



International Stainless Steel Forum Safety and Sustainability Awards 2015 Case Studies

SUSTAINABLE
STAINLESS

© 2015, International Stainless Steel Forum (ISSF)

Rue Colonel Bourg 120
B-1140 Brussels, Belgium

T: +32 2 702 8915

F: +32 2 702 8912

www.worldstainless.org

Disclaimer

The International Stainless Steel Forum believes that the information presented is technically correct. However, ISSF does not represent or warrant the accuracy of the information contained in this document or its suitability for any general or specific use. The material contained herein is by necessity general in nature; it should not be used or relied upon for any specific or general application without first obtaining competent advice. ISSF, its members, staff and consultants specifically disclaim any and all liability or responsibility of any kind for loss, damage, or injury resulting from the use of the information contained in this brochure.

Table of Contents

Welcome from the Chairman of the Health, Safety and Environment Committee	4
Secretary-General's Message	5
Summary of Case Studies	6
What Makes Stainless Steel a Sustainable Material?	8
Section A: Safety Award Case Studies	
A01 Improving crane safety during melt shop transfers (Acerinox)	11
A02 Using animations to reproduce fatal accidents for safety training (JFE)	13
A03 Improving safety during material handling (Jindal Stainless)	15
A04 Creating a better working environment (Jindal Stainless)	17
A05 Developing the skills of strip mill operators and technicians (Jindal Stainless)	19
A06 Reducing CO levels to eliminate the chance of explosion (Jindal Stainless)	21
A07 Creating a heatstroke-free workplace (NSSC)	23
A08 Promoting measures to avoid heatstroke (Nippon Yakin)	25
A09 Reducing the risk of collisions (Nippon Yakin)	27
A10 Preventing fires during transportation of the slag pot (YUSCO)	29
A11 Safety skills training in the workplace (YUSCO)	31
Section B: Sustainability Award Case Studies	
B01 Reducing emissions and costs with a new refractory brick format (Acerinox)	35
B02 Reducing emissions to air: a roadmap 2005 - 2015 (Aperam)	37
B03 Reducing noise from the shot blasting machine (Bollinghaus)	39
B04 Environmental and safety management certification (Bollinghaus)	41
B05 Effective utilisation of waste water (Jindal Stainless)	43
B06 Reducing power consumption in the hydraulic power pack (Jindal Stainless)	45
B07 Reducing the power consumption of air blowers (Jindal Stainless)	47
B08 Minimising the impact of stainless steel production (Jindal Stainless)	49
B09 Using a cover to reduce heat losses in the roughing mill (Jindal Stainless)	51
B10 Reducing power consumption in the EAF (Jindal Stainless)	53
B11 Reducing power consumption during de-scaling (Jindal Stainless)	55
B12 Increasing the recycled content of crude stainless steel (Jindal Stainless)	57
B13 Protecting resources with out-of-furnace desulfurisation (Nisshin Steel)	59
B14 Extending product life and minimising waste with a lean duplex grade (Outokumpu)	61
B15 Decreasing the acid consumption of grade ASTM S44500 (YUSCO)	63
B16 Using a neutral sodium sulphate solution in the recycling process (YUSCO)	65

Welcome from the Chairman of the Health, Safety and Environment Committee



We are all working hard to create sustainability within our companies and among our customers and stakeholders. But there is much that can be learnt from what each of us are doing, because we all handle similar problems in different ways. The case studies which are submitted by our members for our annual awards reveal many different success stories as our members continually seek new ways to address safety and environmental issues, not only for their own companies, but also for their customers and for society in general.

Our members have done very important work in improving safety in the workplace and improving the health and well-being of the people who work in our industry. The health and safety of our workforce is a constant priority for all our member companies and is a continuing priority for our Health, Safety and Environment (HSE) Committee.

For all of these reasons, it is very useful for ISSF to collect and re-circulate the submissions which are received from our members for the annual awards, so that our members may have an opportunity to learn from each other.

This is the fifth year in which we have presented awards recognising excellence in Sustainability and Safety.

In total, 27 case studies were submitted for this year's awards from 10 member companies. Some of those members sent in several entries (which is always good

to see), but having responses from only 10 out of 68 members is disappointing. I would hope that we can encourage all of our members to participate more actively in future years.

It is very pleasing to note that the standard of the entries has improved each year and the judging process has become more and more difficult. As with any competition, not everyone can win an award, but the value of all of the entries will remain evident for all members to see.

The importance of sustainability and corporate responsibility is increasing globally and the challenge which our industry faces is how to turn our achievements in this area to our advantage in the market by adding value for our customers and for end-users of stainless steel. The web pages of ISSF are an important tool for sharing this know-how and these good ideas and improvements. I therefore warmly recommend that you all study this year's submissions, and re-visit the submissions from previous years – there are some very good solutions, practices and cases from which we can all learn and profit.

Dr Juha Ylimaunu

Chairman
ISSF Health, Safety and Environment Committee
Brussels, May 2015

Secretary-General's Message



Dear Members

“Nothing is more important than the safety and health of the people who work in the steel industry.”

That sentence has been endorsed as a statement of principle by the Board of the World Steel Association and was adopted by the Board of ISSF in 2008.

The ISSF Health, Safety and Environment (HSE) Committee has added sustainability as a point of principle, recognising that the world is changing and that consumers and regulators alike are looking for more sustainable ways to utilise the world's resources. Our competitors are highlighting the sustainable features of their products and it is essential that our industry should be at the forefront of this important initiative. We are convinced that stainless steel provides a sustainable solution for its users, but it is important for us to spread that belief to the widest possible audience.

To continually re-position the concepts of health, safety and the environment in the minds of all of our members, the HSE Committee has invited members to submit case studies of their individual efforts every year and has introduced annual awards for the best submissions in two categories: Sustainability and Safety.

The case studies which have been submitted have a relevance to all steel producers. A good idea introduced by one member may be utilised just as effectively by other members, because the risks in the industry are generally fairly common. We have therefore published the entries in full, in the hope that others may learn from them. The publication is available on our Extranet and will also be distributed in booklet form at our Annual Conference.

John Rowe
Secretary-General
International Stainless Steel Forum
Brussels, May 2015

Summary of Case Studies

All ISSF member companies were invited to submit entries for the 2015 Safety and Sustainability Awards. Ten companies submitted 27 cases studies for consideration.

As in 2014, two awards will be presented in 2015. The first is for initiatives that affect the health and safety

of the people who work in the stainless steel industry. The second recognises actions that have improved the profitability of a member company or have led to environmental improvements.

The following tables summarise the entries received.

Safety Award

Company	Case Study	<i>Accident analysis</i>	<i>Safety training</i>	<i>Skill training</i>	<i>Workplace improvement</i>
Acerinox	Improving crane safety during melt shop transfers				
JFE	Using animations to reproduce fatal accidents for safety training				
Jindal Stainless	Improving safety during material handling				
	Creating a better working environment				
	Developing the skills of strip mill operators and technicians				
	Reducing CO levels to eliminate the chance of explosion				
NSSC	Creating a heatstroke-free workplace				
Nippon Yakin	Promoting measures to avoid heatstroke				
	Reducing the risk of collisions				
YUSCO	Preventing fires during transportation of the slag pot				
	Safety skills training in the workplace				

Sustainability Award

Company	Case Study	Emissions	Environmental Management System (EMS)	Energy intensity	Material efficiency	Investment in new processes and products	Value to the customer
Acerinox	Reducing emissions and costs with a new refractory brick format						
Aperam	Reducing emissions to air: a roadmap 2005 - 2015						
Böllinghaus	Reducing noise from the shot blasting machine						
	Environmental and safety management certification						
Jindal Stainless	Effective utilisation of waste water						
	Reducing power consumption in the hydraulic power pack						
	Reducing the power consumption of air blowers						
	Minimising the impact of stainless steel production						
	Using a cover to reduce heat losses in the roughing mill						
	Reducing power consumption in the EAF						
	Reducing power consumption during de-scaling						
	Increasing the recycled content of crude stainless steel						
Nisshin Steel	Protecting resources with out-of-furnace desulfurisation						
Outokumpu	Extending product life and minimising waste with a lean duplex grade						
YUSCO	Decreasing the acid consumption of grade ASTM S44500						
	Using a neutral sodium sulphate solution in the recycling process						

What Makes Stainless Steel a Sustainable Material?

Before we can determine whether stainless steel is a sustainable material, we should first define what we mean by sustainability in relation to what is known as the triple bottom line: People, Planet and Profit.

People

The material, in its use or in its production process, respects the human being, especially in terms of health and safety. A sustainable material does not harm the people working to produce it, or the people who handle it during its use, recycling and ultimate disposal.

Stainless steel is not harmful to people during either its production or use. A protective layer forms naturally on all stainless steels because of the inclusion of chromium. The passive layer protects the steel from corrosion – ensuring a long life. As long as the correct grade of stainless is selected for an application, the steel remains inert and harmless to the people who handle it and the environment.

These characteristics have made stainless steel the primary material in medical, food processing, household and catering applications.

Planet

The emission footprints of the material, especially those related to carbon, water and air, are minimised. Reuse and recyclability are at high levels. The material has low maintenance costs and a long life, both key indicators that the impact of the material on the planet is at the lowest levels possible.

The electric arc furnace (EAF), the main process used to make stainless steels, is extremely efficient. An EAF has a low impact on the environment in terms of both CO₂ and other emissions. The EAF is also extremely efficient at processing scrap stainless, ensuring that new stainless steel has an average recycled content of more than 60%.

Stainless steels are easily recycled to produce more stainless steels and this process can be carried on

indefinitely. It is estimated that about 80% of stainless steels are recycled at the end of their life. As stainless steel has a high intrinsic value, it is collected and recycled without any economic incentives from the public purse.

Profit

The industries producing the material show long-term sustainability and growth, provide excellent reliability and quality for their customers, and ensure a solid and reliable supply-chain to the end consumer.

Choosing stainless steel for an application ensures that it will have low maintenance costs, a long life and be easy to recycle at the end of that life. This makes stainless an economical choice in consumer durables (such as refrigerators and washing machines) and in capital goods applications (such as transportation, chemical and process applications).

Stainless steels also have better mechanical properties than most metals. Its fire and corrosion resistance make stainless a good choice in transportation, building or public works such as railways, subways, tunnels and bridges. These properties, together with stainless steels' mechanical behaviour, are of prime importance in these applications to ensure human beings are protected and maintenance costs are kept low.

Stainless also has an aesthetically pleasing appearance, making it the material of choice in demanding architectural and design projects.

Taking into account its recyclability, reuse, long life, low maintenance and product safety, the emissions from the production and use of stainless steels are minimal when compared to any other alternative material. A detailed and precise analysis of the sustainability of stainless steel makes the choice of stainless a logical one. This might explain why, as society and governments are becoming more conscious of environmental and economic factors, the growth in the use of stainless steel has been the highest of any material in the world.

Section A: Safety Award Case Studies

Section A: Safety Award Case Studies

A01 Improving crane safety during melt shop transfers (Acerinox)	11
A02 Using animations to reproduce fatal accidents for safety training (JFE)	13
A03 Improving safety during material handling (Jindal Stainless)	15
A04 Creating a better working environment (Jindal Stainless)	17
A05 Developing the skills of strip mill operators and technicians (Jindal Stainless)	19
A06 Reducing CO levels to eliminate the chance of explosion (Jindal Stainless)	21
A07 Creating a heatstroke-free workplace (NSSC)	23
A08 Promoting measures to avoid heatstroke (Nippon Yakin)	25
A09 Reducing the risk of collisions (Nippon Yakin)	27
A10 Preventing fires during transportation of the slag pot (YUSCO)	29
A11 Safety skills training in the workplace (YUSCO)	31

Safety Award

Company	Case Study	<i>Accident analysis</i>	<i>Safety training</i>	<i>Skill training</i>	<i>Workplace improvement</i>
Acerinox	Improving crane safety during melt shop transfers				
JFE	Using animations to reproduce fatal accidents for safety training				
Jindal Stainless	Improving safety during material handling				
	Creating a better working environment				
	Developing the skills of strip mill operators and technicians				
	Reducing CO levels to eliminate the chance of explosion				
NSSC	Creating a heatstroke-free workplace				
Nippon Yakin	Promoting measures to avoid heatstroke				
	Reducing the risk of collisions				
YUSCO	Preventing fires during transportation of the slag pot				
	Safety skills training in the workplace				



Acerinox S.A.

Improving crane safety during melt shop transfers

Award: Safety
Category: Workplace improvement

Challenge

The movement of cranes carrying ladles and slag pots in the melting shop involves high risk for the operators who are working underneath. The weight of the ladles and slag pots is very heavy, however, the main risk is from molten steel and slag which can spill or splash onto the operators below.



Acerinox aimed to improve worker safety by eliminating the risks from moving cranes

Action

To minimise the risk, a solution was developed by the Safety Committee, melting shop staff and electrical engineers. The system uses a combination of wirelessly connected traffic lights and simple control panels. A new operating procedure was also developed to standardise the movement of the cranes.

The new operating procedure includes the following steps:

1. Before lifting the load (ladle, slag pot), the overhead crane operator activates the Passing Request signal by pressing a button. This activates the following warning signals:
 - A 'Don't Enter' signal (red light) is displayed to forklifts and other vehicles. At this time, all vehicles are denied access to the work areas.
 - A yellow warning light flashes in the refractory work area.
 - A yellow warning light flashes to warn ladle operators in the work area.
2. When the Passing Request signal is noticed by the operators in the work areas, they must press the Permission Granted button. This turns off the yellow warning lights.
3. When the yellow warning light signals are turned off, the crane operator receives the Total Permission for Overhead Crane signal in the cabin. Forbidden to Pass signals (red lights) are turned on in the work areas. At that point, operators in the ground floor work areas must momentarily leave their position while the crane passes above.
4. Once the crane operator has passed over the work areas and finished the manoeuvre, they press the End of Crane Manoeuvre button. All light signals (for vehicles and for work areas) are turned off. At that point, forklifts and vehicles can move again and operators can return to their work areas.

Outcome

We have minimised the high risk of transporting of heavy and dangerous loads with overhead cranes over work areas. The new procedures minimise the danger to operators on the melting shop floor and other traffic.



Workers can activate the new warning lights at a press of a button



Warning lights around the plant alert workers that the crane is moving



JFE

Using animations to reproduce fatal accidents for safety training

Award: Safety
Category: Safety training

Challenge

Unfortunately JFE has experienced some fatal accidents in the past. In order to prevent any recurrence of similar accidents, we created a guidebook showing the lessons learned from these past accidents. The guidebook was used to train new employees and contractors. However, we realised it was difficult for them to understand the lessons in a short period of time.

An example from the guidebook on lessons learned

Electrical Shock One fatal accident per page

(Kurashiki District) April 10, 2014

Victim suffered electric shock when approaching too close to energized conductor.

The diagram illustrates an electrical accident scene. It shows a duct with a cover that is open. A victim is shown approaching the duct. Labels include: 'Discovered person (Leader A)', 'Victim C Place where discovered', 'Duct cover (Open)', 'Duct cover (Not open)', 'Location of electric shock (presumed)', 'Bus bar', 'Duct', 'Energized part', 'Energized conductor', 'Circuit breaker', 'Disconnecting switch', and 'Removed cover area (Entered area)'. A yellow box highlights the countermeasure: 'Both the ordering party and the order-receiving party shall confirm the area secured for the work and the actual work area based on a document and start work accordingly.'

(Situation) Victim suffered an electric shock when approaching too close to energized conductor in order to perform cleaning inside a duct.

(Cause) There was a discrepancy between the actual work area and the predetermined area secured for the work.

Countermeasure:

① Both the ordering party and the order-receiving party shall confirm the area secured for the work and the actual work area based on a document and start work accordingly.

An example from the JFE guidebook

Action

JFE created an animation which shows graphic moving images relating to five fatal accidents in the past. The DVD replays each accident and shows the lessons learnt. Each animation lasts just three minutes.

The following images are taken from an animation which shows a fatal accident in which the worker fell from a height. The animations are widely used in various training courses.



The accident is replayed to show how it occurred and the outcome

©JFE Steel Corporation



Outcome

It is easier for trainees to understand why a fatal accident occurred and the lessons learnt from the incident. New employees and contractors can understand the information in a short period of time.

◆ 作業指示書への 作業範囲および危険区域の明確な記載



図面などによる
明確な指示

個々に判断を任せる
~~曖昧な指示~~

Lessons learnt from the accident are also included in the animation
©JFE Steel Corporation



Jindal Stainless Limited

Improving safety during material handling

Award: Safety
Category: Safety training

Challenge

Material handling is a daily function in the workplace. Often the task is taken for granted, with little regard for the consequences if it is not done in the correct and safe manner. To reduce the chance of employee injury and/or damage to nearby machinery, attention needs to be paid to how the material or goods are loaded or unloaded.

At Jindal Stainless we faced the following challenges:

- Incorrect operation of material handling equipment by drivers
- Workers bypassing safety interlocks
- Incorrect tools and equipment being used to handle materials
- Unsafe material handling practices.

Action

To overcome these challenges, a Safe Material Handling training programme has been designed and implemented to raise awareness of the issue. It is provided to workers who are directly involved in handling materials. In addition to the awareness training, engineering controls have been implemented to ensure safe and smooth material handling.

The following actions have been taken:

- Special training programmes on Safe Material Handling and Lifting Tools and Equipment are conducted by the Environment, Health and Safety (EHS) department. Crane operators, mobile equipment drivers, riggers, and their assistants are the target audience for the training
 - A daily checklist has been devised and implemented and this is monitored by shift leaders
 - Before starting their equipment, the driver must ensure the equipment is in good working order
 - Maintenance teams have started to conduct regular preventive maintenance instead of just breakdown maintenance
- All safety interlocks have been checked and made operational
 - Surprise audits are conducted on all material-handling equipment.

Outcome

After providing the awareness training and implementing engineering controls, the average number of unsafe acts and conditions has dropped from 79 in the first quarter of 2013 to just 45 in the last quarter of 2014.

Jindal Stainless Limited

Creating a better working environment

Award: Safety
Category: Workplace improvement

Challenge

A few unutilised areas in the plant were creating an unhealthy working environment and demotivating the workforce.



As a result of the improvements, new park areas (above) and sports fields (below) have been created



Action

After performing a complete survey of the unused areas, it was decided to convert them into parks, green areas or sports grounds so they could be utilised by personnel from the plant.

Some of the changes included:

- A small space behind the Personnel department was used as a temporary walkway and had a bore-well in its centre. The well was shifted to the side of the space and the area was cleaned and turned into a sports area.
- A water tank near the canal had been neglected. A duck house was constructed and the area landscaped so that the ducks could easily access the water.
- There was a very large vacant space near the truck parking area. High tension lines pass overhead. As a result, the area cannot be used for processing activities. The area was developed into a park with various landscaped areas and new planting. The space provides a more relaxed working atmosphere for the employees.

Sports fields have been created to improve the health of employees



Outcome

The major benefits of this programme have been:

- Proper utilisation of spare and unused areas
- Beautification of the plant premises
- Enhancement of the Environment Management System as the plant area is now greener
- Creation of a relaxed working atmosphere
- Provision of sporting areas so employees can sharpen their skills after work
- Natural cleaning of the water tank as the ducks eat the small insects and weeds.

Even the plant's ducks have a new (stainless steel) home





Jindal Stainless Limited

Developing the skills of strip mill operators and technicians

Award: Safety
Category: Skill training

Challenge

According to the International Labour Organization (ILO), skill development is of key importance if we want to stimulate a sustainable development process which can contribute to India's transition from an informal to a formal economy.

At Jindal Stainless we face the following challenges due to the low skill-level of our workforce:

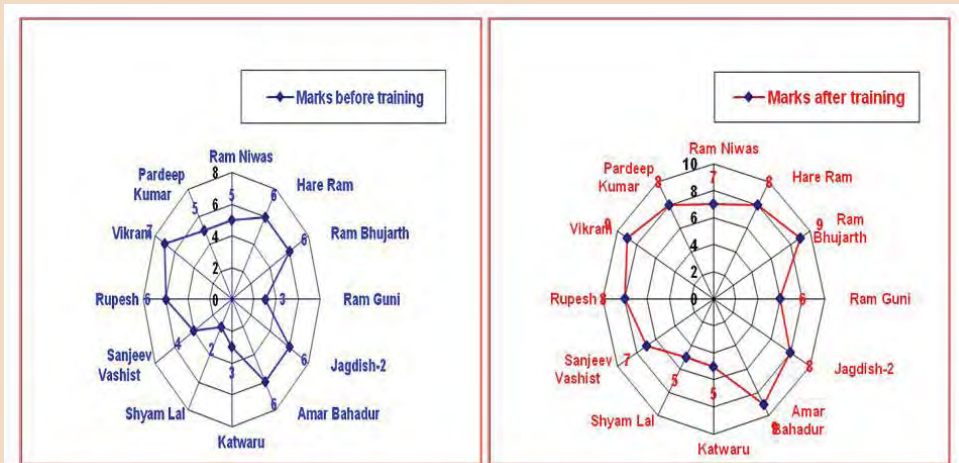
- Low yield
- Frequent breakdowns and high maintenance time
- Quality issues and a high rejection rate
- High incidence of unsafe acts
- High energy consumption.

Action

To overcome these issues, the entire situation was analysed. The investigation concluded that, despite the availability of appropriate systems, procedures and technology, the expected result is not being achieved. Skill mapping was conducted for every operator and technician.

Based on the results of the skill mapping, a Skill-Up Gradation Programme (SUP) was designed and implemented. The SUP programme covered:

- Roughing mill operation
- Re-heating furnace operation
- Hydraulics systems
- Rolling temperature of different grades
- Quality defects
- Industrial safety and fire fighting
- Problem solving tools and techniques.

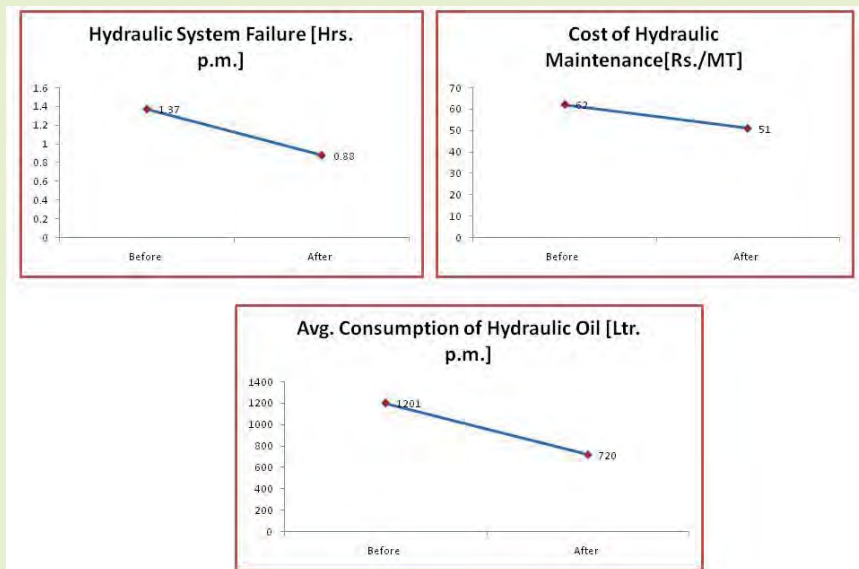


Improvement in skills after strip mill operators receive training

Outcome

After successful implementation of the SUP training, the following benefits were realised:

- Yield improvement
- Improvement in product quality and reduction in rejections
- Reduction in energy consumption
- Reduction in unsafe acts and incidents.



Reduction in incidents following training in the hydraulic system



Jindal Stainless Limited

Reducing CO levels to eliminate the chance of explosion

Award: Safety
Category: Workplace improvement

Challenge

There is a chance of an explosion in the bag house due to the high carbon monoxide (CO) level. The CO level must be controlled to stop this occurring.



Nippon Steel & Sumikin Stainless Steel Corporation (NSSC)

Creating a heatstroke-free workplace

Award: Safety
Category: Workplace improvement

Challenge

NSSC holds the safety of employees as one of the company’s key objectives. NSSC has made continuous improvements to prevent industrial accidents among our employees. The prevention of heatstroke is a distinct example of our commitment.

Heatstroke is a general term referring to disorders that are brought about by an improper balance between water and salt levels in the body, or problems with the body’s temperature-regulating system. These can be triggered by factors such as heat and humidity in the work environment.

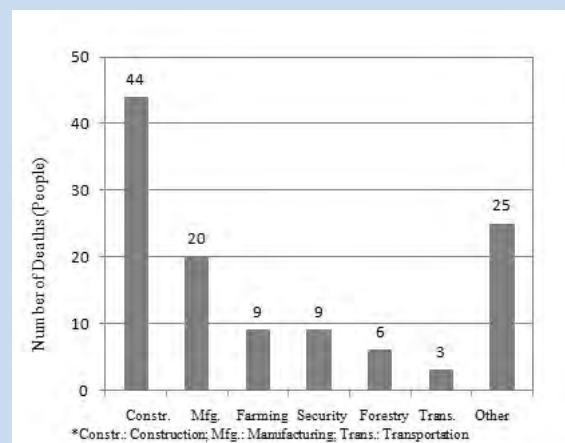
Symptoms of heatstroke include muscle pain, heavy perspiration, nausea, and physical weariness. If the condition becomes severe, the person can become disoriented and death can occur. Heatstroke can quickly become more serious if rehydration is neglected.

Summer in Japan is characterised by high temperatures and humidity, so there is a high risk of heatstroke. For example, during 2013 approximately 58,000 people were transported by ambulance to hospitals due to heatstroke during in the summer (June to September). Of those people, 88 died.

Approximately 20 people die from heatstroke each year in Japan while working, and this has become a

serious issue. An examination of fatal accidents due to heatstroke by industry over the past four years (2010 to 2013) shows that the manufacturing industry is the second-worst affected after the construction industry.

NSSC has not had a fatal accident since the company was established. However, in this time the ambulance has been called five times for problems related to heatstroke. Taking preventative measures has become an urgent task.



Manufacturing has the second-worst record for heatstroke-related deaths in Japan

Action

There are other factors which contribute to heatstroke in addition to high temperature and humidity. These include inadequate fluid and salt intake while working, and individual factors such as our ability to acclimatise to heat.

Actions were developed in the following areas:

- Improvement of workers' awareness of the seriousness of heatstroke
- Provision of information about proper fluid and salt intake
- Measures to help workers acclimatise to heat and manage their personal health
- Improvement of the work environment and protective equipment.

The implementation of heatstroke mitigation measures at NSSC has evolved in three stages since it was first recognised as an issue in 2008. The three stages are:

1. Autonomous activities by individual departments (prior to 2008)

Activities to raise awareness of heatstroke were left to individual departments. Actions included installation of meters, heatstroke drills and provision of water and salt supplements.

2. Start of company-wide management (2009 to 2013)

In 2009, NSSC implemented a company-wide policy to manage heatstroke which established common rules in all departments. Activities started in May each year to raise awareness of heatstroke.

As part of the new policy, workers were required to promptly report cases of physical illness.

Instead of temperature and humidity meters, standard wet bulb globe temperature (WBGT) meters were installed. Improvements were also made to protective equipment.

The main issue identified in this stage was that there was no record of heatstroke mitigation being implemented. This meant our plan-do-check-adjust (PDCA) cycle could not move forward.

3. Quantitative execution management and transition to PDCA cycle (since 2014)

In Stage 3 we have started to record and manage fluid and salt intake, rest times, and the physical condition of each employee.

Outcome

Since the company was established, NSSC's activities have ensured that no industrial accidents have occurred which resulted in absence due to heatstroke.

The summer of 2013 was particularly hot, leading to 30 fatal accidents throughout Japan. At NSSC, there were no ambulance requests arising from heatstroke.

In addition to the measures detailed above, the company has reduced the risk of heatstroke in the workplace by implementing environmental improvements such as cool houses and ventilating interiors with large fans.

The understanding of the seriousness of heatstroke has advanced in the workplace. Each department demonstrates its ability to promptly attend to physical illness. The level of drills has also risen in preparation for an unlikely heatstroke event.

In the future, we will consider combining fluid and salt supplement intake records and physical condition data. This will enable us to create rules regarding the optimal quantity and timing of fluid and salt supplement intake for each workplace.

We would also like to support one-person working locations. These occur in non-routine operations such as

construction. They are difficult to monitor but we want to continue our unbroken record of zero instances of heatstroke.



NSSC has installed fans and cool houses to prevent heatstroke



Nippon Yakin Kogyo Co., Ltd.

Promoting measures to avoid heatstroke

Award: Safety
Category: Workplace improvement

Challenge

At our plant, we have implemented a Safety Priority Action plan to prevent work accidents and health problems amongst employees. Our goal is to keep their bodies and mind in good condition.

In the workplace, we have taken measures to mitigate the risks of hot environments, especially in the melting shop. The environment has been improved with new equipment in order of priority. We also needed to implement additional measures to prevent heatstroke such as health management. This is particularly important in summer as we had several cases of heatstroke in 2013.

Action

The measures below have been implemented as a company-wide policy. This is in addition to guidance provided to employees about heatstroke before the summer season.

- In addition to providing isotonic water, we have started to provide an oral rehydration solution to employees in the workplace.
- We measure the temperature using a wet bulb globe thermometer (WBGT). This provides an accurate heat index which comprehensively takes into account the factors that cause heat disorders including temperature, humidity, radiant heat, and airflow. When the WBGT is measured, we announce the temperature to all employees in each shop.
- We have instructed all shops to decide their own rules for rest and rehydration when the WBGT figure is announced.

Outcome

We achieved zero heatstroke cases in our plant during 2014.

Measures taken in response to WBGT temperatures

WBGT	Level	Examples of measures to be taken
+31°C	Warning	<ul style="list-style-type: none"> • Avoid working outside for more than an hour • Move external work indoors where possible • Drink water, including salt, frequently while working outside • Always use a neck cooler when working outside • Alternate the people working outside every 15 minutes.
28 to 31°C	Strict caution	<ul style="list-style-type: none"> • Drink water, including salt, frequently before working outside • Use a neck cooler as much as possible when working outside • Alternate the people working outside every 15 minutes.
25 to 28°C	Caution	<ul style="list-style-type: none"> • Drink water, including salt, frequently before working outside • Alternate the people working outside every 15 minutes.
21 to 25°C	Attention	<ul style="list-style-type: none"> • Drink water, including salt, frequently before working outside.
Less than 21°C	Safe	<ul style="list-style-type: none"> • Work normally • Drink water when thirsty.



Nippon Yakin Kogyo Co., Ltd.

Reducing the risk of collisions

Award: Safety
Category: Accident analysis

Challenge

In 2013, a collision occurred between a pedestrian and a heavy machine. We wanted to take measures to prevent a similar accident in the plant occurring again.



1. Truck drivers now show a sign with a specific colour and number to indicate their destination



2. An alarm and flashing light warn of approaching forklifts

Action

To ensure there are no accidents, we have taken the following actions:

- Identified areas in the plant where there is the potential risk of collision
- Created a map of the areas which must be risk-free. We defined an order of priorities for action and implemented it on schedule.
- Promoted the installation of alarms in machines which move. We focussed on heavy machinery with poor visibility.



3. This sign is used to warn truck drivers they must make contact with someone inside the plant before reversing

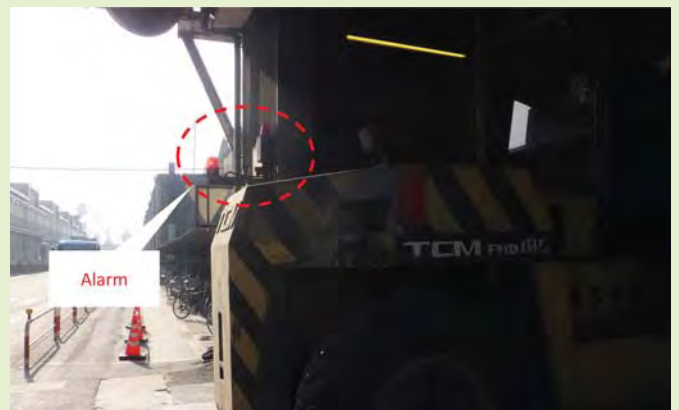


4. A movable barrier prevents pedestrian access during vehicle movements

Outcome

There have been zero accidents between people and machinery since we took this action.

The following table shows the actions taken in different areas.



5. A light warns pedestrians that the overhead crane is working

Collision risk	Action	Image #
Truck drivers and flagman	Truck drivers show a sign with a specific colour and number to indicate their destination. Flagmen understand where the drivers want to go from this information. Flagmen can indicate the correct direction without approaching the truck.	1
Forklift and pedestrian (at entrance to building)	Sound an alarm when a forklift approaches the entrance.	2
Trailer backing into plant buildings and pedestrian	Set out the sign that instructs drivers to make contact with someone inside the building before entering.	3
Forklift and pedestrian (at crossings between plant buildings)	Set movable fences to block forklifts when pedestrians are passing through.	4
Overhead crane and pedestrians	Set electrical signs to show no entry when the overhead crane is working.	5

Yieh United Steel Corporation (YUSCO)

Preventing fires during transportation of the slag pot

Award: Safety
Category: Workplace improvement

Challenge

Liquid steel and slag splashed out of the slag-pot due to vibrations during transport. The molten steel and slag caused a large fire and damaged the slag-pot car.



The slag pot cannot be filled above the cylindrical protrusion which is used to tip the pot

Action

The standard operating procedures (SOP) for slag-pot transportation were modified. The SOP now states that the pot cannot be filled above its maximum limit, and that the slag-pot should be set aside for one hour after it is removed from the filling position. It can then be sent for disposal in the slag-pot car.

A series of 33 fire hydrants were installed along the slag-pot car's path. The range of each hydrant overlaps in case steel or slag splash out during transportation.

The road was smoothed to limit the vibrations to the slag-pot car. Lighting was also improved so the driver's visibility improved.

Lastly, one person rides a bicycle behind the slag-pot car during transportation. This person can react immediately in case an accident occurs.



A series of 33 overlapping fire hydrants have been installed along the vehicle's path in case of a slag splash during transportation

Outcome

Since the actions detailed above have been implemented, there have been no further accidents. People are safe and the slag-pot car is free of damage.



A safety person rides behind the slag-pot vehicle during transportation

Yieh United Steel Corporation (YUSCO)

Safety skills training in the workplace

Award: People
Category: Skill training

Challenge

Employees are YUSCO's most important asset. If our employees work safely, then they will bring safety ideas back to their own families. If every employee takes care, then they will influence other employees to work safely. Therefore, every employee, contractor, visitor and supplier must pay attention to safety.



Action

The company should provide safety skills and training to all employees. YUSCO actively promotes the following training programmes:

1. Employee occupational safety skill training. We have implemented occupational safety education and training programmes including training on hazardous equipment operation, occupational safety and health regulations, hazardous work environment safety, hazardous material operations, and promoting safety awareness to avoid accidents.
2. Training for emergency response personnel in the event of a natural disaster (earthquake, flood or fire). The goal is to eliminate unsafe factors in the work site to create a safe working environment.
3. Training for contractors and sub-contractors before they start work. We train them in occupational safety and health regulations, hazardous work environment safety. Our goal is to enhance safety awareness and to avoid accidents.

4. Health skills training for all employees such as cardiopulmonary resuscitation (CPR). This includes exercise education, health talks, and traffic safety lectures. The goal is to enhance employee health and ensure everyone gets home safely.



Contractors and sub-contractors receive training before starting work

Outcome

Training courses help our employees and contractors to act responsibly. They now understand the provisions of occupational health and safety regulations. They are also familiar with the procedures for operating machinery, controlling risks when working with hazardous substances, and safety maintenance. We are equipped with the skills necessary to reduce risk.



Training for emergency response personnel



Section B: Sustainability Case Studies

Section B: Sustainability Case Studies

B01 Reducing emissions and costs with a new refractory brick format (Acerinox)	35
B02 Reducing emissions to air: a roadmap 2005 - 2015 (Aperam)	37
B03 Reducing noise from the shot blasting machine (Bollinghaus)	39
B04 Environmental and safety management certification (Bollinghaus)	41
B05 Effective utilisation of waste water (Jindal Stainless)	43
B06 Reducing power consumption in the hydraulic power pack (Jindal Stainless)	45
B07 Reducing the power consumption of air blowers (Jindal Stainless)	47
B08 Minimising the impact of stainless steel production (Jindal Stainless)	49
B09 Using a cover to reduce heat losses in the roughing mill (Jindal Stainless)	51
B10 Reducing power consumption in the EAF (Jindal Stainless)	53
B11 Reducing power consumption during de-scaling (Jindal Stainless)	55
B12 Increasing the recycled content of crude stainless steel (Jindal Stainless)	57
B13 Protecting resources with out-of-furnace desulfurisation (Nisshin Steel)	59
B14 Extending product life and minimising waste with a lean duplex grade (Outokumpu)	61
B15 Decreasing the acid consumption of grade ASTM S44500 (YUSCO)	63
B16 Using a neutral sodium sulphate solution in the recycling process (YUSCO)	65

Sustainability Award

Company	Case Study	<i>Emissions</i>	<i>Environmental Management System (EMS)</i>	<i>Energy intensity</i>	<i>Material efficiency</i>	<i>Investment in new processes and products</i>	<i>Value to the customer</i>
Acerinox	Reducing emissions and costs with a new refractory brick format	■			■		
Aperam	Reducing emissions to air: a roadmap 2005 - 2015	■					
Böllinghaus	Reducing noise from the shot blasting machine	■					
	Environmental and safety management certification		■				
Jindal Stainless	Effective utilisation of waste water		■				
	Reducing power consumption in the hydraulic power pack	■		■			
	Reducing the power consumption of air blowers	■		■			
	Minimising the impact of stainless steel production	■			■	■	■
	Using a cover to reduce heat losses in the roughing mill		■				
	Reducing power consumption in the EAF			■			
	Reducing power consumption during de-scaling		■	■			
	Increasing the recycled content of crude stainless steel	■	■				
Nisshin Steel	Protecting resources with out-of-furnace desulfurisation	■		■	■	■	
Outokumpu	Extending product life and minimising waste with a lean duplex grade						■
YUSCO	Decreasing the acid consumption of grade ASTM S44500				■		
	Using a neutral sodium sulphate solution in the recycling process					■	



Acerinox S.A.

Reducing emissions and costs with a new refractory brick format

Award: Sustainability
Category: Emissions Material efficiency

Challenge

Every time the melting shop refractory is disassembled, workers find that approximately 40% of the bricks have not been used. This means that the use of bricks is not optimised. Disassembly is also difficult due to the size of the brick to be removed.

Action

Acerinox sought to develop a more efficient brick format. The goal was to find a format that would enable refractory staff to disassemble the refractory more efficiently and avoid the use of new bricks. Avoiding the use of new bricks would also reduce Acerinox's indirect (Scope 3) emissions.

The solution was to change the position of the bricks at the bottom of the ladle (from vertical to horizontal). The bricks are thinner and they are almost completely used. The number of bricks needed to isolate the bottom is reduced.

Outcome

Acerinox has improved the yield of this refractory material and the quality of the work done by refractory staff in the melting shop. The time taken to disassemble and reassemble the refractory has been reduced by approximately eight hours per assembly. Additionally, the company has reduced the number of bricks used by nearly 10,000 per year. This has two positive outcomes:

- A direct saving on labour and bricks estimated at €280,000 per year
- A 2.1 tonne reduction in CO₂ emissions (Scope 3) during 2014.

Aperam

Reducing emissions to air: a roadmap 2005 – 2015

Award: Sustainability
Category: Emissions

Challenge

As our plant in Genk (Aperam Belgium) is located near to the city of 65,000 inhabitants, we faced the challenge of significantly minimising dust emissions so we did not affect air quality in the local area. The plant is located between a residential area (the nearest houses are just 300 metres from our plant) and an industrial zone.

Our goal was to become a leader in low dust emissions. We also saw a need to start a dialogue with local residents and authorities about our activities and the health, safety and environmental precautions we take. Our goal was to ensure our neighbours understand the progress we are making in reducing dust emissions.

The environmental permit of the plant was also due for renewal. The plant includes a melt shop, a cold rolling mill, de-dusting plants and exhaust systems which capture emissions to air from our processes. As part of our application to renew the permit, we wanted to demonstrate our commitment to the environment.

Our Genk facility includes two electric arc furnaces, vacuum and argon-oxygen decarburising facilities, ladle refining metallurgy, a continuous slab caster and slab grinders. It also includes a cold rolling mill with

annealing and pickling lines, cold rolling mills, bright annealing lines, temper mill, and finishing equipment.

We also have de-dusting plants and exhaust systems which capture emissions to air from our processes. The equipment is designed to contain a de-dusting and gas exhaust system.



Aperam Genk de-dusting plant

Action

Following the EU's Industrial Emissions Directive, Flemish authorities have set the dust emission limit at 10 mg/Nm³.

While we achieve this target, we understood from dialogue with local stakeholders that this is not enough. As a result, our vision has evolved from 'meeting the standard' to becoming a leader in low-level air emissions.

To reach this ambitious goal, we have implemented an extensive action plan at three levels: operational; managerial; and communications.

Operationally, our engineers and environmental specialists analysed how we could further reduce dust emissions inside and outside our plant. Various actions were identified which cover all parts of the plant including:

- Increased continuous monitoring of the most sensitive chimneys
- Intensified maintenance using Best Available Technology (BAT) filtering installations
- Drastic decrease in internal intervention thresholds (to < 3 mg/Nm³ dust)
- Replacing air cooling with water cooling on the annealing line

- Optimization of continuous caster off-gas guiding and filtering
- Enclosing the slag treatment and oxy-cutting areas
- Systematic covering of by-products during handling and transport
- Water spraying and road cleaning
- Implementation of a dedicated truck washing area.

At the managerial level we added a specific 'g/t guided emission' KPI. All managers and workers are incentivised to meet and maintain our ambitious objectives.

At the communication level, we started a dynamic and open dialogue with our stakeholders, especially with the local neighbourhood. For example, we created the newsletter 'Beste Buren' (Good Neighbours) which keeps the local community informed about the advances we have made on health, safety and the environment.

We also organised an Environment Day to kick-off the open exchange with all stakeholders. This allowed us to share our test results (data measurements) in a transparent way.

Outcome

Firstly, we managed to significantly reduce our emissions to air. Compared to 2006, we reduced emissions to air by 72% in 2014. Total emissions were 13 grams of dust per tonne of steel produced.

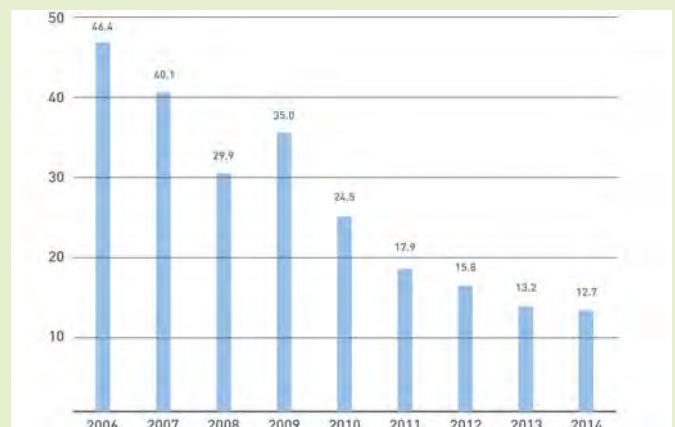
The various actions we have taken have reduced dust emissions and allowed us to build expert knowledge of the topic. We have formalised the outcomes and learning from the broad action plan we implemented and shared best practices with other entities and plants within Aperam.

Due to the lower dust emissions, we have received only two complaints from the neighbourhood in the last four years. This is both proof of the good results we have achieved, and also shows that we have built a positive and strong relationship with local residents. We have managed to convince the various stakeholders of our commitment, continued progress and ambition to communicate in a transparent manner.

Lastly, our efforts have resulted in Aperam obtaining a new environmental permit for its Genk plant. The permit is valid for another 20 years.



Stakeholder meeting in Genk



Specific emissions (grams/tonne) for the Genk steelplant and cold rolling mill

Böllinghaus

Reducing noise from the shot blasting machine

Award: Sustainability

Category: Emissions

Challenge

High levels of noise emissions from the shot blasting machine resulted in complaints from neighbours near the plant. Noise from the ventilation system of this machine can be generated from different sources. These include rotating mechanical equipment (such as fans) and airflow turbulence in the ducts. The noise transmits through the plant's pipeline network, reaching areas which should be quiet.

Action

To reduce the level of noise emissions from the shot blasting machine, Böllinghaus invested in a sound attenuator. This noise-control equipment is used in ventilation systems to reduce the intensity of sound waves which transmit through long pipelines. The attenuator does not obstruct the passage of air which is required for the proper functioning of the system.



Example of a sound attenuator installed by Böllinghaus

Outcome

Before the noise attenuator was installed, the noise level was 93 decibels (dB). After the sound attenuator was installed, the noise level was just 70 dB.

Bölinghaus

Environmental and safety management certification

Award: Sustainability
Category: Environmental Management System (EMS)

Challenge

Society is increasingly aware of the need for environmental responsibility and requires commercial organisations to commit to respond to these concerns. On the other hand, customers in developed markets want suppliers to offer their goods at an attractive price while still valuing other criteria such as corporate image, social commitment, and company values.

Poor performance in the control and prevention of environmental impacts can have negative consequences for Bölinghaus Steel. These consequences occur at the legal level (risk of sanctions and lawsuits), environmental level (damage risks or ecological accidents), stakeholder level (risks undermine the reputation of the institution), and business level (loss of competitive and financial position).

Another important issue is the workplace environment. A large part of people's lives are spent in their workplace. All organisations exist to create value, so the competitiveness of a business largely depends on how efficiently employees perform their jobs.

The working conditions that are provided to ensure health and safety at work directly determines the productivity and value of an organisation's performance.

For these reasons, Bölinghaus Steel considers the adoption of measures to demonstrate effective environmental involvement and a healthy and safe workplace environment to be priorities. We wanted to implement these measures in a recognised, impartial and credible way.

Action

Following the standards ISO 14001 (Environmental Management Systems) and OHSAS 18001 (Health and Safety Management System), Böllinghaus has developed and implemented new procedures. The procedures contribute to the control of environmental factors and impacts, and increase our ability to control the risks to health and safety in the workplace.

Recently Böllinghaus opted for voluntary certification of these two management systems. We used a certification company that assesses our performance impartially, credibly and with technical rigour. The organisation's impartiality is assured because of its complete independence and freedom from conflicts of interest in its organisational structure.

Now that Böllinghaus Steel has been certified to comply with both ISO 14001 and OHSAS 18001, we are able to demonstrate that we can control the risks associated with our activities. It also shows that we comply with the legal requirements relating to the environment and the health and safety of our people.

Outcome

The adoption of measures to demonstrate effective environmental involvement and a healthy and safe workplace has led to the following benefits for Böllinghaus:

- Lower costs for liability and environmental responsibility insurance
- Position of the company has improved in relation to our competitors
- We have greater control over environmental issues and healthy and safety risks
- We are confident we comply with all legal requirements.

As the new systems have only just been certified, additional benefits are expected in the future.



Jindal Stainless Limited

Effective utilisation of waste water

Award: Sustainability
Category: Environmental Management System (EMS)

Challenge

Jindal Stainless Limited, Hisar is a zero liquid discharge (ZLD) unit. To maintain our ZLD status we have installed an effluent treatment plant (ETP) and reverse osmosis (RO) system. After first stage treatment in the RO, around 25% of the feed water is converted into reject water. This reject water has a very high total dissolved solids (TDS) value and needs rigorous treatment to make it usable. The cost of RO reject water treatment is very high and requires expertise as well as massive infrastructure.



Action

While we are incurring a high cost to treat RO reject water, we are also using fresh water to cool slag.

After analysing the problem it was decided to use RO reject water in slag quenching. This will not only reduce the cost of production (by utilising waste), it will also provide better support to our environmental management efforts.



Outcome

The following savings have been achieved:

1. The cost of treating RO reject water has been eliminated.
Each day, approximately 500 cubic metres (m³) of RO reject water is produced. Treating one litre of RO reject water costs approximately 500 Indian rupee (INR). This change saves around INR 250,000/day (INR 500 x 500 m³).
2. The amount of fresh water required to cool slag is reduced by 500 m³/day.
With fresh water costing INR 5/m³, this translates to an additional saving of INR 2,500/day (INR 5 x 500 m³).

Our total saving is INR 252,500/day (approximately €3,600/day).



Jindal Stainless Limited

Reducing power consumption in the hydraulic power pack

Award: Sustainability
Category: Emissions Energy intensity

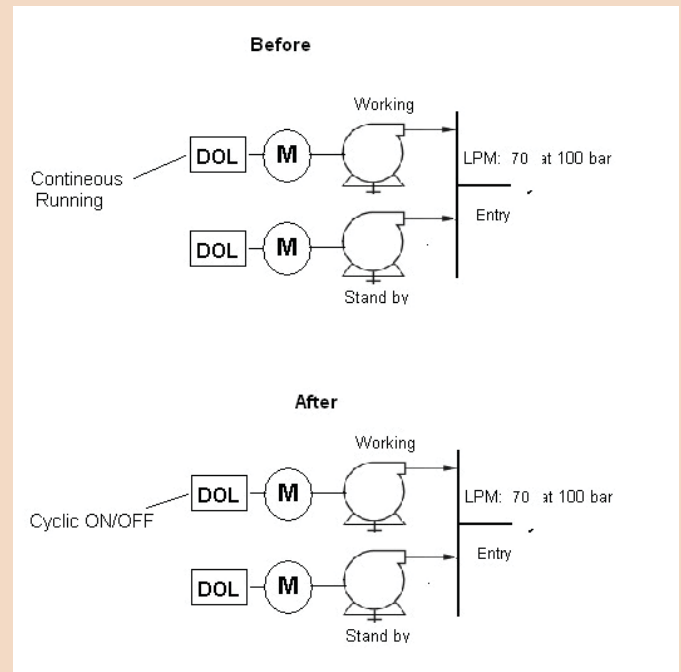
Challenge

The hydraulic power pack at our cut-to-length (CTL) line consists of two pumps. One pump works while the second remains on stand-by. The pump runs the centre position control (CPC) system at the uncoiler.

After the coil is initially threaded and centred, the CPC is no longer required at the uncoiler. Strip tension itself is sufficient to maintain the correct coil position. However, the hydraulic motor runs continuously which leads to high power consumption in the hydraulic power pack.

Action

As strip tension is sufficient to maintain the correct coil position, the hydraulic pump is not required continuously. We decided to switch off the pump motor within five minutes of the operator's On command. The programmable logic controller has been modified so the hydraulic pump can be turned on or off as required.



Outcome

The modification has resulted in:

- Power consumption being reduced by 29,203 kWh/year
- CO₂ emissions were reduced by 17.5 tonnes/year.



Jindal Stainless Limited

Reducing the power consumption of air blowers

Award: Sustainability
Category: Emissions Energy intensity

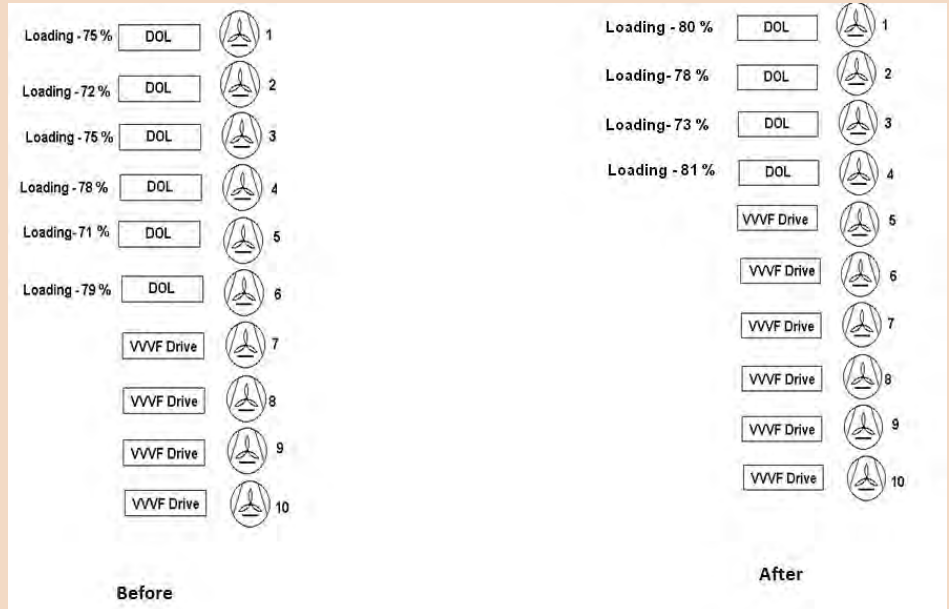
Challenge

On one of our annealing pickling lines, ten air blowers are used to reduce the temperature of annealed sheets after they have been through the furnace. Each blower has an alternating current (AC) motor. Of the ten air blowers, the first six used to run at full speed while other four blowers used a variable voltage and frequency (VVF) drive.

Action

To minimise power consumption, two of the full-speed blowers were switched off as a trial. During the trial we observed that there was no appreciable difference in the quality of the annealed sheets. If these blowers were equipped with VVF drives, power consumption could be reduced.

An infra red pyrometer (IRP) was installed to measure the temperature of the strip. The control logic was altered so that the blowers can run at reduced speed to lower the temperature of the strip when required.



Outcome

After installing the VVF drives and modifying the control logic, two key benefits were realised:

- Power consumption was reduced by around 480,000 kWh/year.
- CO₂ emissions were reduced by 288 tonnes/year.



Before ↑



After →



Jindal Stainless Limited

Minimising the impact of stainless steel production

Award: Sustainability
Category: Emissions Material efficiency Investment in new processes and products Value to customers

Challenge

The production of stainless steel requires the consumption of a large amount of raw materials, power, and fuel. While we have implemented the best and latest technologies from Europe, any increase in yield, beyond the designed capabilities of our equipment, can help to reduce our carbon footprint. Increasing yield while using the same amount of raw materials and energy reduces emissions, waste generated, and the consumables required.

As Jindal Stainless Limited is one of the leading stainless steel producers in India, the responsibility is on us to establish the benchmark and optimise the use of resources.

Ensuring stainless steel has the aesthetic look that it is known for requires the use of certain chemicals and acids. These consumables require proper treatment before disposal.



Action

Since the plant was commissioned in 2011, we have made continual efforts to reduce waste and improve yield beyond the designed capabilities. The actions we have taken include:

Fuel and energy savings

- Several trials have been carried out to process certain grades without annealing. This reduces the fuel and power consumed per tonne of stainless steel. Grades 430 and 409L are being successfully processed without annealing at the hot rolled annealed and pickled (HRAP) stage.
- We now use different pickling tanks with varied acid concentrations for different grades. This minimises wastage as the tanks do not need to be drained and refilled each time the grade is changed.
- We have installed waste heat recovery boilers. They supply most of our in-house steam needs.
- Optimization of air and steam pressure for specific operations has saved power and energy.
- Installation of capacitor banks and VVF drives on the annealing and pickling lines drives has reduced power consumption by 10%.

Recycling and reuse of water, metal and paper

- Modifications to the pickling line mean we can reuse strip rinsing water (instead of fresh water). This has lowered our water intake from about 1,800 to 1,100 m³/day, reduced the load on the effluent treatment plant by half and minimised the volume of waste generated.
- Scales, shot dust, and sludge generated in the plant are added to the furnace to recover as much metal as possible. Waste oils are filtered and reused, minimising fume emissions.
- We have optimised trim width and multi-slit orders. This has improved overall yield and reduced material losses.
- Machines and spare parts which were previously scrapped are being reused and repaired.
- Scrap generated when the head and tail ends of coils are cut is reused. These defect-free but unrolled pieces of strip were previously sent to the melt shop. Today they are sold for utensil applications.
- The interleaved paper used to prevent scratches between wraps is also being reused.

Outcome

The overall benefits from these include:

- Reduction in steel wastage and overall yield improvement of 3%
- Increased energy efficiency has resulted in a 30% reduction in power use
- Reducing propane consumption by 40% has significantly minimised our carbon footprint
- Minimising waste and sludge generation has reduced our water intake by 25%.





Jindal Stainless Limited

Using a cover to reduce heat losses in the roughing mill

Award: Sustainability
Category: Environmental Management System (EMS)

Challenge

During the rolling of thinner gauge (below 2.5 mm) austenitic steel, a huge amount of heat is lost from the transfer bar. Increased roll force is then required.

Action

To control heat loss from the transfer bar, the roughing mill's entry and exit roller tables were covered with heat-retention covers. The inner part of the cover contains insulating material.



Retractable heat retention cover at RM exit side (left shows down condition, right shows up condition)

Outcome

Heat loss is significantly reduced and the rolling process is easier, reducing fuel use.



Jindal Stainless Limited

Reducing power consumption in the EAF

Award: Sustainability
Category: Energy intensity

Challenge

With a heat size of 150 tonnes, an average of 32 tonnes of high-carbon ferrous material is required. This material is added to the EAF during the secondary refining stage. Around 70% of the material (approximately 20 tonnes) is fed into the EAF in either solid or liquid form.

In the past, liquid ferro-chrome was cast, then sized and sent to steel melt shop to produce stainless steel. This process was very energy intensive.

Action

In our current practice, the liquid ferro-chrome is tapped and directly transferred to the EAF. It is poured in during the melting process. The energy in the liquid metal creates a bigger pool of hot liquid in the EAF which speeds-up the melting process. Implementation of the

process at Jindal's Jaipur unit has improved the efficiency of stainless steel production.

The process was tested with one heat and slowly stabilised for all 13 heats produced in one day. It is the first time this process has been utilised in India.

Power use (kWh/Mt)	Observation Period (2013)								
Month	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Liquid FeCr	419.8	403.6	425.5	410.4	409.0	420.4	432.9	437.4	420.6
Normal	469.2	474.0	474.0	466.3	462.8	471.3	479.6	521.4	503.7
MD Heats	519.5	520.8	474.0	483.7	482.8	478.3	470.4	538.2	469.3

Decrease from normal heats	49.3	70.5	48.5	56.0	53.7	50.9	46.8	84.0	83.1
% reduction in power use	11%	15%	10%	12%	12%	11%	10%	16%	16%

Decrease from melt down heats	99.7	117.2	48.5	73.3	73.7	57.9	37.5	100.8	48.7
% reduction in power use	24%	29%	11%	18%	18%	14%	9%	23%	12%

Productivity	Observation Period (2013)								
Month	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Heats with liquid FeCr	0.94	0.97	0.94	0.94	0.95	0.94	0.92	0.91	0.94
Normal heats	0.88	0.87	0.84	0.84	0.89	0.89	0.83	0.82	0.83
Melt down heats	0.74	0.76	0.77	0.77	0.78	0.79	0.78	0.74	0.80

Outcome

The performance of the EAF has been analysed to determine specific power consumption and productivity. The results showed:

- Specific power consumption decreased by 15% in heats made with liquid ferro chrome compared to those in which solid ferro chrome was used. Typically 55 to 60 kWh is saved per tonne of liquid metal produced.
- Productivity of the EAF has increased by 8 to 9%. Typically 10 kWh of auxiliary power consumption is saved per tonne of metal.



Jindal Stainless Limited

Reducing power consumption during de-scaling

Award: Sustainability
Category: Energy intensity Environmental Management System (EMS)

Challenge

We wanted to reduce the power consumed during the hot rolling of stainless steel.

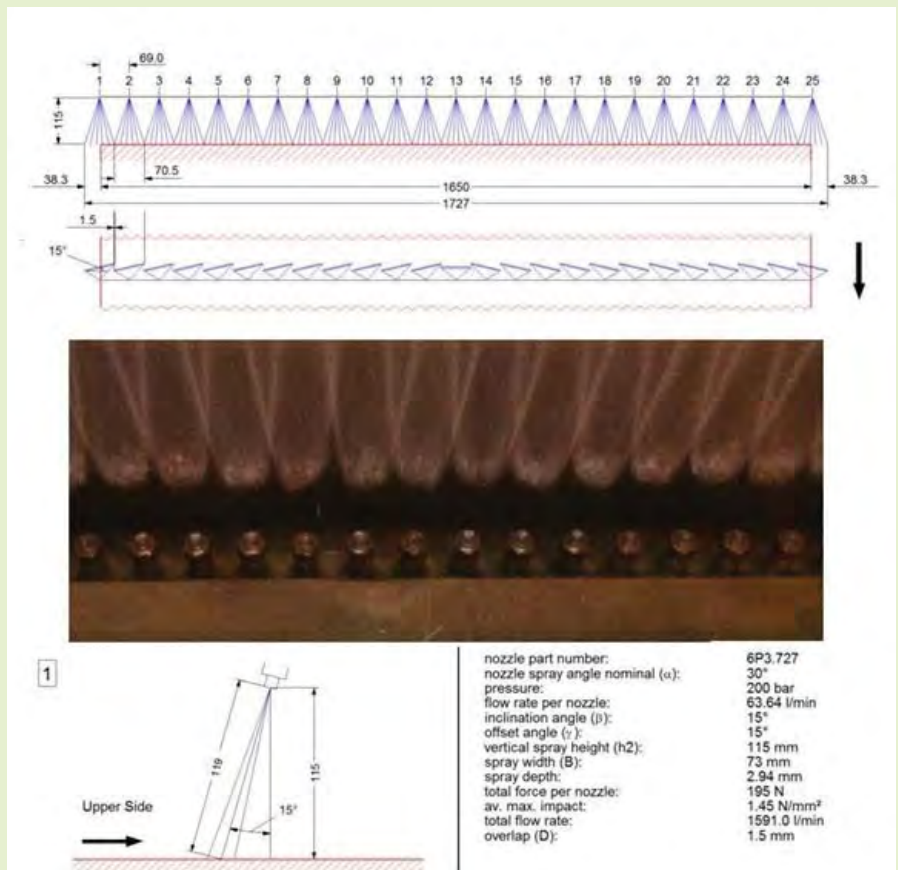
Action

To reduce power consumption at the hot rolling mill, the existing de-scaling nozzles were replaced with superior mini-scale master de-scaling nozzles. This enabled us to stop using one de-scaling pump which reduced energy consumption by 2,100 kW.

Outcome

The following benefits have been achieved:

- After replacing the mini scale nozzles, water use during primary de-scaling was reduced by 22%. The cost of pumping water was also reduced.
- A 2,100 kW energy saving was realised as one pump is now redundant.
- Total energy savings are 482,982 kWh per month.





Jindal Stainless Limited

Increasing the recycled content of crude stainless steel

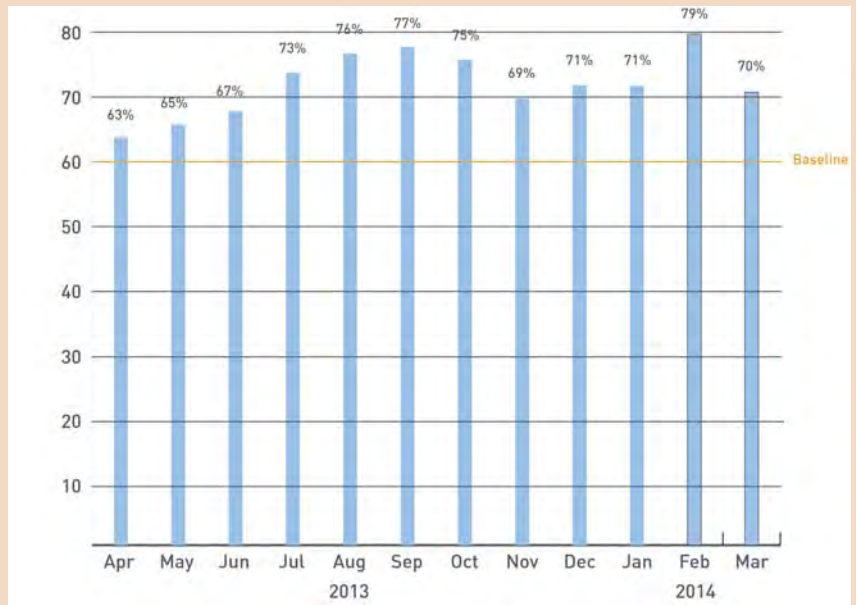
Award: Sustainability
Category: Emissions Environmental Management System (EMS)

Challenge

In stainless steel production, the baseline for recycled content is 60%. At Jindal Stainless Limited, Jajpur we wanted to increase the recycled content to 70%. This will lead to a decrease in CO₂ intensity.

Action

The process at Jindal Stainless Limited, Jajpur has been monitored and stabilised to ensure the maximum tonnage of recycled material (such as scrap) is used.



Outcome

In the period from April 2013 to March 2014, the recycled content of our crude stainless steel has been stabilised at an average of 70%. This compares to the world average of 60%. This has a major impact on the CO₂ intensity of crude stainless steel production.

Globally, on average, 40% of the raw material is sourced from available natural resources. We have reduced that to 30%.

Nisshin Steel Co., Ltd

Protecting resources with out-of-furnace desulfurisation

Award: Sustainability
Category: Emissions Energy intensity Investment in new processes and products Material efficiency

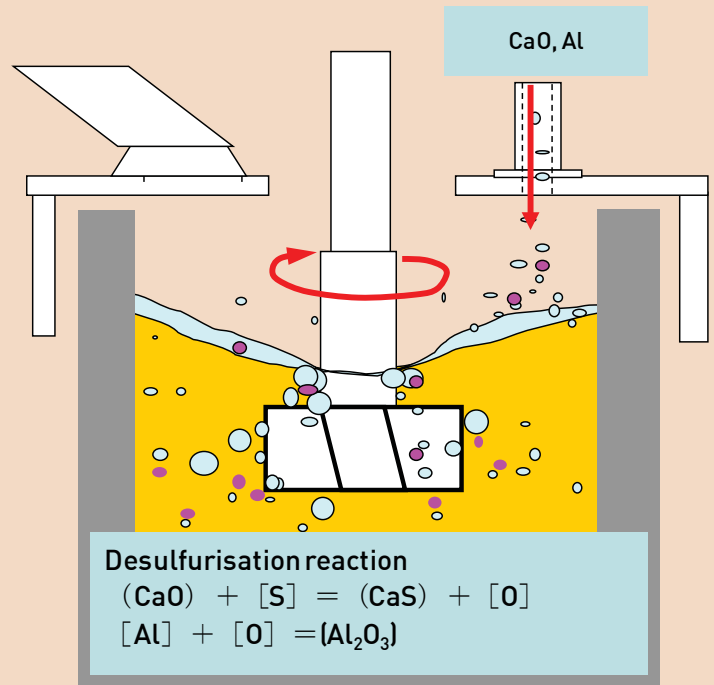
Challenge

Desulfurisation was conducted using flux (CaF_2 , CaO) at the electric arc furnaces (EAFs). However, this operation caused the following problems:

- The EAF slag was not able to be used as a road construction material as the level of fluorine exceeded regulations.
- Using a large amount of flux, which is precious natural resource, increased production costs significantly.
- Electricity consumption was high because a large amount of flux was used at the EAF.

Action

Desulfurisation equipment which uses mechanical stirring was introduced to the stainless steel production process for the first time in the world. After the equipment was installed, several technological improvements were made in order to increase the desulfurisation ratio.



Schematic of Kambara Reactor de-sulfurisation

Outcome

The introduction of out-of-furnace desulfurising equipment has enabled us to recycle EAF slag, conserve natural resources and energy, and reduce costs. Benefits include:

- CaF_2 consumption at the EAF has decreased to zero.
- For grade SUS304, a CaF_2 -free operation has been achieved throughout the entire steelmaking process
- CaF_2 -free EAF slag can be used as a material for road construction (80,000 tonnes/year)
- CaO consumption has decreased by more than 40%
- Electric power consumption has been reduced by over 9 kWh/tonne.

Outokumpu Oyj

Extending product life and minimising waste with a lean duplex grade

Award: Sustainability
Category: Value to the customer

Challenge

In North America, water heaters are traditionally made from carbon steel. Domestic, potable water contains oxygen which creates iron oxide when it comes into contact with carbon steel. Our customer, PVI Industries, had been using electricity-free nickel plating to reduce corrosion in their water heater tanks. The process was generating about 1.3 million pounds (590,000 kilograms) of waste per year. The process created a water heater with a useful life expectancy of 5 to 15 years.



Action

The PVI team began looking for ways to reduce waste. They started by examining which materials ASME (formerly the American Society of Mechanical Engineers) had certified. They were aware of stainless steel as a material for corrosion resistance, but some grades are not ideal for potable water applications.

Eventually their research led them to Outokumpu and our duplex grades. They identified a couple of duplex grades which were suitable and found favourable characteristics in Outokumpu's LDX 2101® grade. However, the grade wasn't yet certified for water heater applications.

A prototype (test Unit #1) was built using Outokumpu's lean duplex grade LDX 2101® and then underwent accelerated life testing. Initial testing started in 2009. Unit #1 was put through the equivalent of 30 years of normal use at highly elevated temperatures of about 190°F (87.8°C). Using the results from test Unit #1, PVI approached ASME for approval to use LDX 2101® in production water heaters. The Outokumpu datasheets for the grade were used as part of this presentation.

Outcome

Five years after development, Unit #1 is still operational. PVI has since produced more than 3,000 stainless steel units. All but five are still in operation. The company now guarantees standard duplex water heater tanks for up to 25 years.

Despite the benefits of using stainless steel over carbon steel, there is no change in the cost of the water heaters for customers. The additional cost of the stainless steel is offset by savings as it is no longer necessary to coat and plate the carbon steel.

Moving to duplex stainless steel has reduced PVI's waste stream to almost zero. PVI's efforts were recognised by the State of Texas at the 2014 Environmental Excellence Awards where the company received the Pollution Prevention award. Moving to Outokumpu's LDX 2101® grade has resulted in a significant reduction in waste and a jump in the useful life of the water heater.



Yieh United Steel Corporation (YUSCO)

Decreasing the acid consumption of grade ASTM S44500

Award: Sustainability
Category: Material efficiency

Challenge

When YUSCO produced hot rolled ASTM S44500 grade coils, acid consumption was higher than for other grades such as ASTM S30400 and ASTM S43000.

For this reason, more acid waste is discharged. This results in a high cost for the treatment of acid waste and has a huge impact on the environment.

	H ₂ SO ₄ (kg/m ²)	HF (kg/m ²)	HNO ₃ (kg/m ²)
ASTM S44500	0.032	0.126	0.192

Action

Through experimentation, we have improved the pickling efficiency and surface of ASTM S44500 by using a high concentration of H_2SO_4 .



Tests were done on grade ASTM S44500 using progressively higher concentrations of H_2SO_4 (highest concentration on right)

Outcome

By increasing the concentration of H_2SO_4 , we have been able to decrease the amount of HF and HNO_3 used. The benefits include better efficiency and quality in production, and a smaller impact on the environment. Costs of production and acid waste treatment are also reduced:

- Acid waste discharge reduced by 2.2 tonnes/day, saving US\$25/day
- Reduction in the use of fresh acid saves US\$1,319/day
- Overall saving: US\$1,344/day.



Yieh United Steel Corporation (YUSCO)

Using a neutral sodium sulphate solution in the recycling process

Award: Sustainability
Category: Investment in new processes and products

Challenge

At YUSCO's cold rolling mill, the production procedure on the annealing and pickling line (APL) involves electrolytic pickling. In this process, the specific gravity of the neutral sodium sulphate solution is 1.12. The waste electrolytic solution, which has been used to leach the steel plates or sheets, must be channelled into the wastewater treatment plant.

The waste solution contains heavy metals (Cr^{6+} 2.3 grams/litre; Ni 0.5 g/l; Fe 3 g/l). The highly toxic Cr^{6+} must be reduced to Cr^{3+} at the wastewater treatment plant. The reduction process usually means the sludge is not stable after water treatment.

To maximise recycling and minimise waste, we faced the challenge of finding and utilising appropriate methods to reuse and recycle the waste electrolytic solution.

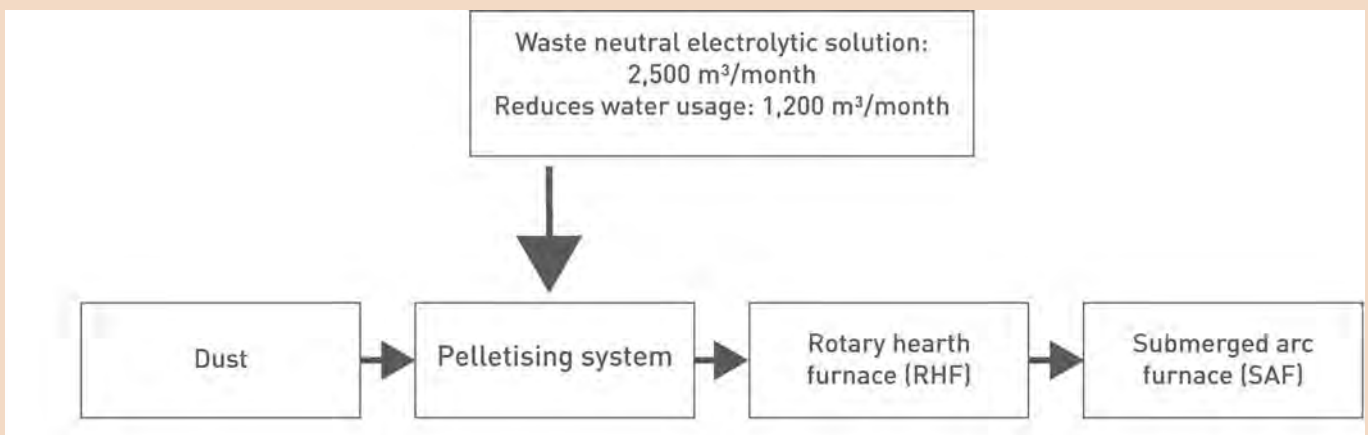
About 30,000 m³ of waste neutral electrolyte solution is produced by the plant each year. It was estimated that this creates 1,710 tonnes of sludge with a moisture content of 45%. The cost of disposing of sludge per tonne is TWD\$3,400. Large amounts of reducing agents have to be used and there is a risk that the Cr^{6+} content in the sludge will exceed recommended limits.

Action

YUSCO's dust metal recycling process required about 1,200 m³ of tap water per month. After switching to waste neutral electrolyte, we have saved about 14,400 m³ of water annually.

Not only does this reduce water usage, it also means that less reducing agents are required. Valuable metals are reclaimed, less sludge is created and the cost of disposal is reduced. The benefits are huge for YUSCO.

Below is the processing diagram:



Outcome

YUSCO recycles 14,400 m³ of waste neutral electrolytic solutions every year (1,200 m³ per month). In total we can save USD\$32,324 every month.

We not only reduced our outsourcing costs, we also reduced the cost of water treatment and pollution.



International Stainless Steel Forum (ISSF)

Rue Colonel Bourg 120
B-1140 Brussels, Belgium

T: +32 2 702 8915

F: +32 2 702 8912

www.worldstainless.org

SUSTAINABLE
STAINLESS