



International Stainless Steel Forum 2013 Sustainability Award Case Studies

SUSTAINABLE
STAINLESS

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



This is the third consecutive year in which I have had the honour of introducing the entries for ISSF's annual Sustainability Award. As in previous years, the selection committee will attempt to choose the entry that contributes the most to the sustainability of stainless steel. As we saw last year, this won't be easy.

In 2012, the selection committee decided to present the Award to three companies because of the high standard of entries. As a result, the 2012 ISSF Sustainability Award was shared between:

- Aperam (France) for its SolarStyl® building integrated photovoltaic (BIPV) system.
- Nippon Metal Industry Co., Ltd. (Japan) for its improvement in recycling performance.
- Taiyuan Iron & Steel Group Co. Ltd. – TISCO (China) for its system to reuse the remaining heat in steam.

In 2013 we have received 25 entries for the Award from 12 member companies. The entries show how members are converting waste into valuable raw materials, improving employee training and health, reducing greenhouse gas emissions, and developing better stainless steel products to meet the needs of their customers.

This year the category of Employee Training has been expanded to include employee health issues. It follows ISSF's decision to change the name of the Health and Environment Committee to the Health, Safety and Environment Committee (HSE) in order to emphasise the importance that is attached to health and safety in the stainless steel industry.

I urge you to read the 2013 case studies and discover the many creative ways our industry has found to improve its sustainability. There is still work to be done, but through these examples we gain valuable experience and knowledge.

David Martin

Chairman,
ISSF Health, Safety and Environment Committee

Secretary General's Message



The 2013 ISSF Sustainability Award is an excellent reminder of the important role our Forum has to play in spreading best practices around the world. Since its inception in 2011, almost 80 case studies have been published as part of the Sustainability Award. Covering issues ranging from Employee Training and Health, to Value for Customers, the case studies show how our industry is responding to issues such as the health and safety of our workforce, using resources efficiently, and improving economic viability.

Although the number of entries for the 2013 Award is down on last year, the quality remains extremely high. This year's case studies once again demonstrate the commitment of the global stainless steel community to the principles of sustainability. In innovative and creative ways, ISSF member companies are finding solutions to ensure the economic, environmental and social viability of our industry.

As in previous years, these case studies serve to act as examples to the rest of the industry. One of the strengths of an organisation such as ISSF is our ability to share non-competitive information which can improve the sustainability of our industry as a whole.

As you read through the 2013 entries, you will see how our members are building on the work done by other members in previous years. Instead of just recovering important metals from waste materials, companies are now recovering and adding value to these resources or reusing them in their own stainless steelmaking processes. In previous years companies have outlined the importance of using data to identify gaps in safety performance. This technique is now being used to target specific problem areas such as safety amongst older workers or subcontractors.

I would like to take this opportunity to thank our Stainless Steel Fellow, Tatsuya Kawamoto from Nippon Yakin Kogyo who has been responsible for collecting and publishing these case studies. Without his hard work and dedication, these stories might remain within the individual member companies. By sharing this knowledge we are considerably more effective than if we struggle alone.

John Rowe
Secretary General, International Stainless Steel Forum

Summary of Case Studies

All ISSF member companies were invited to submit entries for the 2013 Sustainability Award. Twelve companies submitted a total of 25 entries. These members operate stainless steel plants around the world.

Members were asked to choose a category that best described their entry. In many cases, multiple categories were selected.

The following table summarises the entries received.

	Company	Case Study	<i>Employee training and health</i>	<i>Energy intensity</i>	<i>Environmental management systems (EMS)</i>	<i>Greenhouse gas (GHG) emissions</i>	<i>New processes & products</i>	<i>Material efficiency</i>	<i>Safety</i>	<i>Value to customers</i>
01	Acerinox	Using scale briquettes as a source of raw materials								
02	Aperam	Improving biomass energy generation systems with stainless steel								
03		Developing a ferritic solution for NOx reduction systems in vehicles								
04	Columbus Stainless	Employee training and development is key to sustainability and growth								
05	Jindal Stainless	Developing high potential employees through leadership programmes								
06		Improving operator skills								
07		Controlling pollution through continuous emission monitoring								
08		Converting waste into valuable raw materials								
09		Reducing our carbon footprint by improving energy efficiency								
10	Nippon Metal Industry	Effective utilisation of EAF slag as a road base material								

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24		Perfecting colour uniformity in 400-series coils								
25		Reducing energy use and emissions to improve sustainability								

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.



Acerinox S.A.

Using scale briquettes as a source of raw materials

Greenhouse gas emissions Material efficiency

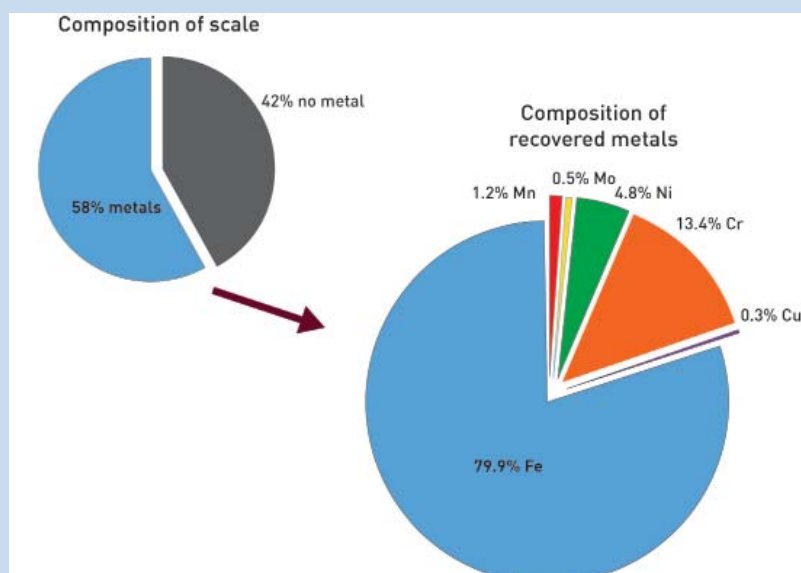
Challenge

Acerinox is committed to the principles of sustainable development and environmental management. Our environmental management system promotes the adoption of efficient manufacturing practices, minimisation of waste and environmental emissions, and recycling as much material as possible.

Our company has made a significant effort to reduce waste and manage its recovery at all stages of

the stainless steel production process. Measures to enhance internal control of waste have been implemented and waste reduction programmes have been developed for all process stages.

Today, Acerinox sends most the metallic waste generated to an external company. This company recovers the metallic material and it is used as a raw material in the stainless steel production process.



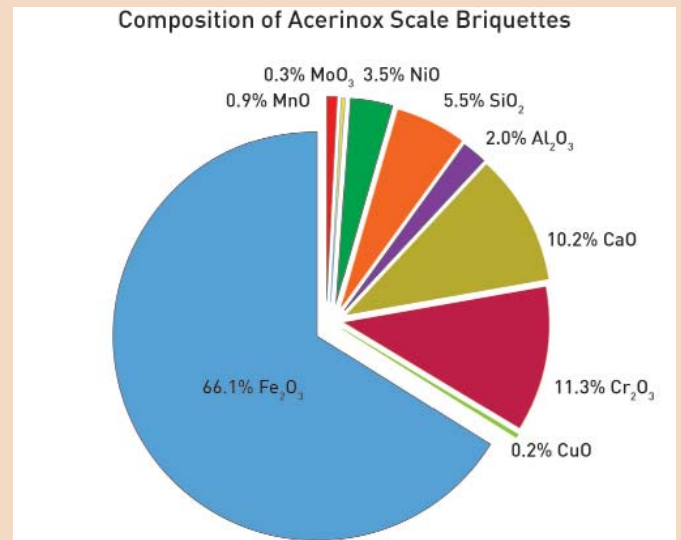
Acerinox experimented with directly loading scale into the furnace. However, 80% came back as waste while only 20% of the metal was incorporated into the steel.

In order to increase metal yield, scale briquettes have been produced. They are made from the scale which comes from the continuous casting, hot rolling and cold rolling processes. The scale briquettes are melted in the electric furnaces.

Action

Before implementing this process, Acerinox asked an external company to investigate the technical and economic viability of reprocessing the scale as briquettes and using them as raw material in the furnaces. The assessment found:

- Manufacturing scale briquettes by adding a reductive product and a mix of solid additive and (alloying) liquids makes the material compact.
- The briquette forms through a process of agglomeration. The density of the briquette can be increased via pressure rolling.
- Incorporation of the scale into the steel was measured by using one of the trace elements in the scale as an indicator. By measuring the quantity of the trace element in the steel or slag, the metallic yield can be quantified.
- About 1.5 tonnes of scale briquettes can be added to each cast (110 tonnes).



Outcome

Using the briquettes, metallic yield is now 90%. The value of the briquettes is three times that of the recovered scale.

Greenhouse gas emissions are reduced as waste is not being transported long distances and less raw materials need to be brought in. Scope 3 emissions are reduced in compliance with our climate change commitment.

Aperam

Improving biomass energy generation systems with stainless steel

Energy intensity

Greenhouse gas emissions Safety

Value to customers

Challenge

Interest in energy production from biomass has increased considerably as the world seeks renewable, clean and CO₂-neutral energy resources to replace fossil fuels. Globally the sugar and ethanol industries process about 1.7 billion tonnes of sugarcane per year. This generates approximately 382 million tonnes of bagasse – the dry pulpy residue left after the extraction of juice from the sugarcane.

Sugarcane bagasse has high energy content. Cogeneration systems have been installed in many sugar mills to take advantage of this fuel source. This makes the sugar mills energy self-sufficient. In many plants, surplus electricity is sold to the national grid to generate income.

Effluent from the bagasse burning process is treated in gas washing systems. When made from carbon steel, the equipment requires about three months of maintenance annually and must be completely replaced after the third season. Reducing lost time for cleaning and replacement of equipment would enable green energy to be generated continuously from bagasse.



Action

Much of the equipment utilised in sugar mills is made from carbon steel which is commonly specified due to its low cost per tonne. However, a sugar mill is a very aggressive industrial environment and causes corrosion and wear to equipment.

Aperam undertook a joint technical-commercial project to increase the use of stainless steel in sugarcane mills. The most successful implementation has been in the gas washing system. A new system was developed which is completely made from stainless steel. This includes the washing tower, ducts, exhaust and chimney.

Laboratory experiments and industrial tests were performed to guide Aperam's research and development team. The results indicated that the system should be built using stainless steel grade K03 (DIN WS 1.4003/ UNS S41003).



Outcome

The use of grade K03 makes it possible to reduce the thickness of the stainless steel plate by up to 50% due to its high yield strength. This reduction reduces raw material costs, and saves energy during the transportation and welding of the plate.

The new gas washing system in grade K03 has shown excellent results. Seven full systems have already been installed, each requiring about 110 tonnes of stainless steel. The first system was installed in 2009 and is now in its fourth season. To date no maintenance has been required and it is expected that the system will last at least five more years.

The change enables the sugar mill to generate green energy all year long. Over the four years the K03 system has been operating it has generated an additional year of green energy compared to the carbon steel system. Reducing maintenance has also resulted in a safer environment for employees.

In summary, the stainless steel system has a much longer life and allows the sugar mills to produce renewable energy all year long. The mills have enough energy for their own production and can sell excess energy to the national energy grid.





Aperam

Developing a ferritic solution for NOx reduction systems in vehicles

Material efficiency

Value to customers

Challenge

Regulators worldwide are requesting that industry and transport reduce emissions of nitride oxides (NOx) and particulate matter (PM) due to their harmfulness on human health. In automotive applications, new regulations will require the implementation of new and complex emission control systems.

Since 2004, NOx and PM levels have been controlled using ten methods including diesel particle filters (DPF), selective catalytic reduction (SCR) converters, and exhaust gas recirculation (EGR) systems. These systems drastically alter the thermo-chemical conditions inside the exhaust system.

The most efficient NOx control systems inject liquid urea through the hot exhaust gas flow using an SCR converter placed upstream. This converts the NOx into inert nitrogen. These systems have recently been installed on buses and trucks and will be expanded to include most diesel passenger cars when the European Union's Euro VI regulations on emissions come into full force.

Depending on exhaust gas temperature and the pressure of the urea injection, a new corrosion reaction may occur. It combines oxidation, carbo-nitridation and erosion. This could lead to perforation of the part if inferior materials are used.

The Aperam R&D team have anticipated this problem and undertaken research to understand this new type of corrosion and anticipate the changes needed for trucks, off-road vehicles and passenger cars. Original equipment manufacturers (OEMs) and Tier One suppliers to the automotive industry have also asked Aperam to find a technical and cost-effective solution.

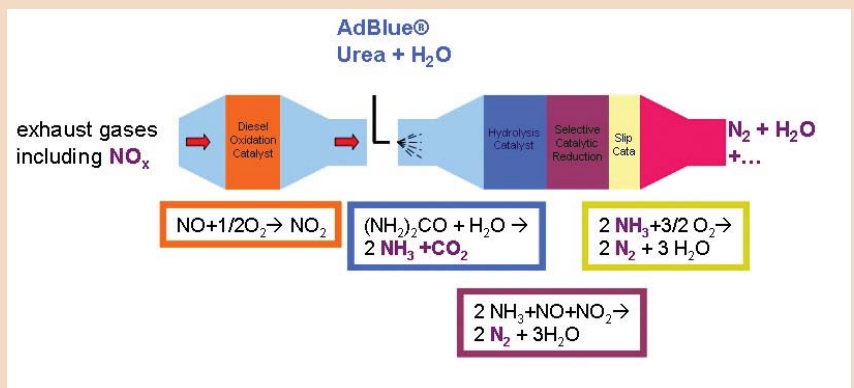
Action

The first action our R&D team took was to simulate the effect of urea injection on hot stainless steel at our Isbergues laboratory. Aperam developed an original test rig to apply cyclic heating to the metal and to inject liquid urea on its surface. Injection was achieved using a drop-by-drop pump or a high pressure injector. Valuable contacts with OEMs and Tier One suppliers helped us to set the temperature and urea dosing flow.

Metal exposed to these conditions undergoes a new process of corrosion because of the high temperature (400-600°C) and the atmosphere which contains vaporised and decomposed urea. The corrosion affects the metal through oxidation combined with homogeneous carbo-nitridation and inter-granular nitride precipitation. The depth of the affected zone can reach hundreds of microns.

Test results showed that stabilised ferritic stainless steels performed better than standard austenitic grades. Austenitic grades were more sensitive to nitridation at high temperatures. Including the requirements for condensate corrosion resistance in Euro VI, the best choice was

found to be grade K33X (1.4513). Understanding the corrosion mechanism allowed us to demonstrate the role of the stabilisation and composition effects. As a result, K33X might be considered to be an optimal grade for more severe conditions, for example, in off-road vehicles.



Outcome

Aperam were able to propose a fast answer to the automotive market due to our continuous technical survey of exhaust and pollution control systems. The solution is cost-effective because ferritic stainless steel is used. It offers the best corrosion-resistance against this new type of oxidation.

In 2011, a paper was presented at the Society of Automobile Engineers (SAE) International Automotive congress in Detroit. More recently, we worked with a major OEM to demonstrate that the ferritic grade K33X (1.4513) shows the highest resistance. The OEM will apply this solution on all its diesel engines.

K33X is already used today in the SCR of trucks. Once Euro VI comes into force, these SCRs will be applied to most diesel passenger cars. The skills and knowledge we have developed have been shared across Aperam and are now also used in South America.

In the near future, NOx reduction using urea will be deployed in de-pollution equipment used in the energy sector. This represents a huge potential market for the ferritic stainless steel solution Aperam developed for the automotive market.





COLUMBUS
STAINLESS
— [Pty] Ltd —



Columbus Stainless (Pty) Ltd

Employee training and development is key to sustainability and growth

Employee training and health

Challenge

Columbus Stainless (Pty) Ltd is situated in Middelburg in the Mpumalanga Province of South Africa. We employ around 1,500 people on a full-time basis and are a member of the Acerinox Group.

Our main philosophy is that people are the most important asset in a business. A competent workforce is the foundation of achieving operational excellence and the route to sustainability.

Generally the South African labour market has very high levels of illiteracy which results in a very high unemployment rate and national skills shortage. The upsurge in mining activities and the re-commissioning and construction of new power stations in our area poses a very serious skills challenge. We are all competing for a very small pool of engineers and artisans.

In 1992 Columbus went through an expansion project which cost R3.5 billion (US\$1 billion). This project included installation of new technology that necessitated a better skilled workforce with computer literacy and advanced engineering and technical skills. As our plant is located in a rural agricultural and mining town we had to invest heavily in training our workforce.

This meant that we had to seek accreditation to train our own artisans and operators.

The Health and Safety Act of 1993 also requires an employee to be declared competent to perform a specific task. This requires an extensive training system to meet the legislative requirements and monitor the competence of a workforce with a diverse skills base.

Action

Columbus Stainless has developed a training system to ensure a competent workforce in line with legislative requirements and the complexity of the plant.

The Standards Based Training (SBT) model requires competencies to be confirmed through evidence collection. Progress towards the performance requirements are measured against criteria set out in a standard, or a learning outcome.

Outcomes and standards are developed based on an analysis of the role and equipment used during a process. Training material is developed and includes Component Modules to address knowledge outcomes and Standard Work Instructions describing practical tasks.

Monitoring and tracking of competence for each role is achieved by capturing requirements and achievements on a Competency Profile.

A gap analysis is conducted to determine the training needs. These are then captured in an Individual Development Plan so that structured training and coaching can be conducted in accordance to the role requirements. Employees are assessed against the competencies. If they are competent, their profile is updated accordingly. If an employee is not yet competent, they re-enter the training and coaching phase.

In an endeavour to address the artisan skills shortage, Columbus Stainless Pty (Ltd) is taking part in the Jipsa (Joint Initiative for Priority Skills) initiative to accelerate artisan training. This entails a condensed and focussed training programme for artisans.

Since 2000, Columbus Stainless has participated in the development of national qualifications for production employees. This culminated in Columbus Stainless pioneering the first formal qualifications in the country. These include the Certificate in Metals Production, and Metals Engineering Process Qualifications.

Additionally we have designed a detailed programme for training engineers and technicians to ensure that their practical experience is addressed. This programme covers engineering, metallurgy, financial and information technology.

Each year we also offer bursaries to young students to study engineering degrees at university. Technicians can also study mechanical, electrical, metallurgical and industrial engineering. Over the past 10 years, more than 100 young people have been sponsored in this way.

Outcome

The following programmes are now available to employees:

- Self-study: All employees can enrol in studies that benefit Columbus Stainless.
- Management Development: The aim is to empower our first line supervisors and managers.
- Engineers in Training: To develop engineers.
- Technicians in Training: To develop mechanical and electrical technicians.
- Apprenticeships: To train and develop fitters, boilermakers, millwrights and electricians.
- Learners Steelmakers: To develop plant operators.

Our SBT model has resulted in structured training and a uniform approach between all plant areas and meets all legislative requirements. It enables Columbus Stainless to have a multi-skilled, flexible workforce that can meet the demands of the technical and international stainless steel market. Every employee has a Portfolio of Evidence which details their assessed competencies.

Columbus Stainless is an accredited training provider and our SBT model has been audited to ISO 9000 and the standards of the Skills Education and Training Authorities (SETA).

Since 2008 Columbus Stainless has been recognised by SETA as one of the top training companies in South Africa and a supporter of the National Skills Development Strategy.

Columbus Stainless has maintained an Artisan Trade Test first-time pass rate above 90% for apprentices. This compares well to the national pass rate which is below 40%. Since 2004, a total of 317 apprentices have passed their trade tests with Columbus Stainless.

In 2002 we took part in a pilot project to implement production qualifications in a manufacturing environment. All new operators must complete a 12-month Metals Production Qualification before they are appointed. A total of 298 employees have received this qualification.

Columbus Stainless has also established a culture of continuous learning where employees are encouraged to take an interest in their own development. This is evident in the 1,282 self-study enrolments we have subsidised over the last six years.

We also conduct management development programmes to empower our managers. Since 2007, a total of 234 candidates has benefited from this leadership training.

With these initiatives, Columbus Stainless is creating a strong workforce geared to the future. Sustainability is assured by addressing our own skills needs and the needs of our country so that Columbus and South Africa remain competitive on the world stage.

Jindal Stainless Limited

Developing high potential employees through leadership programmes

Employee training and health

Challenge

Our challenge was to:

- Retain employees with high potential within the organisation.
- Develop a pool of talented people who are ready to take-up larger and strategically important roles in the future.
- Accelerate development of the high-potential talent pool to create a robust pipeline of leaders and aid in succession planning.

Action

We developed two new programmes for our high-potential people – Leadership Enhancement for Accelerated Performance (LEAP) and Excellence Through Enhanced Leadership Development (EXCEED).

LEAP involves:

- A nine-month programme to provide focused accelerated career progression.
- Pre-programme leadership assessment and focussed career-development planning with various learning laboratories, team coaching sessions, and active learning projects.
- Individual mentoring contacts.
- A team building programme.
- Cross-functional business exposure.

EXCEED provides:

- An 11-months programme designed to identify individual development needs and group development themes.
- Structured modules including simulations, case studies and theory on leading yourself, other people, the business and change.
- Real-time experience through various leadership challenges as part of the Outbound Training programme.
- Team challenges on using live learning on business critical and high impact projects.

Outcome

LEAP and EXCEED provide us with:

- A robust pipeline of leaders.
- Enhanced employee engagement, motivation and satisfaction.
- Talent retention within the organisation.
- Qualified people. We have filled some senior positions through this process which reduces hiring costs as we do not need to hire people from outside.

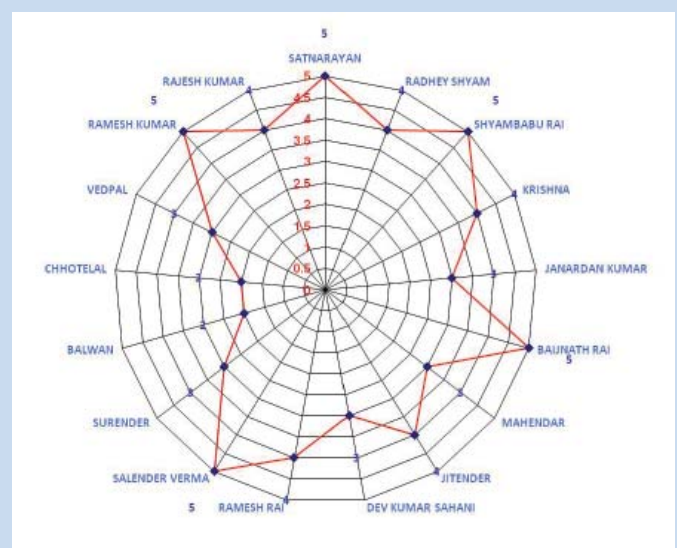
Jindal Stainless Limited

Improving operator skills

Employee training and health

Challenge

Due to the low technical skills of some operators, we experienced more breakdowns. These breakdowns required long maintenance periods and led to an increase in the Cost of Poor Quality (COPQ) metric.



Action

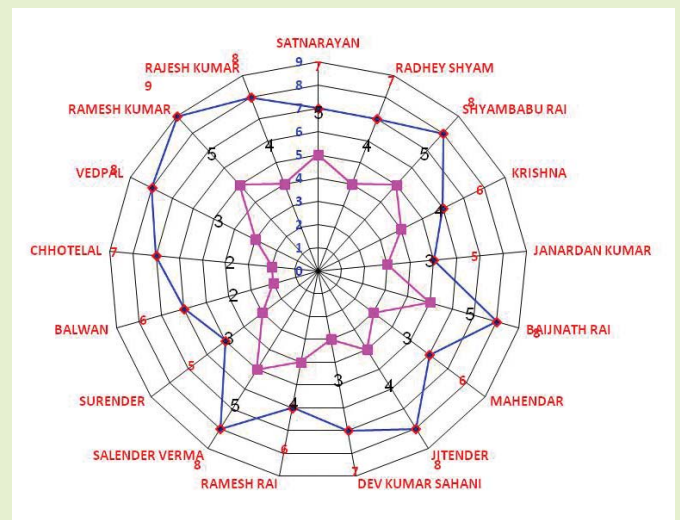
The following actions were taken to improve operator skill levels:

- The skills of each operator were mapped and measured
- A skill enhancement programme was created for each operator.

Outcome

Measurements were taken before and after the programme. The results have shown significant improvement in operator skills and led to the following benefits:

- Reduced maintenance times
- Improved product quality
- A motivated workforce.



Jindal Stainless Limited

Controlling pollution through continuous emission monitoring

Environmental management systems

Challenge

Emissions to the environment can originate from several operations in the plant. Various pollution control devices are installed to eliminate these emissions and their performance is checked on a regular basis using manual processes. However, it takes time to analyse the samples that are taken during these checks. This can lead to delays in detecting problems or failures of air pollution control systems.

Action

To reduce the chance of failures going undetected, Jindal has installed a continuous emissions monitoring system. The system provides us with a better view of our emissions and problems are detected within 30 seconds.

Outcome

The continuous monitoring system enables us to quickly respond to changes in emission levels. Failures of air pollution control devices are detected immediately. Quick detections results in immediate rectification of problems with pollution control devices and better control of our emissions.

This results in:

- A reduction in air pollution
- A healthy and pollution-free environment
- Better process control
- Wide acclaim for our Centre for Environmental Excellence which introduced the system.

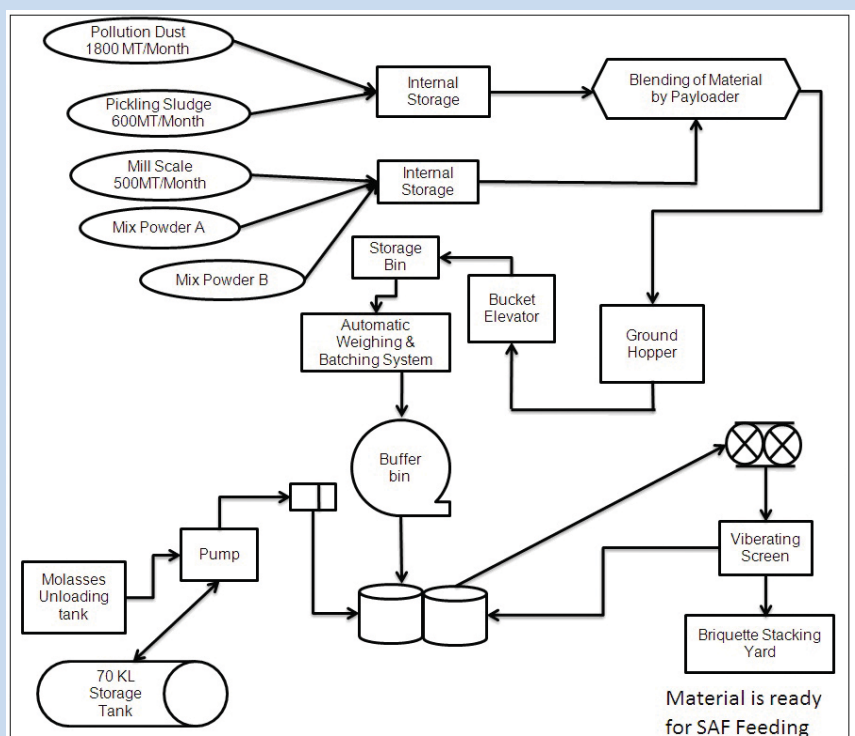
Jindal Stainless Limited

Converting waste into valuable raw materials

Environmental management systems Material efficiency

Challenge

Stainless steel plants generate wastes from many processes. Some of these waste materials are classified as hazardous substances. It is a challenge for stainless steel plants to efficiently recycle, reuse or dispose of this waste. The waste can also contain high levels of valuable metal oxides such as chromium, iron, manganese, nickel and zinc.



Action

Recovering the valuable waste materials has been achieved by:

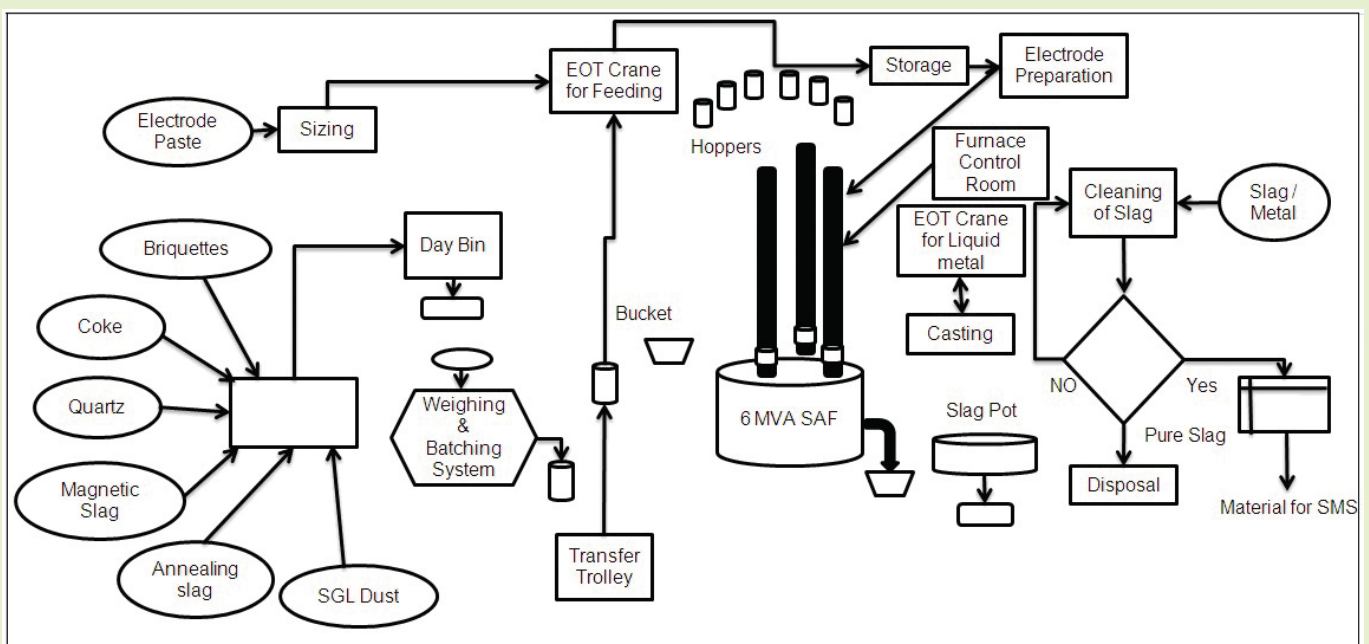
- Collecting waste products such as flue dust, grinding dust, shot-blasting dust, mill scale and pickling sludge
- Packaging the waste products into briquettes using molasses to bind the material together
- Smelting the briquettes in a submerged arc furnace along with coke, quartz and slag.

The result is a master alloy which contains iron, chromium, manganese and nickel which can be reused in the stainless steel making process.

Flue dust collected from the bag filters in the pollution control device of the submerged arc furnace contains zinc oxide which is 35% pure. The zinc oxide can be sold to generate income for the plant.

Outcome

Reuse of waste materials has significant environmental benefits. It is also profitable as less raw material is required and some (such as excess zinc) can be sold. This improves both cost efficiency and resource management.



Jindal Stainless Limited

Reducing our carbon footprint by improving energy efficiency

Greenhouse gas emissions

Challenge

Being an energy intensive industry, stainless steel production has a larger carbon footprint than other industries. Jindal Stainless Limited Hisar wanted to take action to reduce energy use in order to minimise our carbon footprint.

Action

A systematic Energy Efficiency Improvement Programme was initiated across the plant with the active involvement of the Indian Bureau of Energy Efficiency (BEE). The following actions have been taken:

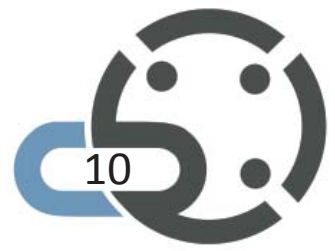
1. Redesign of existing equipment has led to a 21% reduction in energy consumption. Major savings were achieved by:
 - Reducing the working pressure of the hydraulic system and replacing a pump (saving of 73.5%)
 - Stopping the 90 kW cooling-water pump and modifying the pipelines in the Z-4 mill (-48.6%)
 - Redesigning the flat rolling equipment at the strip mill reduced fuel consumption (-11.6%)
 - Redesigning boiler equipment to reduce fuel consumption (-10.8%)
 - Reducing the cycle time (Rolling Time + Gap Time) by 90 seconds for thinner gauge (2 mm) rolling (-10.2%).
2. Investment in new products helped to reduce energy consumption by 35.8%. Savings were achieved by:
 - Controlling the loading and unloading of the compressor (-81.6%)
 - Reducing the speed of the electric arc furnace fan from 500 revolutions per minute (rpm) to 300 rpm during idle times (-68.7%)
 - Reducing the energy consumption of motors during mill idle time (-52.5%)
 - Controlling the speed of the 110 kW high pressure blower to match the speed of the line (-35.5%).
3. Redesign of the automation interlock scheme has reduced energy consumption by 12.4%. Actions taken included:
 - Switching off hydraulic oil supply pump in auto mode and linking it to the level of the hydraulic tank (-75.0%)
 - Changing the operation cycle of the grease lubrication machine on the roller table by modifying the timing interlocks (-62.5%)
 - Switching off major energy consuming equipment during idle times at the Z4 mill (-30.9%)
 - Avoiding idle running of cooling tower fan motors by linking them to the temperature of the water (-18.6%).

Outcome

Together with the changes we have made to the energy and electricity supply mix, these improvements have decreased the mean carbon footprint of our products significantly over the past two years. In this period we have reduced our CO₂ emissions by 9,000 tonnes/year on average.

The Indian Bureau of Energy Efficiency and Indian Ministry of Power have recognised our efforts to strengthen energy management and improve energy efficiency. Jindal Stainless Limited Hisar has been named as one of the best energy saving companies in the steel rerolling sector for the past two years.

We plan to increase our efforts to voluntarily reduce our carbon emissions. We aim to reduce our carbon footprint by another 50,000 tonnes over the next five years.



Nippon Metal Industry Co., Ltd.

Effective utilisation of EAF slag as a road base material

Material efficiency

Challenge

The local authority where our Kinuura works is located has its own evaluation system for recycled materials known as Aikuru. The Aikuru standard regulates the properties and safety of recycled materials used in public works. The standard includes specifications on:

- Quality and properties of road base materials
- Recycled material content
- Environmental safety
- Quality control
- Environmental impact.

Material suppliers must show the local authority that their recycled material meets the standards before it can be approved as an Aikuru-certified material. Nippon Metal Industry had to develop new technology in order for our EAF slag to meet the Aikuru standard.



Action

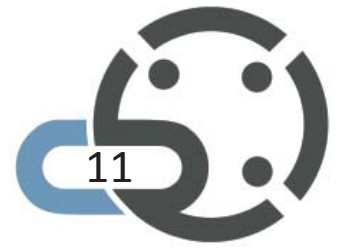
To meet environmental criteria, the level of some materials in the slag had to be kept below the limit imposed by the Aikuru standard. Fluorine was the main material in the slag which exceeded the limit.

To reduce the amount of fluorine in the slag we developed a new production method. By adjusting the composition of the slag we can control its melting point in the EAF at low temperature. This enables us to produce high quality stainless steel without any fluorites.

Outcome

EAF slag from our site has been approved for use as a recycled road-base material according to the Aikuru standard. The slag has been utilised successfully in this application. It has replaced crushed stone which is produced from limited resources of natural stone.





Nippon Yakin Kogyo Co., Ltd.

Making maintenance-free marine structures with super austenitic jackets

Material efficiency

Value to customers

Challenge

More projects are using steel structures called jackets for harbour quay walls, piled piers, and breakwaters. Jackets are truss-like cube structures assembled using steel pipes. The legs and piles that are driven into the sea floor are welded into an integrated structure.

Because the jackets are made of steel pipes, corrosion protection from seawater is key. Steel pipes can be protected from rust and corrosion by applying electrolytic protection to the area submerged in seawater and by applying coatings to the area above the water.

A drawback of this approach is that electrolytic protection is not effective on parts of the pipes subject to splash or exposure to the atmosphere at low tides. The coating also comes off, requiring regular recoating which increases maintenance costs.



Action

We examined whether it was possible to protect the steel pipes of the jackets from corrosion and make them maintenance-free by welding and sheathing the splash and tidal zone of the steel pipes with super austenitic stainless steel grade 185N (UNS S31254: 20Cr-18Ni-6Mo-0.8Cu-0.2N). As part of the testing, the stainless steel was exposed to a variety of different seawater environments for an extended period of time.

The results show no rust or pitting corrosion in the seawater at ordinary temperatures. No crevice corrosion was observed in the areas where marine creature such as corn barnacles and blue mussels attached themselves to the structure. This demonstrated the excellent corrosion resistance of super austenitic stainless steel in seawater.



Steel pipes which have not been protected with super austenitic stainless steel jackets

Outcome

Super austenitic stainless steel grade 185N has been chosen as the sheathing material for steel pipes in a variety of jacket-type applications as it shows superior corrosion resistance in seawater. Stainless steel sheathes which are resistant to corrosion in seawater do not require the same level of maintenance as conventional coatings. They reduce harbour maintenance and management costs, providing long-term benefits to the customers.

Grade 185N has been used to restore the harbour facilities in the city of Ishinomaki which suffered major damage in the 2011 Great East Japan Earthquake. It has played an important role in rebuilding the devastated city.

Use of grade 185N (UNS S31254) protects harbour installations





Nippon Yakin Kogyo Co., Ltd.

Educating workers over 40 about safety

Employee training and health Safety

Challenge

It goes without saying that employee safety is one of the most important issues in manufacturing stainless steels. Of the 220 or so industrial accidents in the ten-year period between 1992 and 2001, about 40% involved workers aged 40 or above. These workers were presumably experienced in their work.

The high level of accidents amongst this group of workers prompted us to implement safety measures which focus on middle-aged and elderly workers. These measures are in addition to the routine safety practices all employees must observe.

Action

Analysis of the causes of the industrial accidents involving workers over 40 showed that a primary cause was their lack of awareness of the decline in their physical abilities (for example, cardio-pulmonary function and athletic performance).

To address this issue, a new educational programme was provided to all employees aged 40-years or older. The aim of the training was to inform them about age-related declines in physical abilities and to encourage them to work in a way that is appropriate for their age.

The training was provided by a safety management leader who was supported by an external safety consultant. The training was provided in a two-hour session to groups of about 20 workers.

Training covered:

- Age-related declines in physical abilities, and recognising the confidence and pride of workers aged over 40.
- Safety measures which take these issues into account.

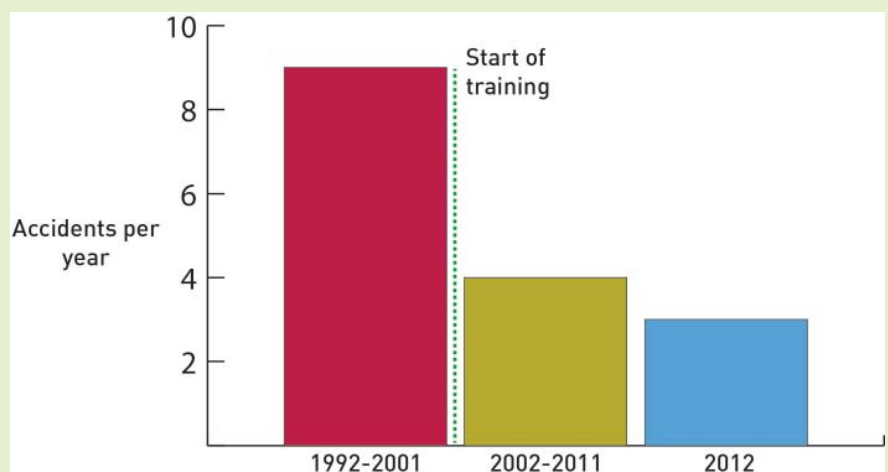
A group discussion was also held on safety measures for mature workers.

Outcome

As a result of this safety training, the number of industrial accidents involving workers aged 40 and older was reduced to an average of four incidents per year for the decade between 2002 and 2011. In 2012 the figure dropped to three incidents in the year.

This compares favourably to the 10 years between 1992 and 2001 when there was an average of nine incidents per year. The training has also had an impact on younger employees. As many of the employees over 40 are in leadership positions in their groups, the improvement in their safety awareness has been passed on to the younger generation.

Number of accidents per year for employees over 40





Nippon Yakin Kogyo Co., Ltd.

Reducing CO₂ emissions through gas fuel conversion

Greenhouse gas emissions

Challenge

Following the enforcement of the United Nations Kyoto Protocol to reduce greenhouse gas emissions, the Japanese Act on Promoting Global Warming Countermeasures was revised. Effective from April 2006, businesses that released greenhouse gases in excess of limits specified by the ordinance had to report the volume of emissions to the Japanese Government.

In response to these global initiatives, Nippon Yakin Kogyo has implemented measures to further reduce our emissions.

Action

An ISO 14001 environmental impact objective was set with the goal of reducing emissions by 10% or more (compared to 1990 levels) by 2010.

Investments were made to change the heating furnace fuel from liquid petroleum gas (LPG) to liquid natural gas (LNG). The furnaces affected included the walking beam reheating furnace, the pit furnace, and four annealing pickling lines.

If the emission coefficient for crude oil is 1, the emission coefficient for LNG is 0.74. For LPG it is 0.87. Changing the fuel source was expected to reduce CO₂ emissions.

Outcome

Efforts to change the fuel source for heating furnaces started in 1997. More than 90% of LPG consumption has been replaced by LNG.

By 2010 we had managed to achieve our aim of reducing emissions by 10%. In 2012 we expect to achieve a 17% reduction compared to the baseline year of 1990.

Provisional calculations estimate that the change in fuel type reduced greenhouse gas emissions by 33,000 tonnes in 2012 compared to 1990.

Trend in CO₂ emissions at Nippon Yakin Kogyo's Kawasaki Plant





Nippon Yakin Kogyo Co., Ltd.

Initiatives to prevent recurring ISO14001 non-conformance

Environmental management systems

Challenge

Nippon Yakin Kogyo's Kawasaki Plant obtained ISO 14001 certification in environmental management systems in 1999. Since then our environmental efforts have continued.

However, each year there have been four to five cases of non-conformance. Incidents have included brown water effluent being released into gutters and acid leakage from a pipe. These incidents posed a challenge to our environmental efforts and we wanted to ensure they did not happen again.

Action

Each time an incident occurs, an Environmental Non-conformance Investigation Committee is formed. It comprises members of the department where the incident occurred and representatives from other relevant departments.

The Committee inspects the site, confirms whether an incident has occurred and investigates the causes. The investigation gathers facts and suggests improvements where needed. Improvements can cover a wide variety of areas including human resources, facilities, techniques, and materials.

Outcome

As a result of the improvement measures devised and implemented by the Environmental Non-conformance Investigation Committees, the number of non-conformance incidents was reduced to one in 2011.

Because the Committee comprises members representing multiple departments, information concerning corrective measures and recurrence prevention was effectively shared across the Kawasaki Plant. This helped to reduce the number of non-conformance cases and spread the implementation of preventive measures.



Nippon Yakin Kogyo Co., Ltd.

Reducing electricity consumption

Energy intensity

Greenhouse gas emissions

Challenge

Electricity accounts for a large share of the total energy consumed by the Nippon Yakin Kogyo's Kawasaki Plant. This is common among stainless steel suppliers that use an electric arc furnace in the manufacturing process.

The Fukushima nuclear disaster has heightened concerns about stable energy supply globally. Energy saving, especially the reduction of electricity use, is a major challenge.

Action

A project team was established comprising people from across the Plant. They have launched the following initiatives:

- Using LED bulbs to light the plant
- Introducing invertors for motors
- Reviewing how fans and pumps are operated
- Implementing everyday energy-saving initiatives. For example: reducing the number of lights and/or the length of time they are lit; and reducing air-conditioning operating time.

Outcome

Electricity consumption has been reduced by approximately 4.4 million kWh per year. This represents about 1.3% of the total electricity consumed at the Kawasaki Plant.

This reduction contributes to a direct saving in electricity costs reduction. Indirectly it reduces the greenhouse gas emissions of the electric supplier.

Nisshin Steel Co., Ltd

Avoiding stress cracking using a modified austenitic grade

Greenhouse gas emissions Value to customers

Challenge

In gas water-heaters, hot water is created by burning a combustible gas at high-temperature. In conventional heaters of this type, the temperature of the exhaust gas after heat exchange is around 200°C. Only around 80% of the combustion energy is recovered by the water.

One of our customers developed a new type of heater which incorporates a secondary heat-exchange to recover the heat from the exhaust gases. The customer contacted Nisshin Steel to discover if there was a stainless steel which had good weldability, high resistance to stress-corrosion cracking (SCC), and which could perform at high temperatures.

Action

The secondary heat-exchange has components which complex shapes that require a number of welds. This requirement defined that an austenitic stainless steel should be used.

As the temperature of the exchanger ranges up to 200°C, condensation occurs as the exhaust gas is cooled. This creates an environment in which dew-point corrosion can occur, which in turn leads to SCC.

A drawback of some austenitic stainless steels is that they are susceptible to SCC in certain applications. We decided to offer the customer a proprietary stainless steel. Similar in properties to SUS 315J2 (AISI xxx), our grade offers excellent formability, weldability and resistance to SCC. It has already been utilised successfully to create components for an oil-fuelled water heater.

Outcome

With the use of our highly SCC-resistant proprietary grade in the secondary heat-exchanger, the thermal efficiency of the heater has improved from 80% to 95%. This reduced gas consumption and led to a 13% drop in greenhouse gas emissions.

Lower gas usage conserves natural resources and decreases running costs. These benefits are expected to lead to the widespread adoption of heaters fitted with secondary heat-exchangers.

Secondary heat-exchangers improve the environmental and economic performance of hot water heaters





Nippon Steel & Sumikin Stainless Steel Corporation (NSSC)

Ongoing drive to achieve a safe working environment

Safety

Challenge

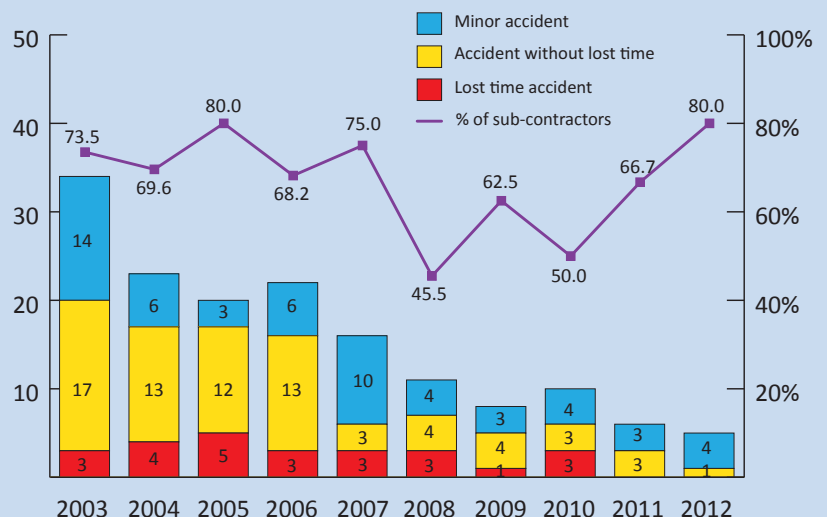
NSSC, the largest stainless steel manufacturer in Japan, was established in October 2003 through the consolidation of the stainless steel divisions of Nippon Steel Corporation and Sumitomo Metal Industries. At the time NSSC was established, several lost-time accidents had been occurring every year. When combined with minor accident statistics (including accidents involving subcontractors) the total number of incidents climbed to over 30 per year. Preventing these incidents required in-depth accident prevention measures.

Statistical research showed that accidents involving subcontractors accounted for about 70% of the total. The most common causes of accidents were found to be violations of company rules, incorrect work procedures, and operator carelessness.

In order to raise the level of safety awareness among all workers at our sites, NSSC started promoting a zero accident culture. The approach was company-wide and involved our subcontractors.

Works	Employees		Sub-contractors		Total
Hikari	892	37%	1,534	63%	2,426
Kashima	220	54%	191	46%	411
Yawata	192	45%	234	55%	426
Total	1,304	40%	1,959	60%	3,263

Below: Number of accidents and percentage of sub-contractors since NSSC established in 2003



Action

NSSC's approach involved three main steps:

- Enhancing and promoting company-wide safety activities with subcontractors. Our activities are guided by the following principles:
 - Top management should be able to disclose information regarding safety issues.
 - Forepersons, supervisors, and managers should be able to take initiatives and act on them.
 - Developing effective safety activities by prioritising interactive dialogue between all regular employees and managers.
 - Improving safety and health education. Actions included:
 - Creation of a new training curriculum by NSSC's Development of Human Resources Centre (DHRC). The curriculum is improved each year based on feedback from trainees.
 - Providing all employees with individual safety education programmes. Safety education for employees with less than five years of experience has been enhanced as this group of employees are more prone to accidents.
 - Holding simulation training to increase sensitivity to danger.
- Implementing effective practices to eliminate unsafe acts. Actions included:
 - Raising awareness by chanting the safety principles at meetings.
 - Remembering past incidents.
 - Promoting safety measures after every incident, even minor ones.
 - Encouraging managers to lead activities to raise safety awareness among their teams.
 - Sharing details of safety activities and past practices at semi-annual presentations to workers from all levels of the company.
 - Holding group discussions with subcontractors to develop a sense of unity.
 - Transferring best practices throughout the company through briefing sessions attended by employees at foreperson-level.

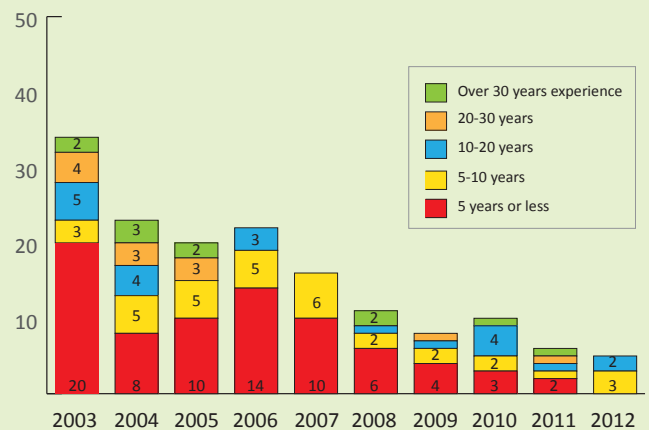
Outcome

Thanks to the strong leadership provided by top management, NSSC has been dedicated to developing a zero accident culture for the past ten years. By making safety an explicit priority, forepersons, supervisors and managers have been able to take the initiative and work with our subcontractors. For example, managers have been encouraged to ask their subordinates to follow company safety rules faithfully, through dialogue and practice.

Since 2010, when an accident (a fall) occurred at our Hikari Works resulting in lost time, NSSC has actively promoted interactive dialogue in which both managers and regular employees can exchange their honest opinions.

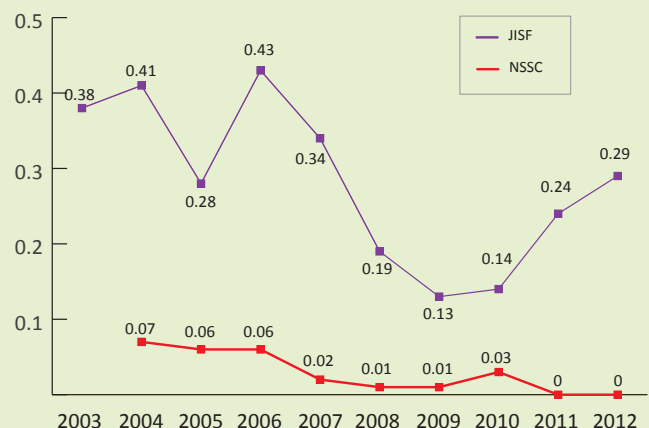
As a result, no accidents resulting in lost time have occurred since 2011 at any of NSSC's works. The statistics show that our safety performance has continued to improve since NSSC was established in 2003. Our safety activities have been checked and commended by the Japan Iron and Steel Federation (JISF) in 2012.

Lastly, we will be greatly honoured if our safety activities help the other ISSF members to improve their own levels of safety. NSSC also remains committed to improving our own safety performance in the future.



Above: Number of accidents by years of experience

Below: Accident severity rate for industry (JISF) and NSSC



Outokumpu Nirosta GmbH

Recovering acids and metals from waste acids

Material efficiency

New processes and products

Challenge

Outokumpu Nirosta's Krefeld plant produces stainless steel flat products – mainly in the form of strip and sheets for customer applications. During the production process it is necessary to anneal the coils before and after the cold rolling step. After annealing, the stainless steel is pickled to remove the scale from the steel. This ensures the final product has good surface quality.

The annealing and pickling processes are performed on the continuous annealing and pickling lines. The pickling process uses mixed acids (such as HF and HNO₃) to separate the scale layer from the ground material. During the pickling process the metal content (such as metal fluorides and metal nitrates) in the mixed acid pickling bath increases. After a number of pickling operations the mixed acid must be discharged and replaced with fresh acid.

Previously the discharged waste acid was sent to a neutralisation plant. After neutralisation the liquid was discharged into the public waste water network while the sludge was used for landfill. During the neutralisation process, free and bound acids are

lost and the metals are dissolved. This results in additional direct and indirect costs and also affects the environment.

Our goal was to recover the acids and metals (such as nickel, chromium, iron and molybdenum) from the waste acid and avoid the neutralisation process.

Action

Two actions were taken:

1. An acid recovery plant was installed onsite.

The recovery plant uses a thermal process (PYROMARS) to evaporate and absorb free acids. The metal fluorides and nitrates (bound acid) are cracked to form additional free acid which is also evaporated and absorbed. The free metals form metal oxides which are separated in the process. The recovered acid is continuously fed into the pickling circuits of the annealing and pickling lines. The acid recovery plant has a nominal capacity of 4.5 m³/hour. The recovery rate for HF is >95% and approximately 40% for HNO₃. The volume of sludge produced by the neutralisation process is reduced significantly.

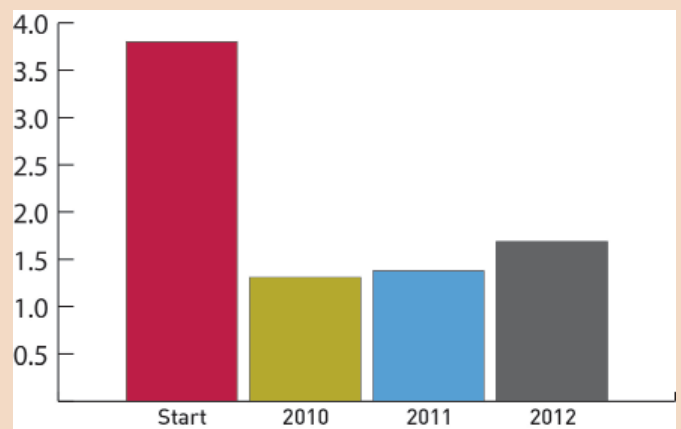
2. A new procedure to recover the metal oxides so they can be used to make stainless steel was developed.

Approximately 120 tonnes of metal dust oxides are sent to a local company each month. The company compresses the dust into stones with other metal oxides from the cold rolling mill. The stones can be added to the stainless steel production process at our steelworks. A special

recipe was developed to achieve the required mechanical properties. The process reduces the amount of metal oxide and recovers nickel and chromium which are valuable in the stainless steel production process.

HF volume (kg/tonne of product)

Note: Lower order volumes in 2011 and 2012 reduced the efficiency of the process, although gains are still significant.



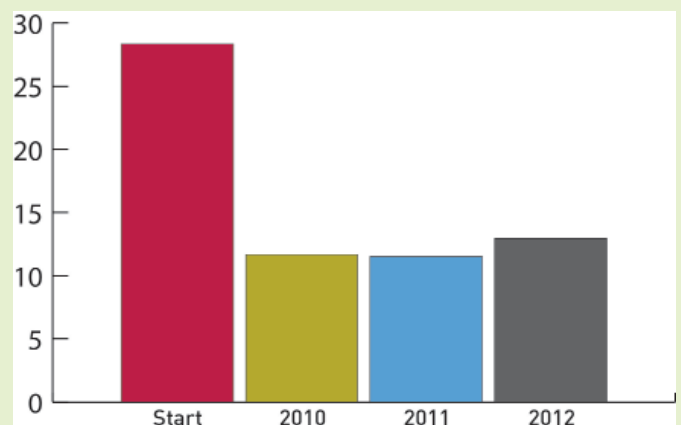
Outcome

Consumption of expensive HF was reduced by approximately 60%. Sludge volume after neutralisation was reduced by a similar amount. Valuable metals are recovered from the metal oxides and these can be reused to make new stainless steel. From the metal oxides we recover about:

- 7% nickel
- 8% chromium
- 46% iron.

Annual savings are more than €4 million.

Sludge volume (kg/tonne of product)





POSCO

Leadership training programme

Employee training

Challenge

POSCO has a unique leadership training programme which is designed to nurture talent as part of its effort to become a sustainable and growing company. POSCO recognises the importance of having a different and competitive working process. Such training programmes help employees change their way of working and thinking and become more innovative. This approach maintains improvements over the long-term and encourages the active participation of all employees. This creates a sense of ownership, ultimately increasing the company's competitiveness.

Action

POSCO's Leadership Training Programme has operated since 2006. The programme includes off-the-job Leadership Training Programme (four-month course for groups of 3-5 employees). The training provides the employees with the skills they need to:

- Share the need for sustainable innovation with other staff and lead voluntary efforts. This enables them to pass on a sense of ownership to fellow employees through change management training.
- Identify and reduce waste, learn how to resolve on-site issues and benchmark the best innovative practices of our competitors.
- Enhance their problem-solving ability by carrying out improvement tasks based on innovation techniques or methods transferred from the training course.

Once they have completed the training, employees are appointed to positions as Innovation Leaders. This enables them to:

- Gain practical experience in a leadership role after training.
- Lead the activities of a small group which contribute to sustainability improvements.

Outcome

Thanks to our Leadership Training Programme, POSCO has successfully added innovation to working and learning. The programme has strengthened POSCO's good relationship with the labour union and secured an innovative POSCO culture where all employees share an enhanced sense of ownership.

To date, 49.4% of our employees in the stainless steel division have received the Innovation Leadership training. In addition, cost savings of US\$3.6 million were achieved in 2012.

POSCO

Stainless steels pipes for drinking water distribution and fire protection

Value to customers

Challenge

Ensuring clean water for domestic use requires pipes which do not corrode. Traditionally zinc-plated carbon steel pipes have been used but these can become blocked with rust. Copper and plastic pipes are used to avoid corrosion, but these materials have their own problems. Copper can corrode and discolour the water, leading to additional maintenance costs. While plastic pipes are relatively cheap and easy to install, they are fragile and environmentally hazardous.

Stainless steel is recommended as the best alternative for water distribution and fire-protection system. The stainless steel pipes are:

- Corrosion and hazard-free
- Cheap and easy to maintain
- Recyclable
- Long lasting (usable for more than 50 years)
- Easy to assemble and install
- Highly durable
- Usable even with high-temperature water or environments (for example, in fire protection applications).

Action

POSCO conducted a joint research project with the Seoul metropolitan government for three years. The project aimed to define appropriate stainless steels for water purification systems. Seven types of stainless steel (including austenitic, ferritic and duplex stainless steels) were tested both in the field and laboratories. Their corrosion patterns were measured and analysed in ten field sites including water reservoirs, water tanks and distribution pipelines. Key findings included:

- Duplex stainless steel showed the best performance in water purification facilities. The high corrosion resistance of the duplex grades was proven in 2012 when they were applied to actual filtering facilities. Stainless steel with PREN 38 and higher is recommended for use in the water treatment systems.
- The lean duplex stainless steel had high corrosion resistance in the water reservoir application. Welds in the stainless steel applications should be pickled in a mixed solution of nitric and fluoric acid.

- Type 304 can corrode within a year on riverside soil which has high concentrations of humidity and chlorine. Type 316 (and higher grades) should be specified in areas high in humidity and chlorine.

Together with the Korea Fire Institute of Industry and Technology (KFI) and Korea Iron and Steel Association (KOSA), POSCO analysed the use of stainless steel in fire protection applications. Stainless steel pipes and joints were tested for their mechanical strength, vibration resistance, performance at high temperature and corrosion resistance. The results showed:

- Type 304 pipes and joints performed well in hydraulic pressure tests and vibration tests, meeting the standards set by Korean fire protection regulations.
- Type 304 stainless steel did not leak during fire ignition tests where the pipes and joints were exposed to flames for ten minutes.

Based on the vibration and corrosion tests, type 304 pipes and joints have a long lifetime.

Outcome

Since 2003, the Seoul metropolitan government has used stainless steel pipes in its water distribution system. Ninety percent of the pipes smaller than 80 mm are made from stainless steel, mostly type 304.

POSCO and the metropolitan government have sought ways to expand the use of stainless steel in the water treatment system, especially in facilities with high corrosion rates. In 2011, duplex stainless steel was recognised for its high corrosion resistance and was deployed in filtering facilities. No corrosion has been found.

In January 2013, POSCO proposed a revision of the water system regulations to include the use of duplex stainless steel. Korea Water and Waste Water Works Association (KWWA) and the Seoul metropolitan government are working on the proposed revision.

South Korea plans to construct or rebuild many water distribution facilities over the next five years. Countries in south-eastern Asia and South America also plan to build new water facilities over the next decade. With these developments, demand for duplex stainless steels is expected to increase.

ThyssenKrupp Nirosta GmbH

Smart and resource-efficient air cooling

Employee training and health

Greenhouse gas emissions

Material efficiency

Challenge

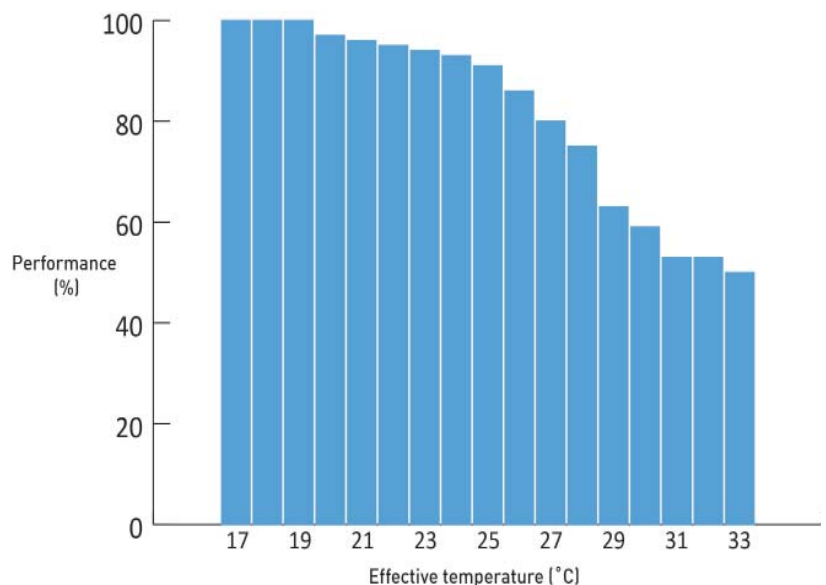
The headquarters of ThyssenKrupp Nirosta in Krefeld (Germany) is a late-1950s building. Like most buildings from this time, it is not insulated to the standards of today. In summer, the interior temperature can reach up to 30°C.

Employees were stressed with the conditions and often complained. This was understandable as it has

been scientifically proven that employee productivity decreases in-line with temperature. Above 26°C, effectiveness drops rapidly to just 50%.

To insulate the building effectively would require an extremely high level of expenditure. A more cost-effective solution had to be found.

Employee effectiveness in response to temperature (Source: Dr. Ing. W. Maag)



Action

We explored three options including:

- New insulation for the building
- A different air conditioning system
- Cooling systems.

From a comparison of the economics of each solution it emerged that a site-specific cooling system offered the best value solution.

At the Krefeld site we operate a steel plant and a cold rolling mill. In addition to our own production plants there are other companies based in the industrial park. The water management protocol for the site is based on water cycles and cascading water use.

The intake water needed for production processes normally comes from groundwater sources. The temperature of the groundwater remains stable at about 11°C throughout the year. The solution for our site was to pump this water through air coolers in the offices of our headquarters before it is used in production.

Outcome

The groundwater cooling system maintains the offices at around 23°C during the seven warmest months of the year. Its main value has been the improvement in the health and well-being of our employees, and their increased effectiveness.

The solution is very economical as it only requires a little electrical power for the water pump in the building. The natural coolness comes from the environment.

Production is not affected by the higher temperature of the water as it leaves the building's air cooling system. The water is not consumed, so no additional resources are necessary. This makes it a cost-competitive solution compared to other options. Greenhouse gas emissions from the system amount to just 23.5 kg/year – between 20 and 25% of the other solutions we examined.



Yieh United Steel Corporation (YUSCO)

Finding new applications for stainless steel slag

Material efficiency

Challenge

YUSCO is a major stainless steel manufacturer with annual production of nearly one million tonnes of crude steel per year. However, as stainless steel production has increased, the amount of slag has also increased. At YUSCO, slag is processed into valuable secondary resources for the cement and construction industries. This reduces the amount of waste we need to send to landfill.

Action

Slag contains many valuable and recyclable metals such as chromium, iron and nickel. Inclusion of these metals limits recycling opportunities as they make it difficult to crush or grind the slag.

Slag is also unstable if it contains free calcium oxide (CaO) or magnesium oxide (MgO) molecules. These chemicals react easily with water and will expand the volume of the slag as they do so.

To improve the recycling options for slag, YUSCO implemented the following actions:

- A slag treatment plant has been established to crush, screen and recover metals in the slag.
- The crushed slag is classified as either fine or aggregate.
- Methods to stabilise the slag were studied.
- Applications for slag in green building materials were explored.

Outcome

YUSCO's aim is to promote the added-value of waste from the melting shop and to use it for the sustainable development of the company. The slag treatment plant enables us to use both dry and wet processes to separate the slag and metals. These by-products are recycled according to their physical and chemical properties.

The following possible applications for slag are being assessed by YUSCO:

- Aggregate for asphalt roads or concrete.
- Fine slag as an additive to cement.
- Use of fine slag as a raw material for sintered brick.
- Applications in the cement industry.

Yieh United Steel Corporation (YUSCO)

Improving the thickness accuracy of hot-rolled plate

New processes and products Safety

Challenge

YUSCO's hot rolled plate is produced in the rough mill which is part of our hot strip line. The thickness of the plate is controlled by adjusting the gap between the working rolls. However, this is done without measuring equipment. The accuracy of the gap varies according to the different temperatures of the plates as they go through the rolls.

To improve thickness accuracy, the operator has to measure the thickness of the plate at high temperature to set the gap for the next plate. This exposes the operator to a high temperature hazard.

Action

The target thickness for the plates is between 16 and 30 mm. In the original rolling pattern, thickness was controlled by the rough mill. After rolling, the plates were pushed to the crop shear and cut to the required length.

Thickness accuracy was improved by modifying the rolling pattern. The new rolling pattern has the following steps:

1. Using the rough mill, the plate is rolled to a thickness that is between two and five millimetres greater than the final thickness required.
2. The plate is moved to the finishing mill where it can be rolled into heavy gauge strip at the required thickness. Measuring equipment is available so quality can be controlled.
3. The heavy gauge strip is moved to the crop shear where it is cut to length.

Outcome

Implementation of the modified process has resulted in a dramatic improvement in thickness accuracy. With an allowed deviation of ± 0.3 mm, accuracy has improved from 34 to 100%.

The new procedure also avoids the high temperature risk to the operator.

Yieh United Steel Corporation (YUSCO)

Perfecting colour uniformity in 400-series coils

Value to customers

Challenge

A producer of packaging machines purchased a number of coils of 400-series (2B finish) stainless steel from a YUSCO dealer. The stainless steel was used to produce the surfaces of the machines.

The machine surfaces were composed of two stainless steel boards. The customer noted that there were differences in colour where the boards came from separate coils. The effect on the aesthetics of the product led to problems with sales. The customer was also reluctant to accept new coils.

Action

YUSCO checked the production processes for its 400-series (2B) stainless steel. The results showed that, while the coils might reach the 2B standard, the colour of the coils was not identical.

YUSCO immediately began to review and correct its production processes. This included optimising the rolling, annealing and pickling processes to reduce the chance of colour differences between coils.

Outcome

After the process improvements were implemented, the colour uniformity of YUSCO's stainless steel coils is now much better. The changes have solved the customer's problem. It has also widened the number of applications for YUSCO's 400-series (2B) stainless steel and sales have increased.



Yieh United Steel Corporation (YUSCO)

Reducing energy use and emissions to improve sustainability

Greenhouse gas emissions

Challenge

Energy usage accounts for about 82% of YUSCO's total of greenhouse gas emissions. If energy use could be reduced or our performance improved, emissions should be reduced as a consequence.

Action

All of YUSCO's production lines were requested to reduce energy wastage and improve energy efficiency.

Actions taken included:

1. Changing crew schedules to reduce the overall power consumption (kWh/Nm³) of the air compressors.
2. Adding an oxygen blowing module to the carbon steel production process to reduce power consumption.
3. Replacing existing lighting with high-efficiency fluorescent lighting.

Outcome

The actions highlighted above resulted in:

1. A 4% reduction in air compressor power consumption
2. Power consumption reduction of 50 kWh/tonne of carbon steel.
3. Payback on the investment in new lighting within two years.

The annual greenhouse gas inventory which YUSCO has agreed to undertake will confirm the total level of emissions from our operations. This will help us to develop improvement plans for the future.



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