and boast high safety, and crushed stones the reduction of environmental load.

The figure below is an LCA<sup>(1)</sup> evaluation comparing ferronickel slag products and quarry products<sup>(2)</sup>, confirming a reduction in CO<sub>2</sub> emissions<sup>(3)</sup>.

\*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

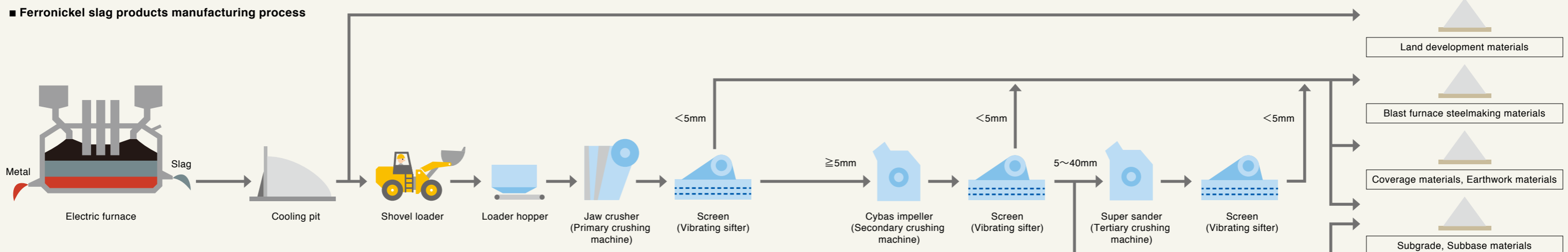
## Environmental contribution of ferronickel slag products

Ferronickel slag product application	CO <sub>2</sub> emissions (t-CO <sub>2</sub> /year)		CO <sub>2</sub> reduction rate
	Crushed stone	Pacific Metals ferronickel slag products	
(1) Land development materials	2,360	44	98%
(2) Subgrade, Subbase materials	115	32	72%
(3) Coverage materials, Earthwork materials	2,059	571	72%
(4) Blast furnace steelmaking materials	5,518	1,477	73%
<b>Total</b>	<b>10,052</b>	<b>2,124</b>	<b>79%</b>



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

## Ferronickel slag products manufacturing process



# Services That Contribute to the Environment

## – Waste Recycling Business –



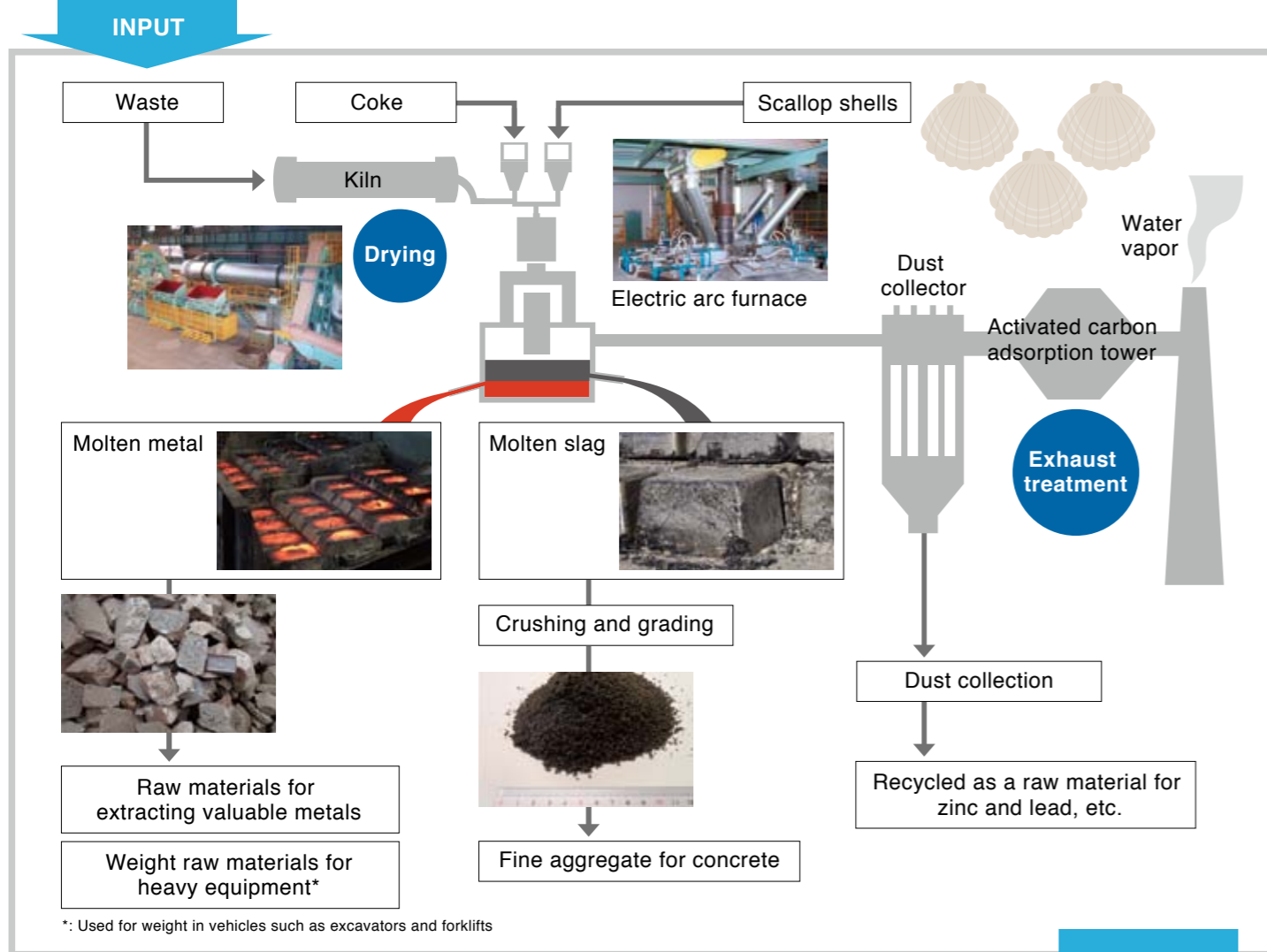
We are engaged in the waste recycling business by utilizing the advanced technology cultivated in ferronickel smelting. At the incineration ash / scallop shell recycling facility, incineration ash from general waste and industrial waste together with scallop shells in Aomori Prefecture are melted in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



Incinerator ash/scallop shell recycling facility

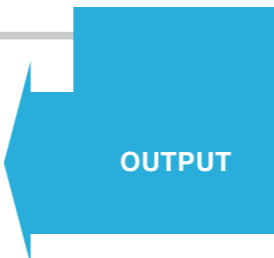
### ■ Incinerator ash/scallop shell recycling process

Main raw materials		Total energy
Waste	2,224 t	10,000 GJ
Scallop shells	617 t	
Waste generated in-house		Industrial water
Collateral raw materials	1,232 t	
	600 t	1,251 m <sup>3</sup>



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

Product	Wastewater	Atmospheric release
Molten metal	Discharged water	CO <sub>2</sub>
135 t	0 m <sup>3</sup>	714 t
Molten slag		SO <sub>x</sub>
3,540 t		0.04 t
Waste		NO <sub>x</sub>
Soot and dust, etc.	92 t	0.56 t
		Soot and dust
		0.012 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.

### ■ Information regarding acceptable industrial waste material, etc.

#### ● Target industrial waste material

Industrial waste material	Cinders (general waste, industrial waste), sludge (inorganic only), plant and animal residue (shells without any deposits of combustibles only), metal scraps, glass scraps, concrete scraps, and ceramic scraps, slag, soot and dust
Industrial waste requiring special treatment (Includes specified toxic substances)	Cinders, soot and dust, sludge (inorganic only)

#### ● Incineration and melt processing capabilities of industrial waste

Classification of business: intermediate processing (melting)

Type of Facility	Melting facility : Incinerated ash and scallop shell recycling facility (Waste material incinerator no.2 PWI-2)
Installed Location	20-2, 21-2 Kawaragi,kaigan, Hachinohe, Aomori
Installation Date	Jul-03
Approval Date	Sep-04
Approval Number	16-15-5
Processing capabilities	79.6t/day (24-hour operation)
Cinders	70.0t/day
Soot and dust	
Sludge	12.8t/day
Plant and animal residue	8.4t/day
Metal scraps	1.7t/day
Glass scraps, concrete scraps, and ceramic scraps	11.3t/day
Slag	11.3t/day

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### ★ Certification as an Excellent Industrial Waste Treatment Company ★

There is an excellent industrial waste treatment company certification system certified by prefectures and government-designated cities for excellent industrial waste treatment companies that have cleared standards that are stricter than normal standards. To be certified, companies must comply with all of the following five items.

- ① Achievements and legality (5 or more years of achievements and no adverse dispositions)
- ② Business transparency (authorization details and treatment status are published on the Internet)
- ③ Environmentally-conscious initiatives (conduct business in an environmentally-conscious manner by obtaining ISO 14001 certification, etc.)
- ④ Electronic manifest (able to use electronic manifests)
- ⑤ Sound financial structure (equity ratio of at least 10%, etc.)

We obtained certification as an excellent industrial waste treatment company in September 2020.

