



Nippon Steel & Sumikin Stainless Steel Corporation (NSSC)

15-year plan results in 100% recycling of refractory waste

Category: Planet/Profit

Sub-category: Emissions

Challenge

Over the past 15 years, NSSC has made significant efforts to reuse waste substances generated in the course of manufacturing stainless steel. Our aim is to conserve the environment and effectively use natural resources. We have introduced new processes to recycle spent refractory waste which is generated in the steelmaking and rolling processes.

In 1998, before we started our recycling activities, the Hikari Works generated approximately 4,900 tonnes of spent refractory material per year. Of that, 300 tonnes (6%) was reused. However, the remaining 4,600 tonnes (94%) were sent to landfill as waste.

NSSC determined that we would need to work on recycling refractory waste on a long-term basis. We planned to improve the recycling rate step-by-step, investing in equipment in a planned way. We established a plan for recycling refractory waste in 1998 and started allocating budget to the project in 1999. Our goal was to achieve a recycling rate of 97% or higher by 2010.

The table on the right shows how we recycle refractory and other waste.

We invested in equipment in three steps. The first recycling equipment was installed in 2001. It was further enhanced in two steps during 2003 and 2009. We set target recycling rates as milestones.

In 2001 we started collecting regular-sized refractory bricks. Since 2010 we have promoted the comprehensive recycling of refractory material. We now collect and recycle waste metals from refractory material and collect refractory material which is coated in molten steel splashes.

	Type of waste	Refractory raw material	Slag-making material	Sand (source)	Iron (source)
Refractory waste	MgO-Cr ₂ O ₃	X			
	MgO		X		
	Al ₂ O ₃	X	X	X	
	Al ₂ O ₃ -C	X	X		
Other waste	Slag			X	
	Dust powder		X		
	Splash				X
	Adhered metals/ironware				X

Action

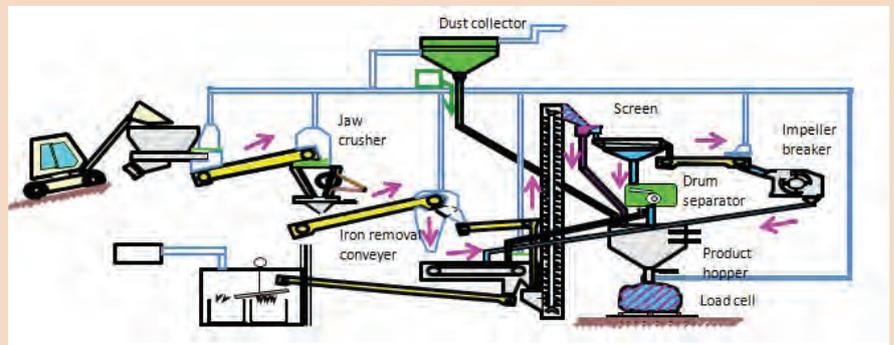
Spent refractory material is collected and separated at the refractory repair site. The recycling equipment crushes the material into predetermined grain sizes ranging from 6 to 100 mm. The recycled material is used as refractory raw materials, auxiliary raw materials for steelmaking, and as a source of iron and sand.

The following list shows the materials recovered and the type of refractory from which they are recovered:

- MgO-Cr₂O₃ (30% of the waste): EAF, AOD and ladles.
- MgO (37%): tundish boards.
- AL₂O₃ (26%): furnaces and other applications.
- AL₂O₃-C (7%): nozzles for sliding and submerged entry.

Collected metals are used as a source of scrap iron for the electric arc furnace (EAF).

The recycling equipment has two crushing lines which makes it possible to process all spent refractory waste



generated in the ironworks. The equipment features:

- High local ventilation and dust collection to reduce dust generation during crushing and pulverisation.
- Built-in magnetic iron removal conveyer. A drum separator on the crushing line improves the quality of crushed and pulverised materials.
- Ability to crush material of any shape including large or long lumps. Metal cases can be separated into metals and refractory material on the line.
- An automatic bagging machine to maximise productivity and ensure operator safety.

Outcome

We have been working to collect metals such as ironware and refractory material splashed with molten iron since 2010 (Step 3). The evolution of our recycling of refractory material is shown in the graph (right). The main steps have been:

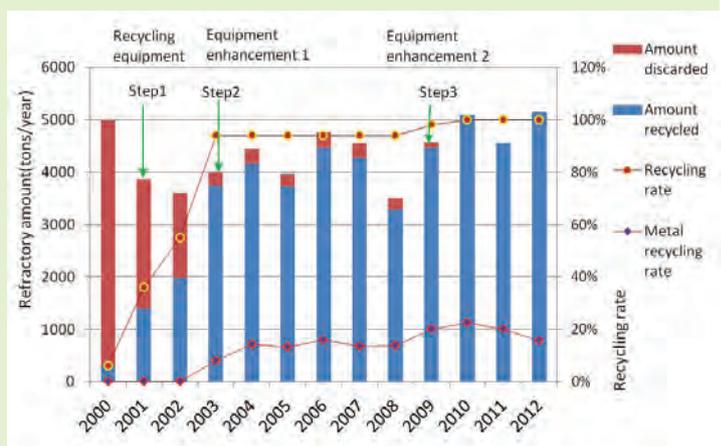
1. Recycling equipment installed (2001) and brick waste (MgO-Cr₂O₃) began to be recycled. A recycling rate of approximately 50% was achieved.
2. The recycling equipment was enhanced (2003) and the number of substances recycled was increased. The recycling rate reached approximately 94%.
3. A further enhancement of the recycling equipment was carried out (2009) so that the number of substances to be recycled could be extended to include other waste. Our recycling rate has been 100% since 2010.

As a result of the recycling, approximately 5,000 tonnes/year of spent refractory material is collected and reused. Previously this material was discarded. All refractory material generated in the steelmaking and rolling processes can be recycled.

Approximately 1,000 tonnes of metal is also collected

each year. Previously this was discarded with refractory material. The metal is used as raw material for the EAF.

NSSC's corporate philosophy is to manufacture stainless steel while preserving the environment and using natural resources in an effective way. In this way we contribute to society. As part this duty, we have steadily developed our ability to recycle spent refractory waste over the past 15 years. Now we have achieved our goal, we will set a new one and continue our work towards making the stainless steel industry even more environmentally friendly.



The graph above shows our activity since 2000.