

Safety and Sustainability Awards

The stainless steels industry; caring for our people and planet



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Caring for our people and our planet
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Introduction

For the 12th time, our members have participated in the Safety and Sustainability Awards.

For these Awards three winners are chosen in each category, giving them a Gold, Silver or Bronze Award. The worldstainless Team strongly believes all case studies and all the work done at the member sites contribute to a safer and more sustainable stainless steel industry.

All companies supplying case studies for the safety and sustainability awards had to answer the following questions:

The Challenge

What problem were you trying to solve or what feature were you trying to develop?

Why?

Why did you decide it was necessary to address this challenge?

Needed Action

What action(s) did you take to solve the problem or undertake the development?

Action Review

Were the action(s) taken SMART? Specific, Measurable, Achievable, Realistic and Time-bound

Target Beneficiaries from the Action

Who are the people, organisations and/or communities who have benefited from the outcome of the above action? (e.g.; host

company, employees, contractors, local community, regional community, customers, global community, etc.)

Horizontal Expansion Capability

Can the actions or approach taken be expanded for use elsewhere within your company and/or applied within other member companies?

Outcome

What benefits have you observed and quantified since you took the action? Please also explain the value of each of the stated benefits to employee health and well-being, job satisfaction, leading indicators (KPIs) and lagging indicators (KPIs).

We hope the case studies will give inspiration to other member companies worldwide.

The worldstainless Team

All the work done at the member sites contribute to a safer and more sustainable stainless steel industry.

Automatic extraction system of lubrication grease

Member Company

ACERINOX EUROPA, S.A.U.

Category

Workplace improvement

The Challenge

Improvement of safety conditions by automation of the lubricating grease removal operation in the AOD converter damping system.

Why?

To avoid risks arising from the operation of the extraction of lubrication grease from the damping system of the AOD converter as it is currently carried out.

The operation is currently carried out manually by a maintenance officer. In order for the lubricating grease to fall continuously, the task has to be done with the converter in operation. The worker is

exposed to the following risks:

- Projection of mechanical elements of the damping system (fatigue of system components).
- Hydraulic oil splashing from cylinders
- Exposure to high temperatures.
- Splashes of liquid steel.
- Explosions.
- Fall from heights.
- Manual handling of loads (drum).

Needed Action;

1. Adapting - converting a standard 200 kgs drum pneumatic pump into a dedicated pump for grease evacuation from the AOD Converter automatically.
2. To attach a small 10 mm air hose by means of a ¼" Smc type fitting and a 20 mm evacuation hose with spigot, which is also very light and easy to

handle.

3. Install guard rails in the drum evacuation area (according to the above operating procedure).

Action Review;

Specific; Design of an automatic lubrication grease extraction system.

Measurable; Completed / Non completed.

Achievable; The design of the system is simple and easy to implement.

Realistic; The proposed system is simple and easy to develop and implement.

Time-bound; The implementation of the new system is estimated to finish in 3 months.

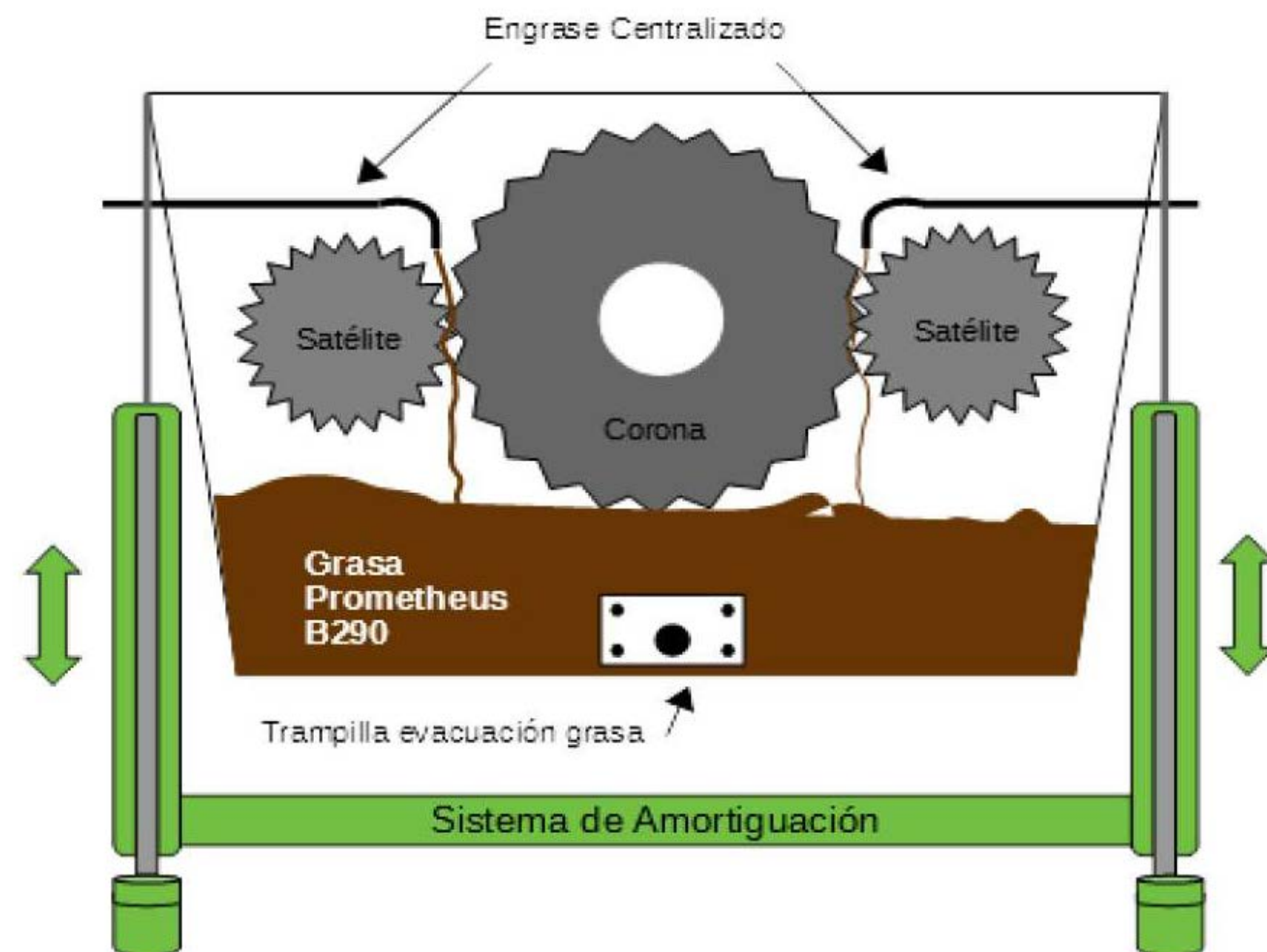
Horizontal Expansion Capability;

Yes, this system can be applied in other equipments or in other companies of the group.

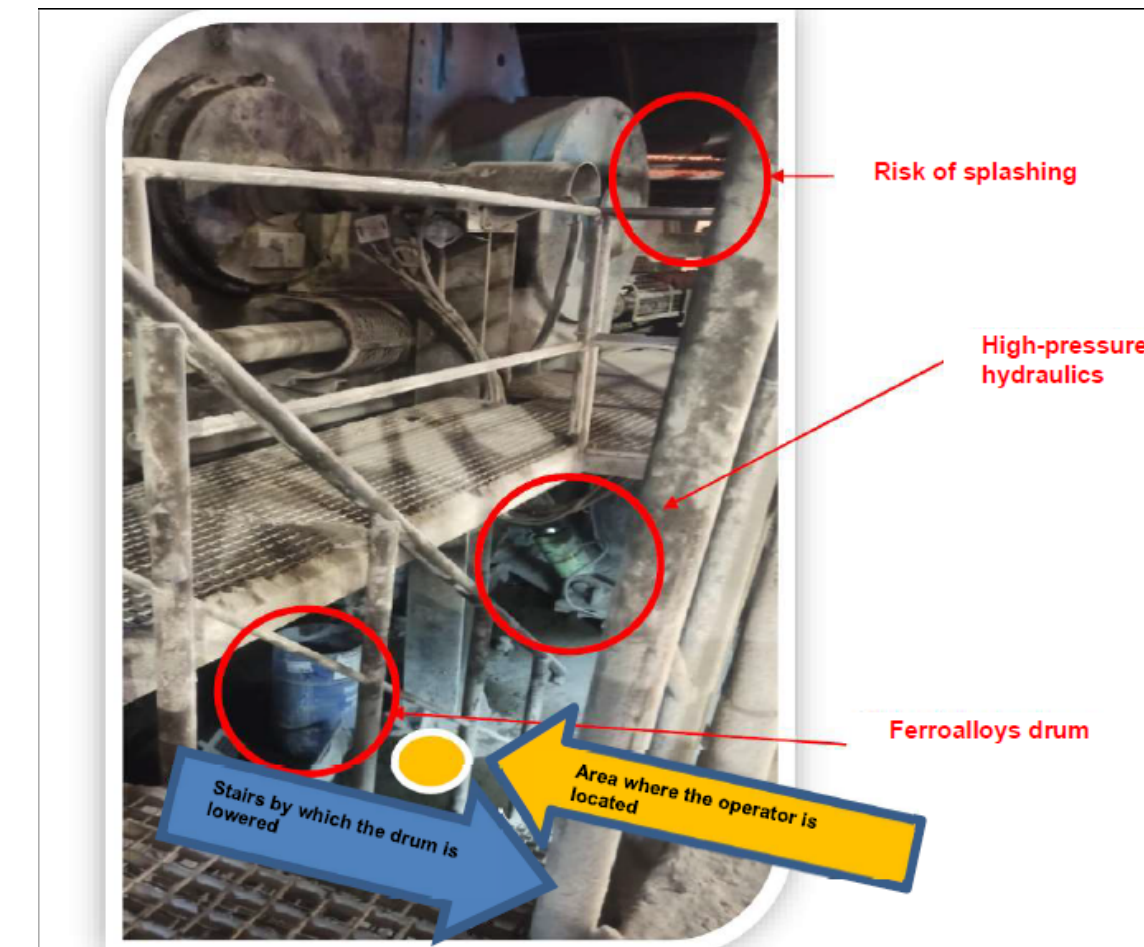


Outcome

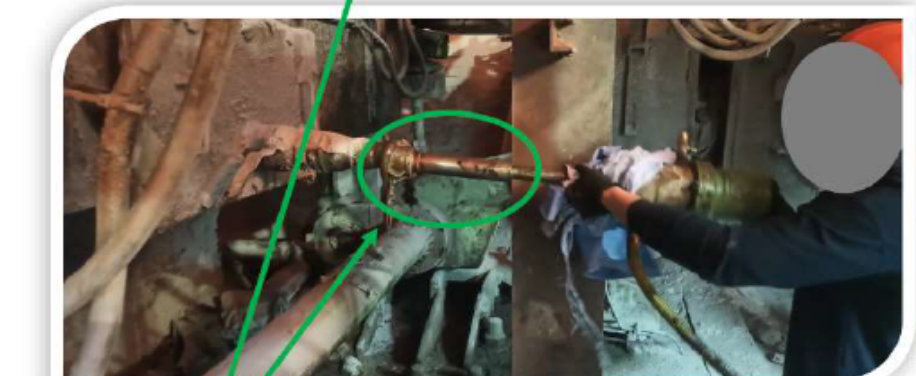
Before the improvement	After the improvement
Operation with the AOD converter processing, with the maintenance officer in area next to the converter	Operation with the AOD converter stopped. The presence of a maintenance officer in the area is not required
Hydraulic Unit processing (high-pressure hydraulic oil splash spray irrigation)	Hydraulic Unit stopped
Maintenance Officer in the risk area for approximately 12 hours	Maintenance Officer doesn't access the risk area
Manual handling of 45 kg drums	Movement of the drum by mechanical means (forklift)
Risk of falling from height during the lowering of the drum, splashes of liquid steel, explosions	The risks are eliminated
Extraction time: 45 kg/3 hours	Extraction time: 180 kg/2 hours



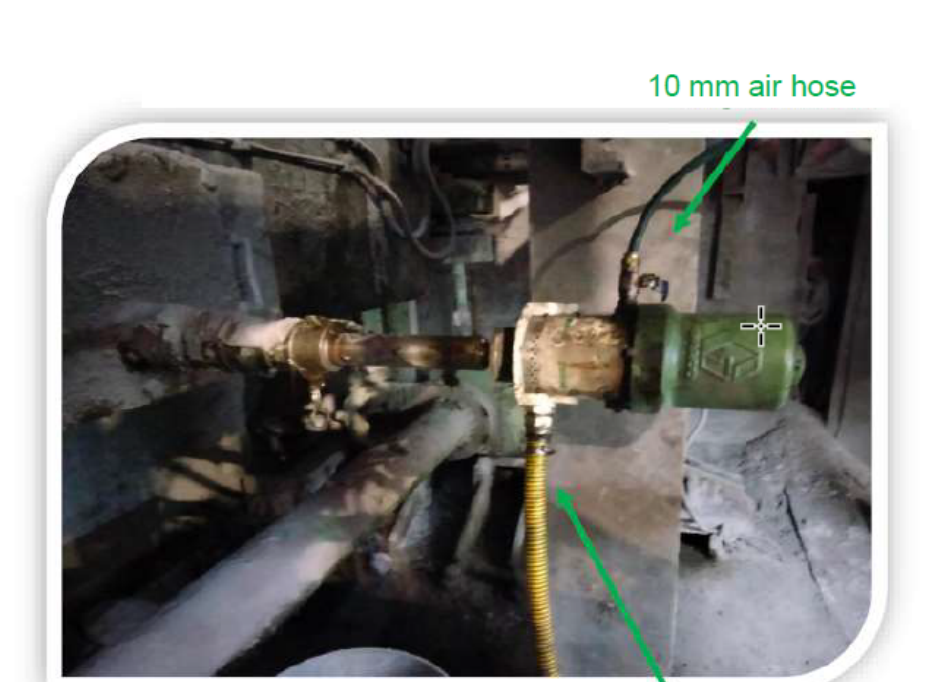
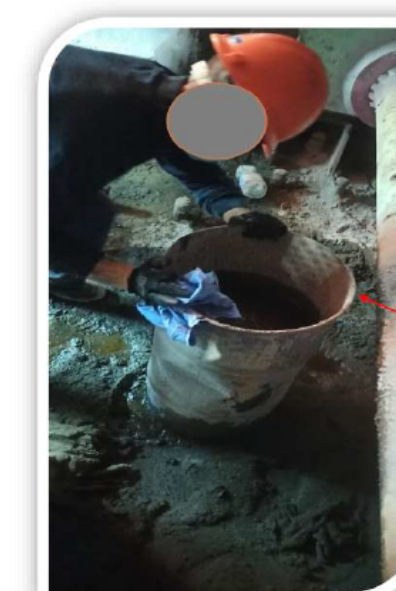
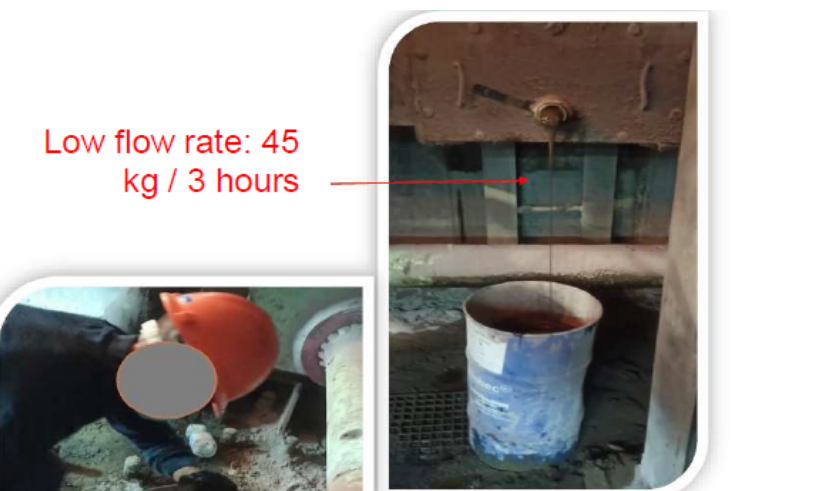
Before the improvement



After the improvement



New designed mechanism for the coupling and operation of the pump in the sump



Coupled extraction system

20 mm evacuation grease hose



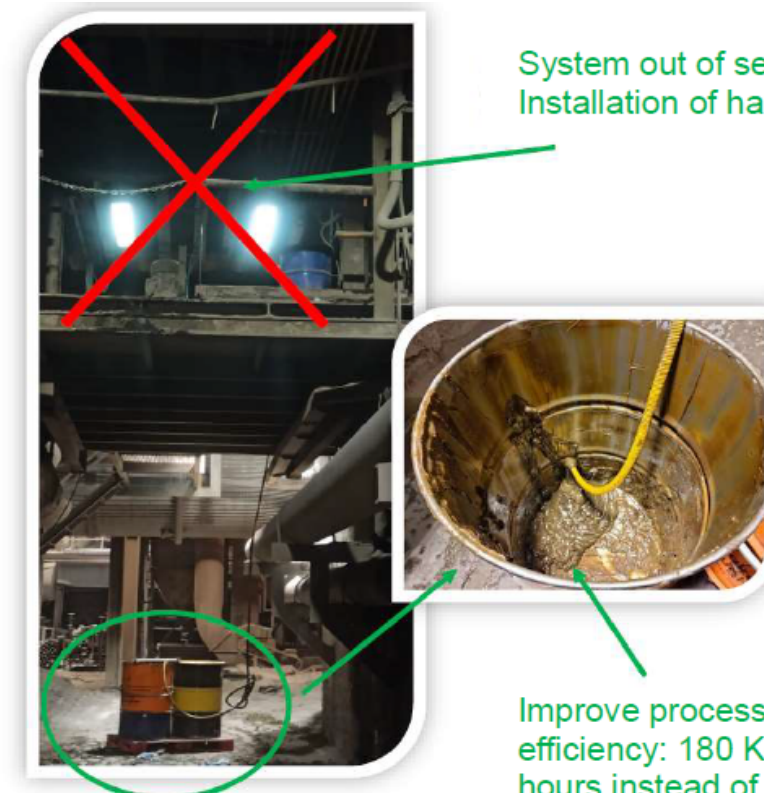
Before the improvement



Area through the drum was lowered

Risk of fall from height

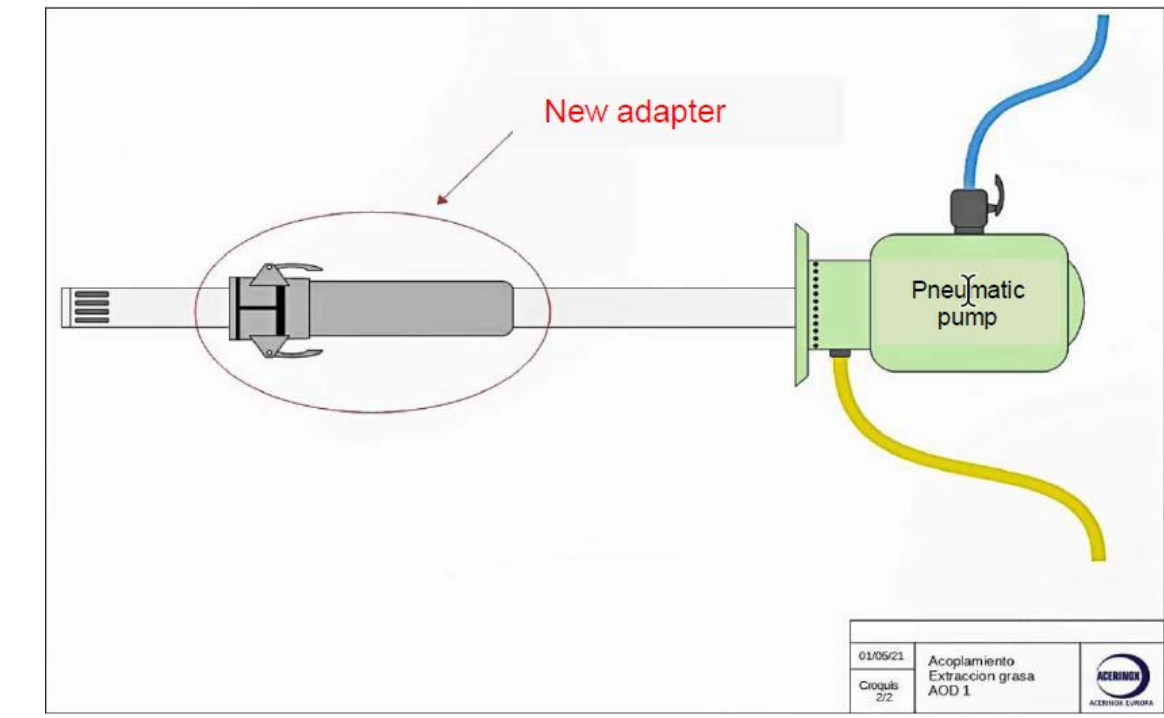
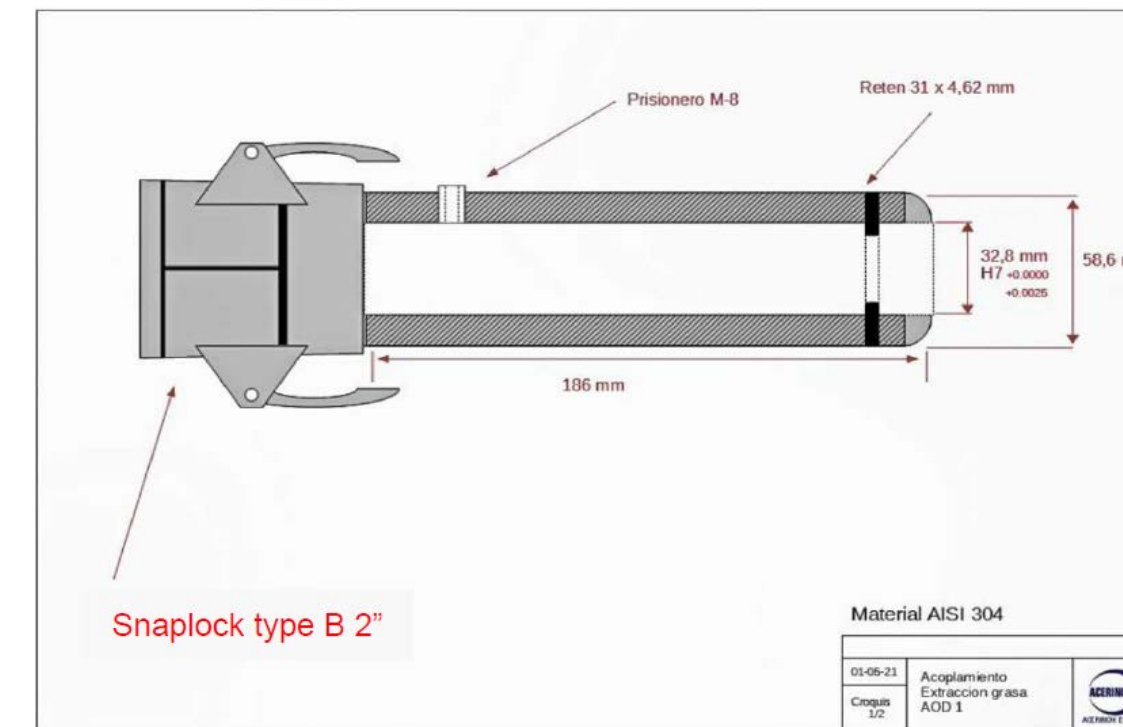
After the improvement



System out of service. Installation of handrails

Filling at ground level

Improve process efficiency: 180 Kg / 2 hours instead of 45 Kg / 3 hours



Cost: 350 € (Some materials are available at the ACERINOX EUROPA warehouse).

Actions to be developed in near future: Treatment to remove the metal particles from the grease so that it can be recycled, increasing the life cycle of the grease used



JUST CULTURE concept

Member Company

Aperam

Category

Workplace improvement

Accident analysis and countermeasure development

Safety training and/or skills development to reduce the number of safety incidents
Introduction or enhancement of behavioural safety approaches

The Challenge

As part of our project to develop the maturity of the Aperam H&S culture, the results of the analysis conducted in 2019-2020 on almost all Aperam sites showed a lack of confidence in Aperam's Fair Play policy: not fair and not clear enough in its application.

But to become a true learning organization we need to learn from our mistakes, that

means if we want to progress in safety we need an environment in which individuals feel free to point out their mistakes.

Why?

We needed to make a fundamental change in our way of treating accidents. In our complex working world, quick decisions are increasingly important. Mistakes are part of everyday work and can rarely be completely avoided. It is crucial to deal with mistakes in a constructive way, which allows the whole organisation to learn quickly. People are less willing to inform the organisation about their own errors and other safety problems or hazards if they are afraid of being punished or prosecuted. Such lack of trust of employees prevents the management from being properly informed of the actual risks. Managers are then unable to make the right decisions in order to improve safety.

But it is also crucial not to accept any deliberate infringement of the rules.

The aim of this revised concept, which we have decided to call the "Aperam Fundamental Standard JUST CULTURE", is to provide a response to improve one of the biggest weaknesses revealed in the survey of our health and safety culture.

This new standard, based on an analysis of human factors, is a guideline to provide sites with a common definition, an understanding of human behaviour and a common methodology for the decision making process.

The application of the Just Culture Standard is intended to ensure a rapid and appropriate response to good/positive individual behaviour and, in return, to correct bad/negative individual behaviour, all in a fair and transparent manner.

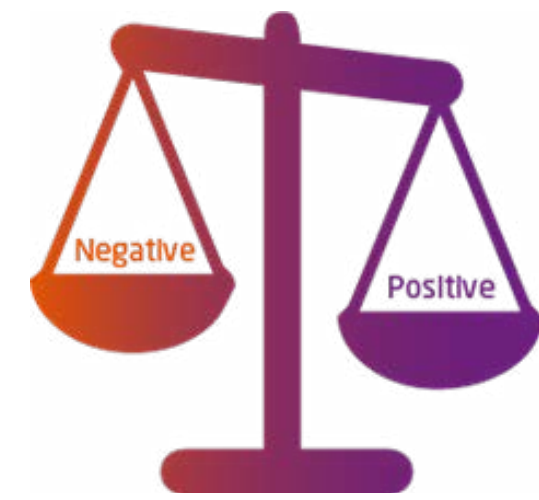
The aim is to value the positive more, to have a culture where the positive

consequences outnumber the negative.

The aim is to ensure that people are treated fairly, without blaming and punishing them hastily - but remaining strict and clear about unacceptable behaviour - by providing a consistent impartial and objective approach when analysing events.

For each event (accident with or without stoppage, first aid, incident, dangerous situation), for which it is clear that the behavioral component is predominant, we ask to carry out a more detailed analysis before taking any personal consequences!

We take care of a qualitative investigation including an analysis of the human failure that led to the accident. This to better understand what are the latent conditions, the weaknesses, in our organization.



The treatment of positive aspects should be given more weight than the treatment of negative aspects - at least 4 times more.

It is important to have a clear procedure for deciding how a breach of the rules should be dealt with depending on the type of behaviour: is it an error of action, an error of understanding or a deliberate violation, and if so for what reasons? The appropriate measures may then vary from coaching to discipline.

Treating people fairly, not rushing to blame and punish, and taking into account the actual circumstances in which staff find themselves, encourages them to be more open and proactive in reporting hazards.

Needed Action

The first step was the H&S cultural maturity evaluation and its analysis.

Then we looked how other companies treat the issue of human failure and

look for literature. We found the Model for a Just and Fair Culture from Patrick Hudson immediately appealing. The Just culture philosophy is already used in a considerable number of high reliability organisations such as the oil and gas industries, airlines and hospitals.

We defined our new standard in collaboration with the worker representatives. We called it the "Aperam Fundamental Standard JUST CULTURE"

We shared the principles with our Top Management and gave them a training on Human Behaviour. Then we gave training to the Site Managers.

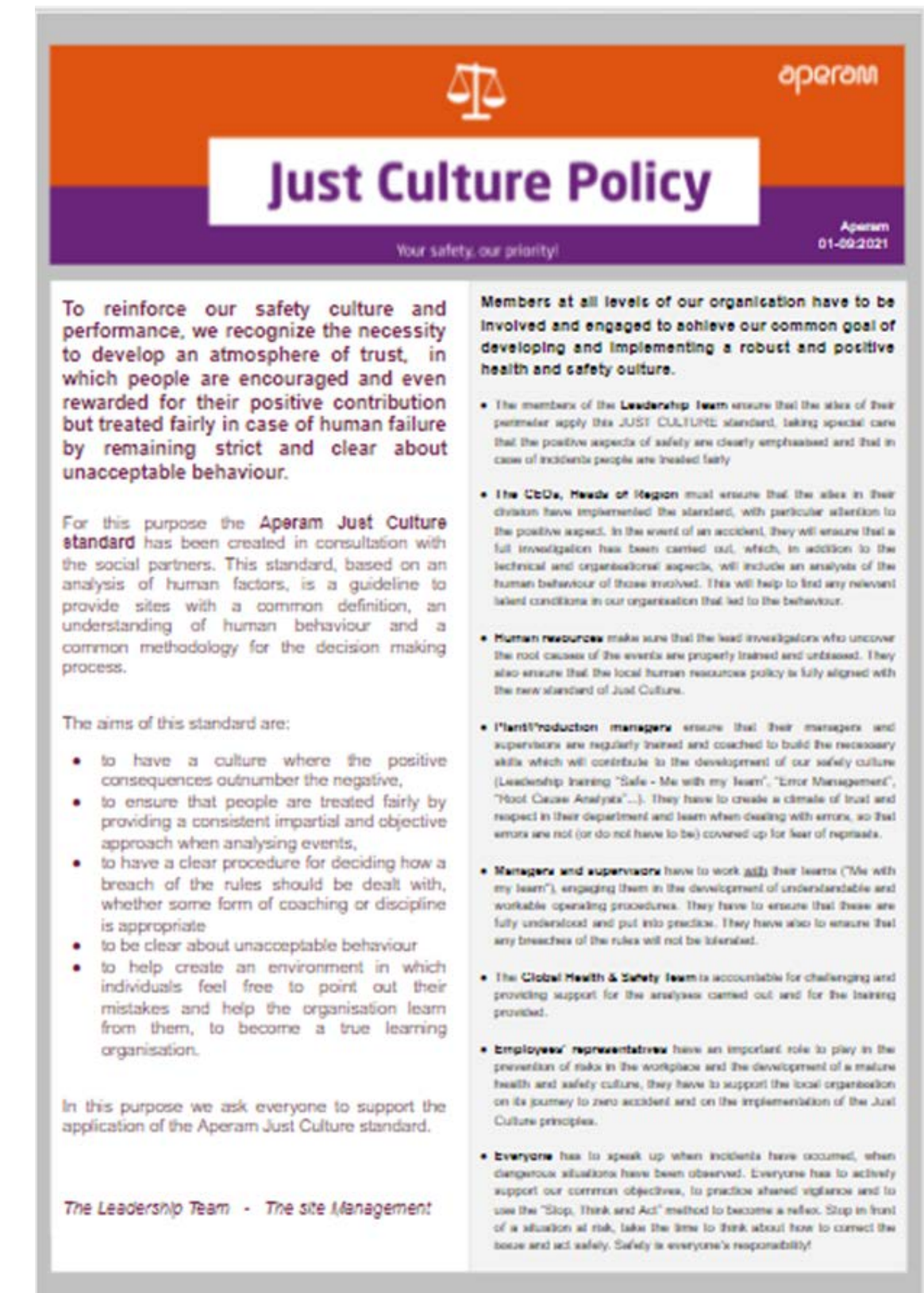
In parallel, training at various levels has been launched. The "Just Culture" philosophy and the understanding of human behavior are core parts of the "Safe - Me with my team" leadership training, given at all sites to operational managers and supervisors. This 20 hours training has been created for the specific needs of

Aperam and translated in 10 languages. It includes workshops and discussion. Today nearly 600 people took part to this training.

For the analysis of safety incidents, a new common Root Cause Analysis tool has been created, taking into account the human factor. This tool has been broadly shared in the Health and Safety network and training has been given. This tool has been developed in consultation with the corporate team of Environmental & Industrial Risk Management, to ensure compatibility with the needs arising from the analysis of such events too.

A part of that an E-Learning on Human behaviour and the main principles of our JUST CULTURE standard has been developed, as well as a complementary training on the practical application of the Root Cause Analysis principles and tool.

A 3 days training dedicated to blue collars has been created. At the moment the future moderators are trained.



What is Just Culture?

"A Just Culture is an atmosphere of trust in which people are encouraged (even rewarded) for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour."

Professor James Reason, 1997
Professor of Psychology, world-renowned researcher on human error

By implementing these principles we become a true **learning organisation**, knowing its risks better and implementing effective measures. This will greatly help us on our **journey to zero accidents**.

[Start](#)


Roles and responsibilities

Members at all levels of our organisation have to be involved and engaged to achieve our common goal of developing and implementing a **robust and positive health and safety culture**.



Find out **which roles are involved** in developing and implementing a positive health and safety culture.

1/6



Is this an example of Just Culture?

Yes
 No

When an accident occurs, the manager first determines what caused the incident rather than blaming the person who caused it.

The 6 different categories of positive behaviour

We can distinguish 6 different categories of positive behaviour, in line with **growing personal responsibility**.

Click on the + signs to discover more.

- Expected behaviour +
- Intervention +
- Creating a safer work environment +

Read more

The 4-Step approach of the concept

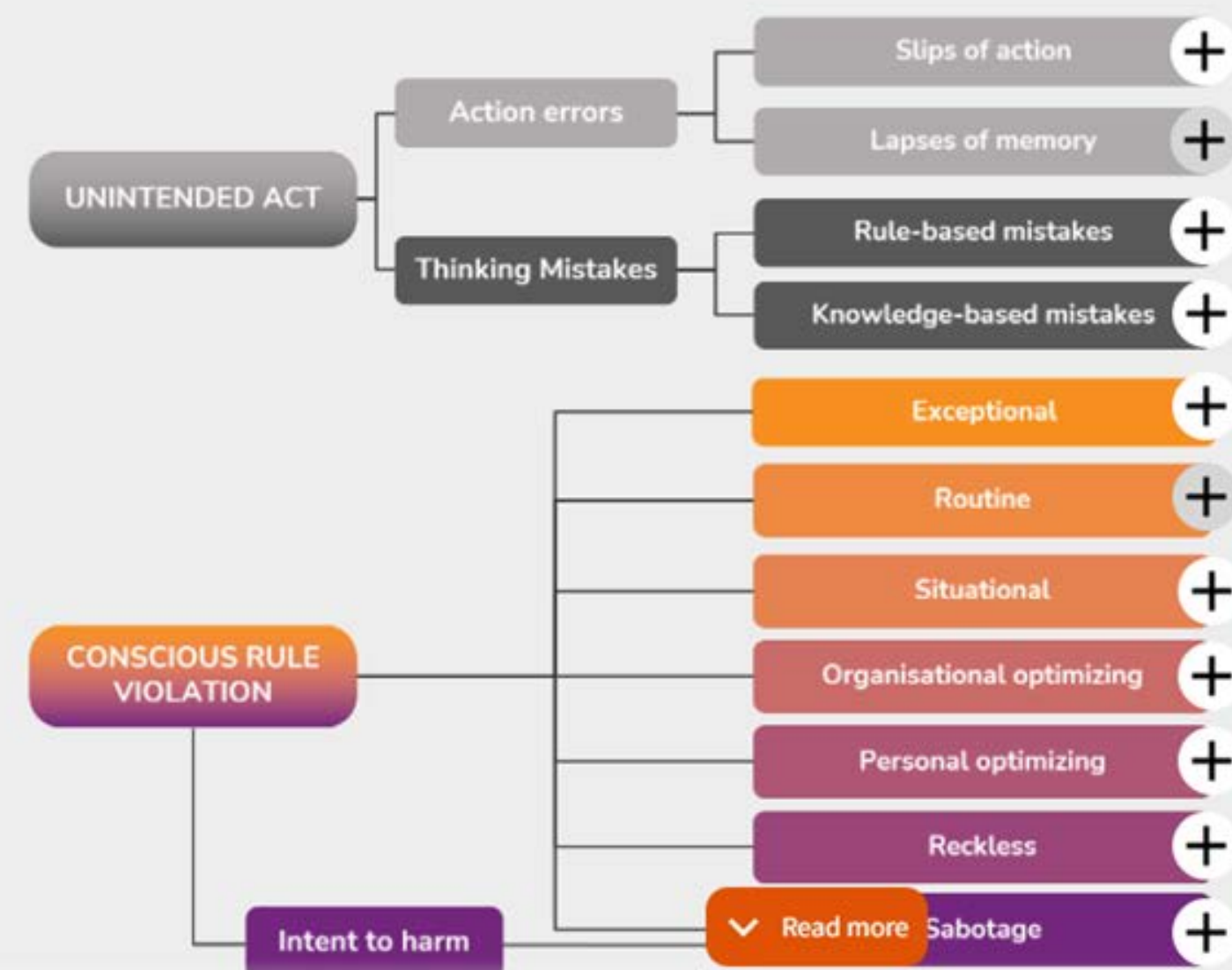
In our complex working world, quick decisions are inevitable. Errors are part of everyday work and can rarely be completely avoided. It is crucial to **deal with errors constructively**, which enables the entire organization to learn quickly. The focus is on **root cause analysis**: What exactly happened? What caused the error? How can it be **prevented** in the future?



Step 1 : Understanding human failure and behaviour classification

In the previous chapter, we have seen examples on how behaviour below expectation is classified. This graph summarizes the categories.

Click on the + signs to see what a person would typically be thinking once the error or mistake has taken place.



Action Review

Specific; standard and training specific to the needs of Aperam, defined after the cultural assessment.

Measurable; nearly 600 operational managers and supervisors have been already trained. About 400 persons will get the training until the end of the year.

Achievable; The new standard has been validated by the Top management and the Aperam’s European Health and Safety Commission*

(*a body in which workers’ and employers’ representatives are brought together to work on health and safety issues at European level).

Realistic; The Just Culture principles are in practice in other industries.

Time-bound; The implementation is immediate, the change of culture will take some time

Horizontal Expansion Capability

The principles of Just Culture can be expanded to all activities where you can have human failure (Quality, sales department, environment incidents, etc.)

Outcome

- Satisfaction of staff representatives with the system’s correctness in the face of human error
- Satisfaction of employees who no longer have to be afraid of making honest mistakes and who know clearly where the line is between a mistake and an intolerable violation.
- Satisfaction of the company which, through the right culture and the analysis of human behaviour, reveals the weaknesses of its system and can thus more easily put in place the appropriate measures to avoid a repetition of an incident.



Mechanical Safety Pin Enhancement

Member company

Bahru Stainless Sdn Bhd

Category

Workplace improvement

The Challenge

To overcome the issue of overlooking on the functionality of the mechanical safety pin during the LOTO process for safety improvement.

Why?

During the LOTO process, safety improvements on the issue of ease of overlooking on the need of plug in the mechanical safety pin to prevent the gravity force. This is found due to the common issue of applying identical colours on the entire machinery.

Needed Action

Implemented Red painting on the mechanical safety pins.

Correlated the mechanical safety pin and the machine parts to be correctly work for safety application.

Action Review

Specific; Mechanical Safety Pin overlook issue is specific address as the review of the LOTO process for safety improvement.

Measurable; The LOTO can be successfully completed without occasion of overlooking on the mechanical pin.

Achievable; The red painted mechanical safety pin and machine part was effectively used during visual checking in the LOTO process, reduce the possibilities of overlooking on the mechanical safety pin implementation.

Realistic; LOTO process effectiveness is



enhanced with the improvement of the mechanical safety pin. Implemented easily by identified the location of the mechanical safety pin.

Time-bound; Simple and easy approach to be completed within short time.

Horizontal Expansion Capability

Same approach can be applied in other machinery as the visual alertness enhancement to prevent overlooking on the safety features.

Outcome

Mechanical Safety Pin with red painting is an improvement to increase visual alertness to prevent the overlooking of necessary safety features available in the machines/process. The same approach can be applied to the others types of hazards identified with the approach of improving visual alertness. This directly improving the safety performance and reduce the incidents.



Mould telescopic removal

Member company

Columbus Stainless

Category

Workplace improvement

The Challenge

Mould telescopic removal is done manually and often results into a tedious job. Manual removal can take 4-8 hours and could also result in an injury to personnel working on the mould.

Why?

The current practice is time consuming and could result in unnecessary injuries.

Needed Action

The project aims to make mould telescopic easier and safer to remove by using a hydraulic pump. This will eliminate any



| Mould telescopic removal

manual action during mould telescopic removal.

Action Review

Specific; Specific attachment tools was manufactured in-house at minimal cost

Measurable; The time it took to manually remove the mould telescopic has been reduced



| Old practice

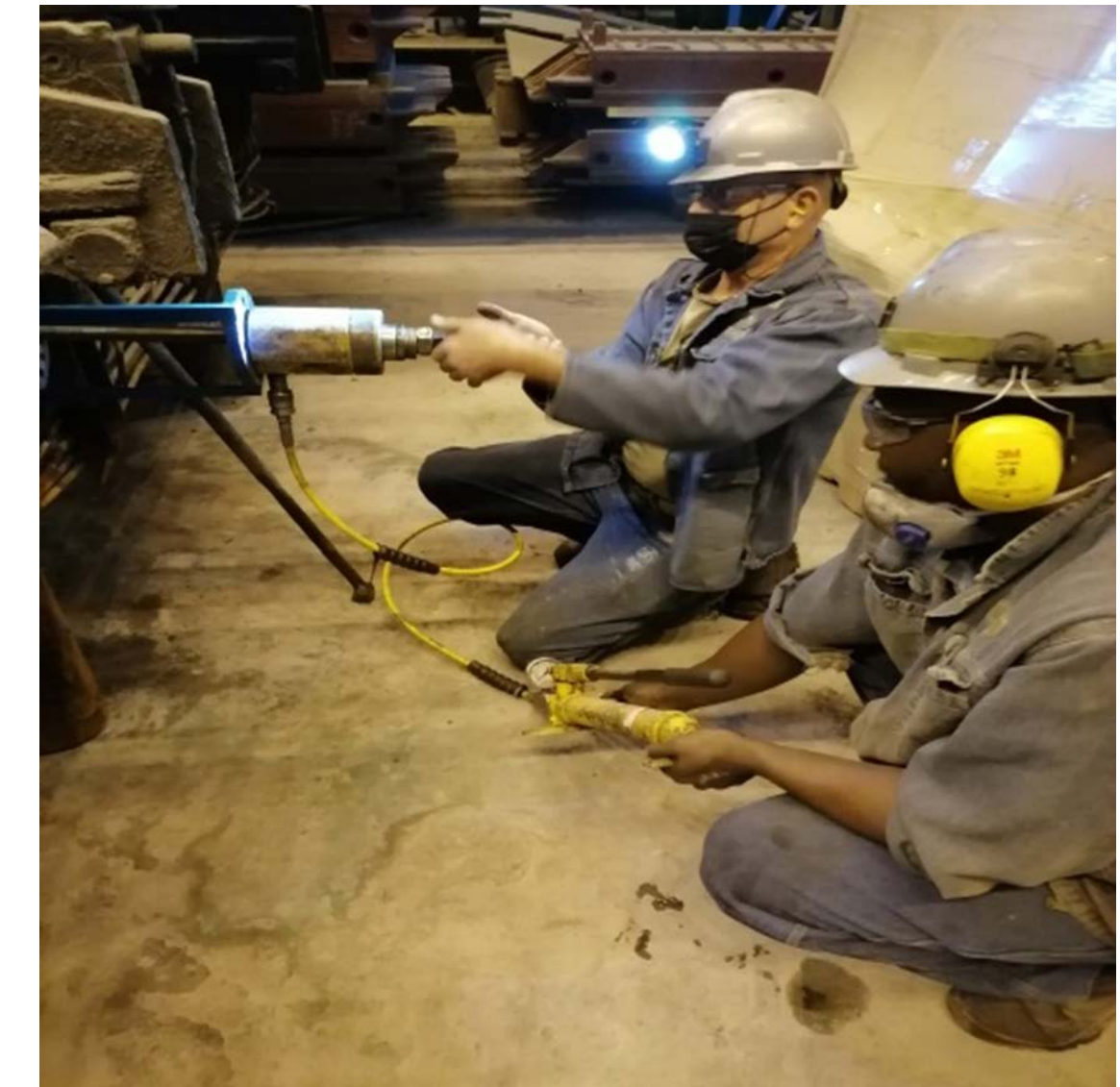
Achievable; Yes

Realistic; Yes. Practice in use

Time-bound; Completed

Horizontal Expansion Capability

It could if there are other companies using this process.



| New practice

Outcome;

Manual handling operations tend to result in injuries. By replacing the manual handling practice with hydraulic equipment, the process resulted in an improvement in time as well as safety of personnel.



Portable safety ladders for securing loads

Member company

Columbus Stainless

Category

Workplace improvement

The Challenge

There were currently no safe means for a warehouse operator or truck driver to safely climb on and off a truck while securing and tarping loads as well as no support to hold onto in the event of the person tripping on the trailer.

Why?

There was an incident whereby a truck driver accidentally fell off the trailer whilst securing a truck load. We wanted to ensure a safe environment without potential injury in future.

Needed Action

After the incident had occurred, preventative measures were explored. Some of the truck drivers are older and it would pose a challenge to get on and off the truck. Secondly, the deck space for a person to move safely on top of the trailer, whilst material was loaded, was evaluated.

Furthermore, the time it took to secure a load was investigated to ensure unnecessary truck standing times.

Action Review

Specific; Yes, this was actioned to a specific scope of work to ensure safety whilst securing stainless steel

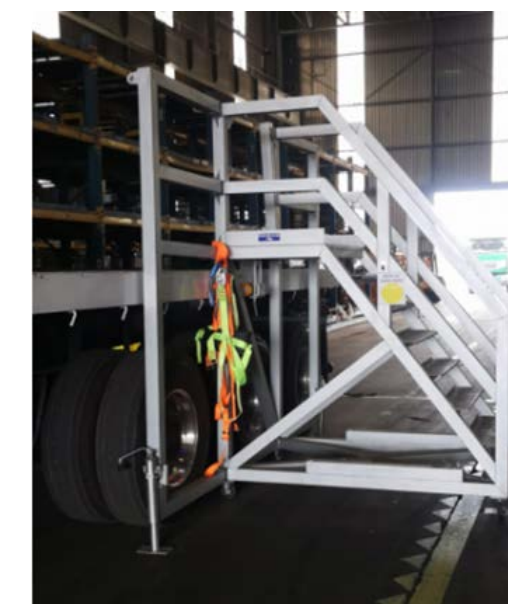
Measurable; Yes, number of incidents that occur

Achievable; Yes, practical solution

Realistic; Yes, implementation and solution fits the requirement



The ladder is stored in demarcated area when not in use. Brakes are engaged and the downriggers are retracted.



Examples of the ladder once attached to a trailer before the person can climb on, for stability.

Time-bound; Yes, the design and manufacturing were 2 months. Thereafter a risk assessment was done before

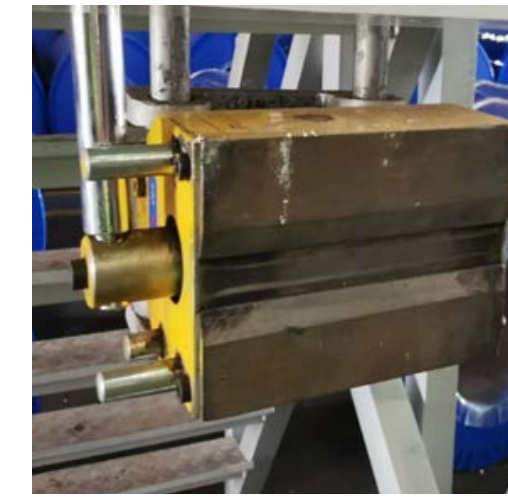
implementation.

Horizontal Expansion Capability

Yes, this can be implemented at all truck loading points in the company and concepts for safe truck loading share with other companies within the group.



Safety features include a braking system and textured steps, a securing point for safety harnesses and adjustable downriggers.



Other features include a strong magnet to secure the ladder to the side of the stationery truck.

Outcome

Incidents

Since the implementation of the safety ladder, there were no further incidents of warehouse operators or truck drivers

falling off a truck.

Well being

The warehouse operators and truck drivers have been given training on how to use the ladder. This contributes to them feeling safer when performing their task.



Key holder

Safe turning of segments at CCM

Member company

Columbus Stainless

Category

Workplace improvement

The Challenge

The turning of the segments is done by using an overhead crane and an attachment with a pivot point. Occasionally the attachment with the pivot point would hook onto the crane cables and gas pipes while lifting up the one end of the segment. During the turning process, the overhead crane and lifting tackle may be exposed to shock-loading due to the turning action when the weight and centre of gravity is displaced.

Why?

It was decided to move the pivot point on the attachment to a different location to steer clear from hooking the crane



| CCM Segment working area

cables or gas pipes which will prevent unnecessary damage to property and possible injuries to personnel as well as reduce/eliminate Lifting Equipment Shock-loading.

Needed Action

A new pivot point was installed on the attachment.

Action Review

Specific; The pivot point has been moved

Measurable; Observations confirmed a smooth turn-over with no events of Damage to property or shock-loading of lifting equipment

Achievable; Completed

Realistic; Practice in use

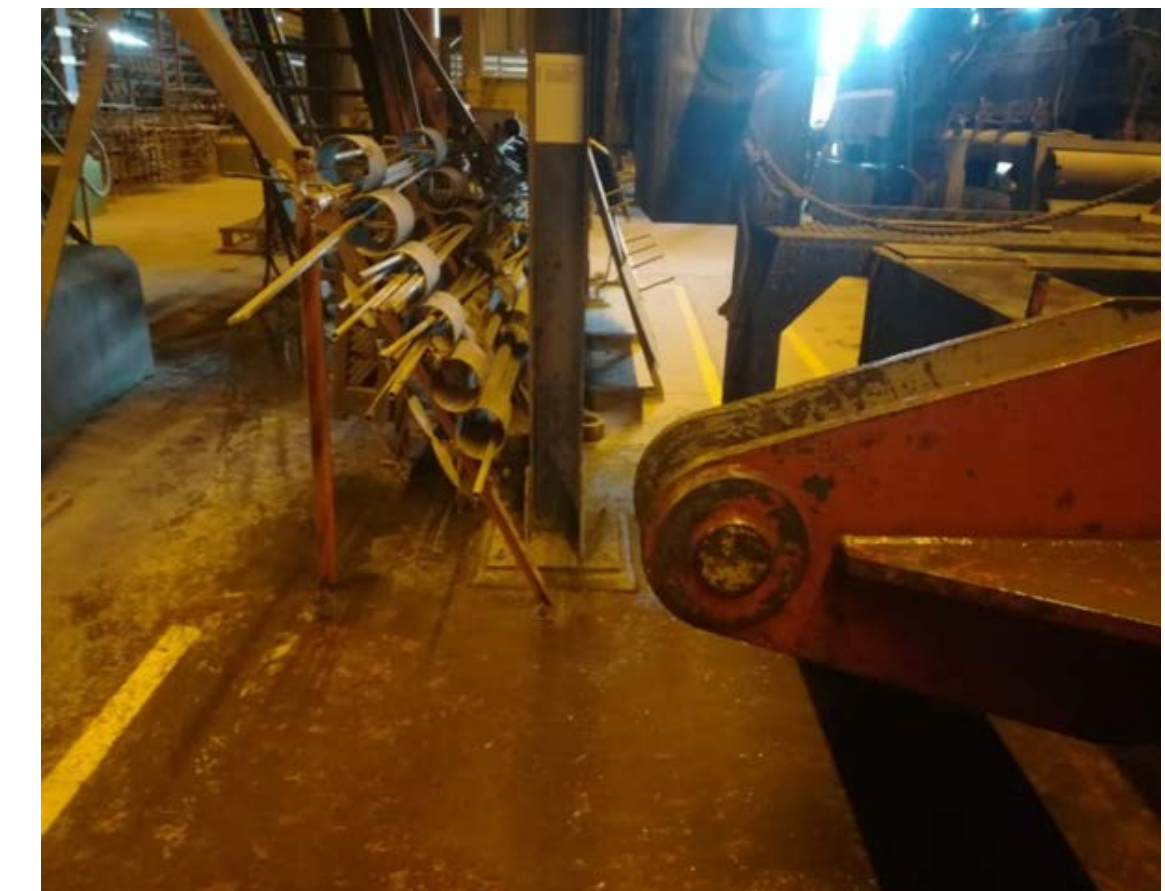
Time-bound; Completed

Horizontal Expansion Capability

Not applicable to anywhere else in the company as it is only the CCM that has the segments that need to be turned.

Outcome

Damage to property and the possibility of an injury has been minimised.



| Old pivot point



| New pivot point

6S Implementation

Member company

North American Stainless

Category

Workplace improvement

The Challenge

Safety audits were identifying more housekeeping issues rather than safety compliance issues. We needed to change the culture of our workforce. 6S is a Sustainable system that has changed the way we view not only housekeeping but the way we address hazards as well.

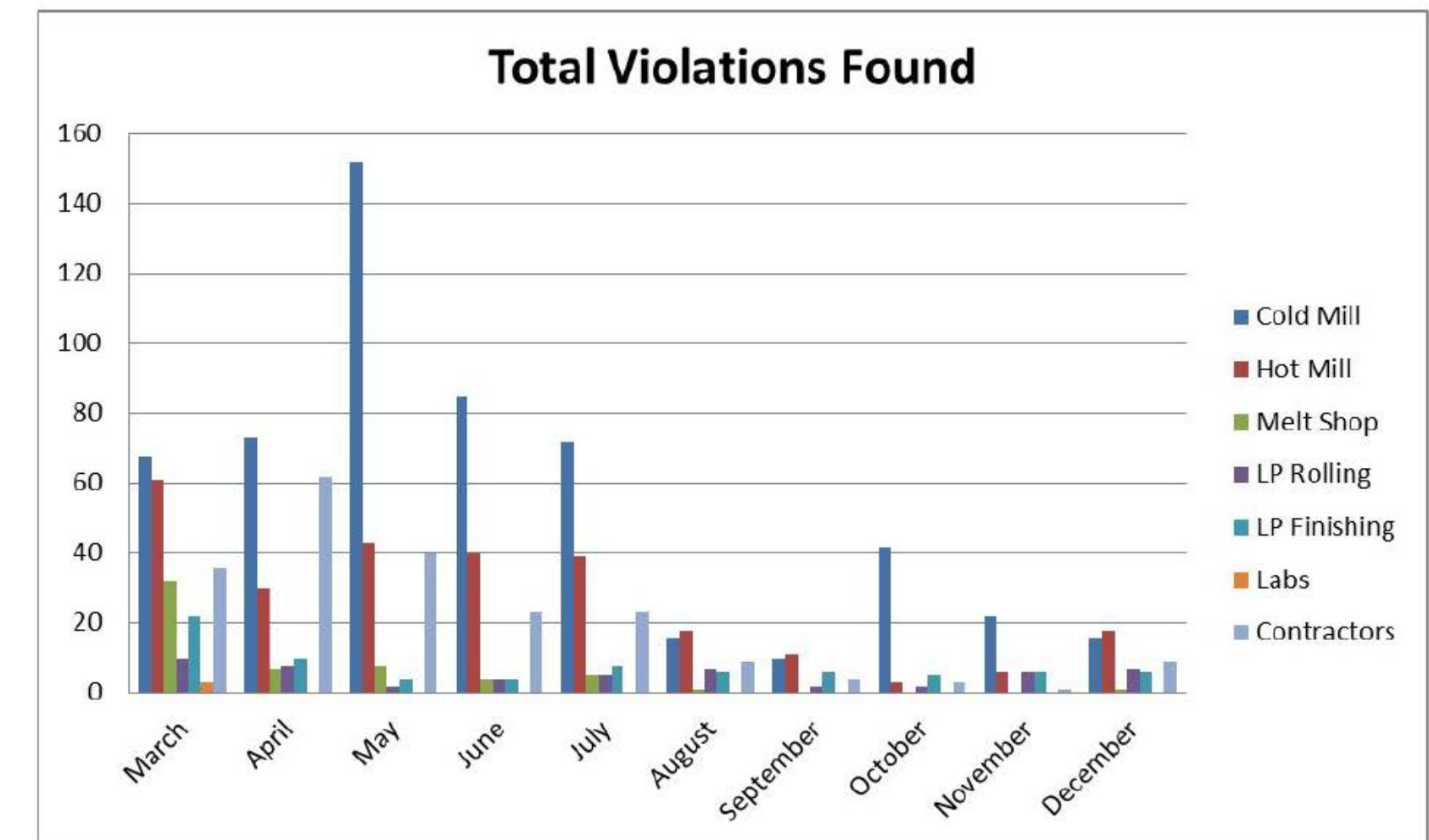
Why?

We wanted a system that could not only improve housekeeping, but would complement the improvements we have made to safety overall.



Improvement from March to December:

- CM - 76%
- HM - 70%
- MS - 97%
- LP Rolling - 30%
- LP Finishing - 73%
- Labs - 100%
- Contractors - 75%



Safety audit findings 2021

implement 6S. These plans were reviewed by top management and progress was tracked throughout the facilities. We also established a 6S Coordinator position dedicated to the facilitation of 6S employee-led initiatives. By educating our employees and engaging their enthusiasm, we were able to achieve unprecedented results in our industry. One of the most effective tools we used was the creation

of shadow boards to keep inventory of items and materials necessary for safe operations (please see pictures). We also used a color-coded walkway system to guide pedestrians safely through all work areas.

Needed Action

Key employees were chosen to complete 6S projects in each mill and warehouse. These areas served as the example for other employees to see, understand, and buy into 6S. Once these areas completed their projects, others were introduced to the system. Eventually every area was asked to formulate a plan to





| 6S Data

Action Review

Specific; Implement 6S in all work areas to improve housekeeping and reduce injuries associated with bad housekeeping.

Measurable; 6S compliance is tracked weekly. Safety audit scores have improved as well.

Achievable; All employees participate in

6S activities, whether it is ensuring that the items they use are put back into the proper place, that their walking/working areas are free from slip/trip/fall hazards to group leaders, supervisors, managers, VP and CEO all completing 6S audits.

Realistic; Overall scores and completion goals are set for each area and group. The goals that have been set are realistic and

achievable.

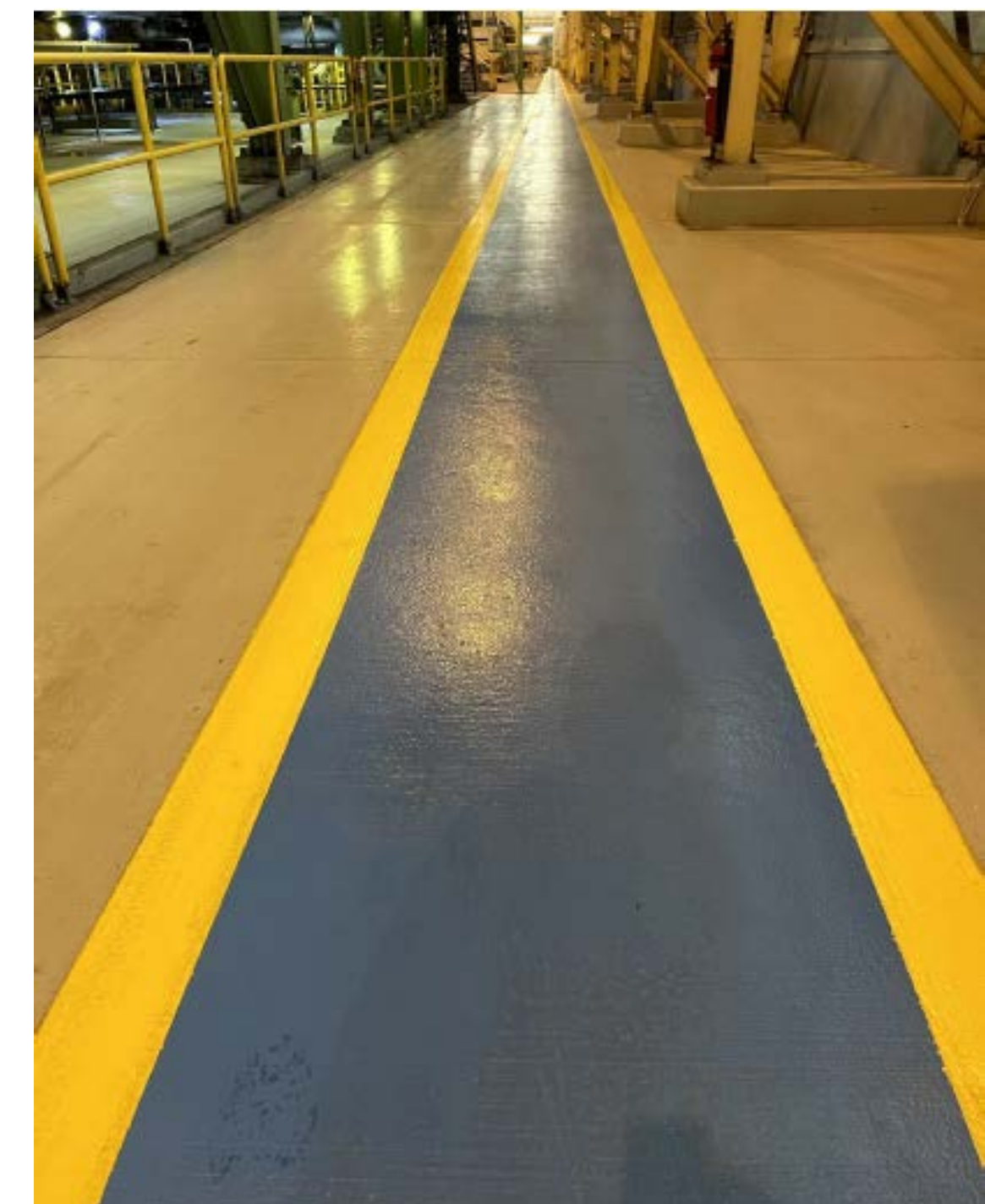
Time-bound; Each area is to be audited bi-weekly. These audits are tracked and scored bi-weekly. 6S completion is a leading indicator for NAS and the progress is evaluated every Monday during the operations meeting. Overall monthly numbers for each mill is discussed in the monthly mill safety meeting.

Horizontal Expansion Capability

Yes. 6S can be expanded elsewhere within both our company and other member companies. It is a process that can seem daunting and unachievable in a steel mill, but once implemented can bring about a change not only to safety, but can improve processes, productivity and effectiveness.

Outcome

Housekeeping has improved in all of our areas where it has been implemented. During our most recent Health and Safety



compliance audit, the significant change was observed and remarked upon by the auditors who both agreed that the overall cleanliness and orderliness has greatly improved within the last year due to the implementation of 6S.





| Before



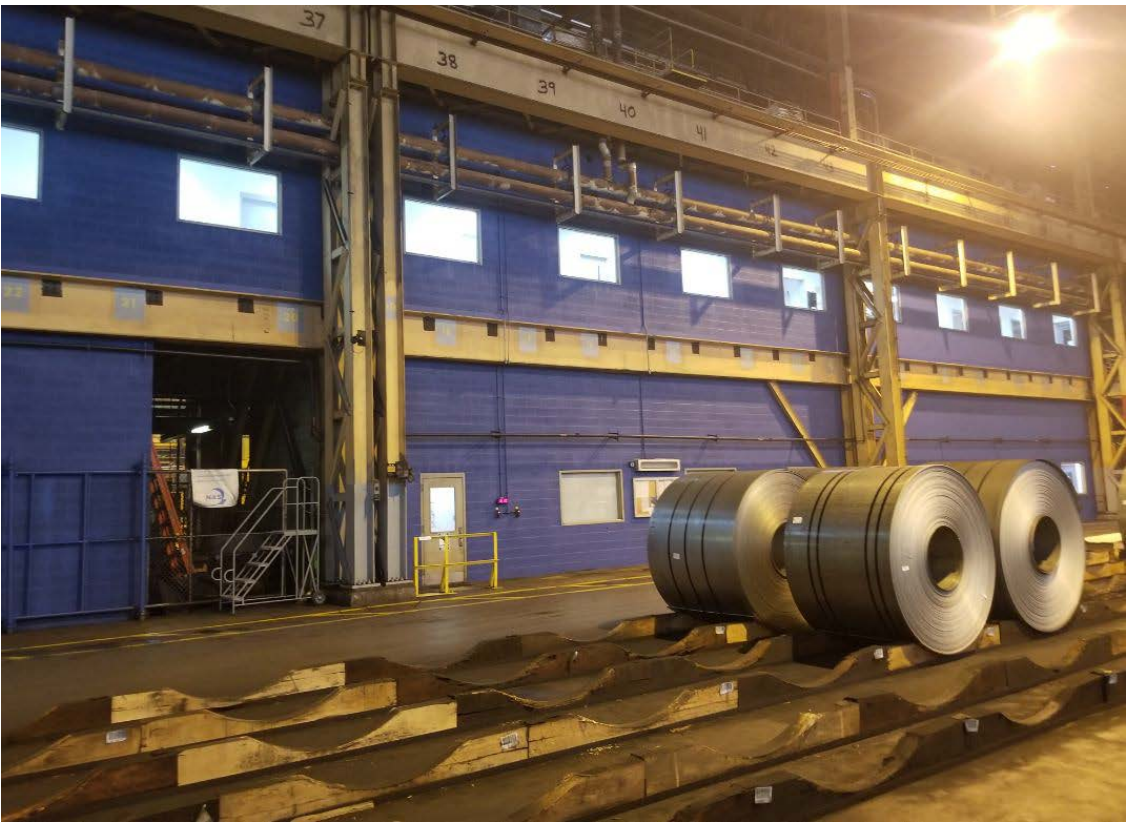
| Before



| Before



| Before



| After



| After



| After



| After



Coil Car Pit Guarding at ZMills

Member company

North American Stainless

Category

Workplace improvement

The Challenge

Employees working in our Z-Mill areas work in close proximity to three coil car pits. These pits are approximately 2 feet deep in certain areas. If someone was not watching where they were walking and walked into the pit or slipped off the edge, than they could sustain a serious injury.

Why?

This is a walking/working surface issue and we needed to identify a way to prevent employees from inadvertently walking or stepping into them when they were in the area.

Needed Action

An assessment was completed for Z-Mill 2 – 5 to identify the hazard and present options for guarding the pits at each one. We had guarding in place at Z-Mill 2, but it needed some improvement. We presented upper management with three options: Railings with gates (no interlocks), Railings with interlocked gates or pit covers.

Action Review

Specific: Identify the need for guarding around coil car pits at Z-Mills.

Measurable; Progression on installation can be tracked.

Achievable; While some Z-Mills have less room to install railings, there are other options available to be able to achieve the same results as railings.

Realistic: It is realistic and achievable.

Time-bound; A schedule has been

identified to complete the installation. Installation is to be completed by third quarter of this year.

Horizontal Expansion Capability

Yes. Guarding of open pits can be expanded on at our facility and other member companies if the hazard is identified.

Outcome

Increased hazard awareness and proactive hazard reduction to prevent a serious injury. While we have not had any serious injuries from employees inadvertently walking into the coil car pits, the addition of these guards have helped to reduce the potential for it to happen, therefore improving employee's health and wellbeing.



Improvement of intrinsic safety level and management standard in coal gas area

Member company

TAIYUAN IRON & STEEL (GROUP) CO., LTD.

Category

Workplace improvement

The Challenge

The problem we are trying to solve:

There are many assembly occupancies at the production site, so there is a safety risk of injuries and death caused by the gas leakage in the gas hazardous areas (Areas prone to gas leakage, e.g. blast furnace tuyere and above platform, converter mouth and above platform, the basement of coking furnace, the areas surrounding hot blast stove, heating furnace, tube furnace and gas boiler, Areas where there may be a large amount of gas leakage, e.g. gravity dust collector, dry dust collector, converter dust electrostatic collector, residual pressure TRT generator Unit,

electric tar precipitator, desulfurization tower, gas cabinet area, gas pressurization station, fan room, gas storage or buffer tank, gas drainer without leak proof device, gas glasses valve).

The feature we are trying to develop:

To reduce safety risk by realizing unmanned or less populated operation in the gas hazardous area, and managing this area in a closed manner.

Why?

1. In recent years, the major accidents of personnel gas poisoning in the industry are mostly in the gas hazardous area, there are more risks in this area;
2. After joining China Baowu, TISCO is carrying out the transformation of "Four-must" (i.e. In the manufacturing process, the operation rooms must be centralized, the operation must be done by the robots, the operation and

maintenance must be remote, and the service links must be online), so it is possible to realize the transformation of on-site intrinsic safety.

Needed Action

1. In 2021, TISCO carried out special rectification and comprehensively investigated the assembly occupancies in the gas hazardous areas, and combined with the centralized production control in accordance with the requirements of "Four must" (i.e. In the manufacturing links, the operation rooms must be centralized, the operation must be done by the robots, the operation and maintenance must be remote, and the service links must be online). The relocation plan of crowded places in gas hazardous areas has been determined through overall research. 100 % of the assembly occupancies in gas hazardous areas will be demolished or the personnel in the

area will be relocated to safe areas, and the gas hazardous area is unmanned and less populated on December 30, 2021.

2. Protective nets, protective railings and other isolation and sealing measures were taken in gas hazardous areas, safety warning signs were improved, infrared detectors and voice audible and visual alarms were set at the entrance of personnel, so as to remind workers to strictly follow the gas safety management regulations and do a good job of safety self-protection.
3. Intrinsic safety transformation of gas equipment and facilities. Improve the intrinsic safety level of gas drainer, and replace the ordinary water sealed gas drainer with leak proof gas drainer; Improve the intrinsic safety level of U-shaped water seal as gas pipeline cut-off device, replace the U-shaped water seal with blind valve or add blind



plates before and after the U-shaped water seal.

4. Implement classified management of the gas area. Divide the gas area into primary gas area and secondary gas area, formulate detailed classification standards and management standards for two types of areas, and implement classified and strict management.
5. Implement classified management of gas operation. Gas operations were managed according to the first, second and third levels, and detailed classification standards and management standards were formulated for different operation levels.

Action Review

Specific; There is no mandatory requirements in relevant Chinese national codes and standards that the assembly occupancies cannot be set up in the gas hazardous areas, there is no mandatory

requirement for the installation and use of leak proof gas drainage devices, and there is no provision for the setting of infrared detectors and voice audible and visual alarms in gas risk areas, so the implementation of the intrinsic safety transformation is specific from TISCO.

Measurable; It defines the scope of gas hazardous areas, the concept of assembly occupancies, the work objectives, the classification standards of gas areas and the classification standards of gas operation: 100% of the assembly occupancies in gas risk areas are demolished or the personnel in the area are relocated to safe areas, which can be measured.

Achievable; Leaders at all levels of TISCO attach great importance to safety work and are carrying out the transformation of "Four-must" (i.e. In the manufacturing links, the operation rooms must be centralized, the operation must be done by the robots, the operation and maintenance must be remote, and the service links must be

online). The measures can be achievable.

Realistic; The equipment and facilities in the gas risk area of each unit of TISCO have the conditions for transformation, the anti-leakage gas drainage technology is reliable, the gas hazardous area has isolation and sealing, and the gas area classification and gas operation classification are consistent with the actual work, so it is realistic.

Time-bound; On December 30, 2021, The gas risk area is unmanned and less populated, the replacement of leakage proof gas drainage device and the isolation and sealing measures were finished.

On November 10, 2021, the gas area classification and gas operation classification was finished.

Horizontal Expansion Capability

The improvement of the intrinsic safety level of equipment and facilities in the gas area, and the management of the unmanned and less populated in gas

hazardous area can be used in all units involving gas in other enterprises.

Outcome

The transformation of unmanned and less populated in gas risk areas and the application of leak proof gas drainer have improved the intelligent and essential safety of gas equipment and facilities, strengthened the hierarchical management of gas area and gas operation, reduced the number of workers in gas hazardous areas and improved the management and control level of gas safety; Protective nets and railings are set in the gas risk area for isolation and sealing. After infrared detectors and voice audible and visual alarms are set at the entrance, irrelevant workers are effectively prevented from the dangerous area. At the same time, the workers entering the gas risk area are reminded to take effective safety protection and improve the level of gas safety control. It has protected the life and health of the staff.



Improvement of personnel behaviour standardization by quaternity

Member company

TAIYUAN IRON & STEEL (GROUP) CO., LTD.

Category

Introduction or enhancement of behavioural safety approaches

The Challenge

The problem we are trying to solve:

To educate and guide on-site operators to operate in accordance with safety regulations and operation standards to reduce the risk of personal injury.

The feature we are trying to develop:

By carrying out the operation standard narration, personnel behaviour safety tracking, supervision and inspection, setting up video monitoring and playback on site, and implementing scoring management for personnel who violate

rules and regulations and operation standard, the workers can be promoted to operate according to standards, so as to protect the safety of workers' lives and property.

Why?

According to statistics, 90 % of production accidents are caused by unsafe behaviours of personnel. From the daily safety inspection of TISCO, there are also unsafe behaviours of personnel during operation. In order to improve the awareness and skills of operators to operate according to standards and avoid personal injury accidents, TISCO has conducted a comprehensive and in-depth analysis on the causes of personnel unsafe behaviour, and decided to take comprehensive measures from the aspects of narration of operation standards, tracking, supervision and inspection of personnel behaviour's safety, so as to standardize personnel operation behaviour.

Needed Action

1. Implementation of operation standard narration: (1) the narration modes of "full participation and everyone narration" and "individual narration + team member discussion + management personnel comments" have been determined; (2) all units have been organized to formulate operation standard narration plans; (3) Take the graphic representation of equipment and facilities or operation activities on the operation site and the video recorded during the operation process as the carrier, and describe it by method of "pointing and narrating"; (4) Organize the revision and improvement of the imperfect operation standards found in the process of narration and discussion.
2. Personnel behaviour safety tracking, supervision and inspection: (1) Clarify that the personnel behaviour

tracking is carried out by "five types of personnel" including the supervisor, deputy supervisor, relevant management personnel, chief operator and team leader of the operation area; (2) Clarify that the personnel behaviour tracking focuses on 8 aspects, i.e. personnel qualification, protective articles, personnel location, equipment and facilities, tools and instruments, personnel response, standard implementation and working environment, and 44 common problems in the process of tracking, supervision and inspection; (3) Carry out follow-up inspection according to the frequency of tracking, supervising and inspecting high-risk operation activities every quarter, medium risk operation activities every half a year and low-risk operation activities at least once a year; (4) Carry out follow-up supervision and inspection in accordance with the principles



of annual planning, weekly tracking and monthly summary; (5) The tracking results shall be applied to the modification of operation standards, the correction of unsafe behaviours of personnel, the rectification of on-site hidden dangers, etc.

3. Setting up video monitoring and playback on site: (1) Clarify the video setting principle of "full coverage, no blind area, no blind corner and applicability"; Video monitoring requirements must be set for all fixed operation posts, construction sites of maintenance and construction technical transformation projects, high-risk production areas and places, and operation places of high-risk equipment and facilities. At present, video monitoring has achieved full coverage; (2) According to the safety risk level of personnel behaviour safety video monitoring object, the playback cycle of weekly, ten day,

monthly, quarterly and half a year is determined, and the playback plan is formulated and strictly implemented; (3) The key points of 7 types of video playback are defined, such as high-risk areas, densely populated workplaces, high-risk equipment and facilities, high-risk posts, posts with frequent human-computer contact and single person operation posts; (4) According to the principle of "graded playback, classified playback and key playback", the playback requirements of five categories of personnel such as red line violators and serious violators under special circumstances are clarified; (5) For typical problems found in video playback by various personnel at all levels, at least one illegal video album shall be produced every month to carry out case warning education. (6) Through video playback, the safety control and warning function of the whole process can be achieved,

promote the standardized operation of post operators, abide by regulations and disciplines, and the management personnel earnestly perform their responsibilities.

4. Implement scoring management for personnel who violate rules and regulations and operation standards: (1) according to the risk and severity of consequences of operators' violations, violations are divided into three categories: red line, serious and general, with violation deduction of 6 score, 3 score and 1 score respectively; (2) TISCO and all its units have established examples of violations to judge violations; (3) Take the year as the cycle, $1 \leq$ violation deduction < 4 score, the direct superior of the violator shall give warning education to the violator, and the violator shall make a written commitment to comply with regulations and disciplines; The personnel with score deduction

≥ 4 will be waiting for post in the operation area for at least 2 weeks. The personnel with score deduction ≥ 8 will leave the post and wait for post in the factory for at least 1 month. The personnel with score deduction ≥ 12 will be retained for observation and adjusted to the labour market; Those who cooperate with the supplier's personnel in violation of the red line twice a year, serious violations of the system for three times, or with a score of 12 deducted, shall be included in the "blacklist" management, and will be strictly prohibited to enter the mill for operation; (4) A personnel violation scoring management system is established, and all personnel's violation behaviours and violation score are uploaded to the violation scoring management system; (5) The violators need to pass the "five parts" education of "team training and education, self-reflection and commitment, plant level



safety training, family supervisor heart to heart talk, and pass the examination and verification in the plant”; (6) During the period when the violators leave the post to be on duty, they shall accept the learning of post violation examples and post operation standards (team level), the learning of post dangerous and harmful factors, production process and equipment performance and post related accident cases (operation area level), watch animation of typical accident cases and video clips of typical accidents; accept the training and education of “five learning, two watching and two talking” to talk about the danger of violation behaviour and the severity of violation consequences, and the purpose and significance of violation scoring management with the family of violators.

Action Review

Specific; The implementation of operation standard narration, personnel behaviour safety tracking, supervision and inspection, setting up video monitoring and playback on site, and scoring management for personnel who violate rules and regulations and operation standard, all the parts are in combination with the actual safety management of TISCO, which is a specific and effective method of TISCO in strengthening personnel behaviour safety management.

Measurable; For each work, the responsible person, time requirements and work standards are defined, and the completion can be measured and measured through the information system or duty performance list.

Achievable; Each work is included in the annual safety work plan of TISCO and all units and the safety performance list of

management personnel, and all work is transformed and refined into inspection and evaluation standards. All work is urged to be implemented in place through daily safety inspection, quarterly safety management evaluation, evaluation and acceptance of safety production standardization operation area, etc. All work is achievable.

Realistic; Each work comprehensively considers multiple factors such as on-site equipment and facilities and working environment, the completion time of the person in charge of the work, the problems to be solved and the results achieved. After the operation of TISCO with all units and communication with the person in charge of each work, all work is realistic.

Time-bound; The implementation of operation standard narration requires to complete all operation standards within one year; Personnel behaviour safety tracking, supervision and inspection

stipulates that the operation area shall be done once a year, covering all operators and different operation periods; Setting up video monitoring and playback on site clarifies the requirements that video monitoring of behaviour safety of all personnel shall be played back at least once every half a year, and the operation behaviour of employees at all posts shall be played back at least once every half a year; The scoring management is implemented for those who violate the rules and regulations and operation standards, and the scoring value and corresponding punishment are effective within one year. Each work has a time requirement to ensure that it is implemented in place.

Horizontal Expansion Capability

The above work has formulated “The Operation Standard Narration Plan”, “Personnel Behaviour Safety Tracking”, “Supervision and Inspection Management



Measures”, “Personnel Behaviour Safety Video Monitoring Management Standards” and “Violation Scoring Management Measures” respectively, forming a relatively perfect management system. All work can be applied to the newly established units of TISCO or other companies.

Outcome

Since TISCO took the above measures, the employees’ awareness of abiding by rules and regulations and operating according to standards has been continuously improved, and the non-standard and unsafe behaviours in the operation process have been continuously reduced, which has protected the safety of employees’ lives and property and improved their sense of happiness and security.



■ Acerinox Europa Sustainable Circular Activity

Member company

ACERINOX EUROPA S.A.U.

Category

Emissions reduction; Investment in new processes and products in order to deliver a defined sustainability benefit: Environmental and Social benefits

The Challenge

Acerinox Europa is fully aware of the need to fight against climate change and to involve society in it. For this reason, the Sustainability Section from Acerinox Europa planned a sustainable circular activity based in a classic reforestation but including not only environmental benefits (CO₂ emissions reduction), also a strong social awareness and consciousness.

Why?

Acerinox Europa, in its commitment to Sustainability, is totally convinced that the implementation of sustainable measures such as the mentioned circular activity is the best way to show a real concern and the actions taken. This activity of mitigation was completed by society. It was a great opportunity for the new generations (primary school students) which learnt the importance of caring and respecting nature and the need of improving the environment that surrounds us. Besides, it requested the involvement of Acerinox Europa volunteers and the participation of associations characterized by working for the same targets.

Needed Action

Acerinox Europa decided to opt for a reforestation activity with a high social implication in order to deal with the significant problem of climate change.

It was considered a 100 % sustainable measure, since in addition to the plenty of environmental benefits associated to reforestation campaigns, also social improvements will be achieved. In this way, Acerinox Europa will have the collaboration of several non-profit associations, a group of volunteers from the company and the participation of students from a local school.

Action Review

Specific; Acerinox Europa decided to launch this activity with environmental and social benefits.

Measurable;

1. Tonnes CO₂ emissions mitigated. The more planted trees, the more CO₂ emissions compensations.
2. Student participation.
3. Hours of volunteering.

4. Participation of associations.

Achievable;

Acerinox Europa (specifically Sustainable Section and Human Resources Section) considered it totally viable to make this proposal. The activity was planned and carried out in a period of 3 months.

On the one hand, Acerinox Europa had a suitable private land for planting.

On the other hand, Acerinox Europa received confirmation from some associations involved in the project:

- “Misión Ardilla”: non-profit association with great experience in educational projects of reforestation. Its target is involving children in caring and respecting nature. Acerinox Europa joins this association fully aware of achieving a better future.
- “APADIS” (Association of parents of



people with intellectual disabilities): this association offers quality jobs to people with disabilities, ensuring their labour insertion. For this reason, Acerinox Europa decided to hire their gardening services and to purchase the species of trees needed in the reforestation campaign.

Acerinox Europa also confirmed the participation of:

- “Nuestra Señora de Guadalupe” School (Palmones): “Misión Ardilla” Association and Acerinox Europa informed about this project to the school and it was considered as a great teaching for their students.
- Acerinox Europa Volunteers: Acerinox Europa has a great group of employees who participates in the sustainable activities that the company proposes. In this case, this group helped in land adaptation and in the trees plantation with students.

Realistic; Acerinox Europa considered both, the targets of the project and their implementation; realistic measures with which achieve sustainable benefits.

Even, once started, the social commitment continues. The stakeholders visit the land and follow the development of the project.

Time-bound; Acerinox Europa decided to start this circular project with a first phase of reforestation in December 2021. Our purpose is continuing with more reforestation activities trying to be as much sustainable as possible, in this case, including social benefits to environmental ones.

Horizontal Expansion Capability;

Acerinox Europa strongly believes that this project could be applied in member companies in order to reduce CO₂ emissions and to increase social implication with sustainable activities.

Outcome

Acerinox Europa achieved 50 new trees plantation (one tree per student) thanks to the great collaboration of the different parts involved in this project (“Misión Ardilla” Association, “APADIS” Association, “Nuestra Señora de Guadalupe” School, Acerinox Europa volunteers [aprox. 6 hours of volunteering per volunteer]) and the good teamwork between the Human Resources Section and the Sustainability Section (Acerinox Europa).

Acerinox Europa estimates that this circular and sustainable activity could be associated with a total reduction of CO₂ emissions up to 8000 kg per year.

Besides, this activity also provides health benefits to the society, the social development though the community awareness about the importance of fight against climate change and the involvement of the workers in the search

of a sustainable environment.

Nowadays, Acerinox Europa has a great land with 50 new trees growing in order to guarantee a better environment to the surrounded society in Palmones. But this first phase does not finish with the plantation. The group of volunteers from Acerinox Europa and the students from “Nuestra Señora de Guadalupe” School compromised to taking care of them to ensure their correct evolution. In the following pictures, this circular and sustainable project is shown:



Finally, Acerinox Europa would like to highlight that in 2022 Spring, a second reforestation phase is planned. In this way, other students could have the opportunity to learn with this sustainable activity, becoming aware of the importance of fight against climate change and how is possible to take care of nature. In this way, Acerinox Europa will have reached CO₂ emissions

reductions of more than one and half tons per year.

Acerinox Europa proposes to continue carrying out “circular” reforestation activities to demonstrate that each individual action adds to the reduction of the impact on the environment and to the development of society.



Global strategy of the Campo de Gibraltar factory to reduce energy consumption

Member company

ACERINOX EUROPA S.A.U.

Category

Emissions reduction; Environmental management system (EMS) development / enhancement; Energy intensity reduction

The Challenge

Reduction of energy used in non-productive periods.

Why?

It is a direct waste that causes:

- Thermal and atmospheric (scope 2) pollution.
- Economic losses.
- Unnecessarily increase the price of the product.

Needed Action

A global strategy has been established in the plant based on shutdown protocols. Now, during nonproductive periods, just enough energy is consumed.

21 procedures have been approved in the organisation's management system. They are audited annually in the context of ISO 50001.

Action Review

Specific; A global strategy has been established in the plant based on shutdown protocols. But each production line has its own instructions. Now, during non-productive periods, just enough energy is consumed.

Measurable; Each production line has its own energy indicator. All stops are verified.

Achievable; All the protocols have required a consensus between the production and maintenance departments. An

important premise is that the equipment is not damaged due to stops. It has been achieved in 100 % of the cases.

Realistic; At the same time that savings are achieved, an important work of awareness is carried out. This makes the work very relevant.

Time-bound; All protocols have had their phases of study, testing and implementation. Today they are all active and in the process of continuous improvement.

Horizontal Expansion Capability

The work done can be reproduced anywhere. Collaboration between three staff people is needed:

1. A coordinator related to energy efficiency. It will be the one who collects, analyzes and communicates data and results.
2. A coordinator of the production field

who must know the process perfectly. It will be the one who gives the final authorization before the approval in the management system.

3. A coordinator of the maintenance area who knows the equipment that can be stopped and its possible damage.

A certain electrical infrastructure (monitoring of meters) and information technology (database, spreadsheet, email) will also be necessary.

Outcome

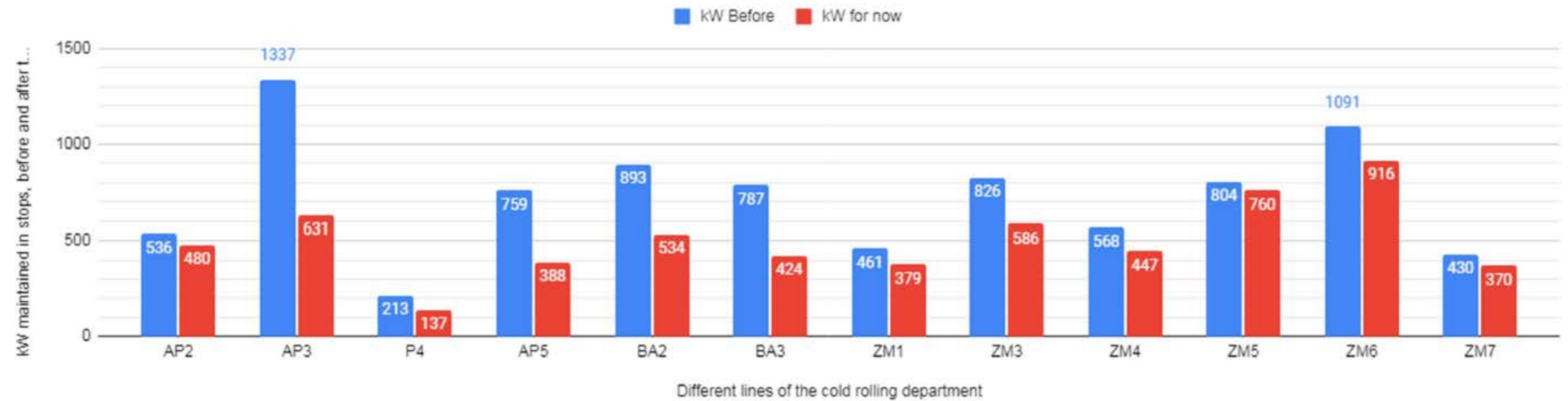
1. A new field has been opened for awareness and continuous improvement:
 - Workers are now more aware of what energy means. Now it is less abstract.
 - Looking for savings, we have detected the production lines with the highest energy loss (see item 5).



- A great field for continuous improvement has been opened (e.g. we are now starting the automation of shutdowns).
- 2. Energy savings: We measure the average power “remaining”, in kW, during non-productive periods.

The figure ‘Evolution of cold rolling protocols’ shows, for example, only the Cold Rolling department of the Campo de Gibraltar factory. Very significant energy savings are shown (and in continuous improvement).

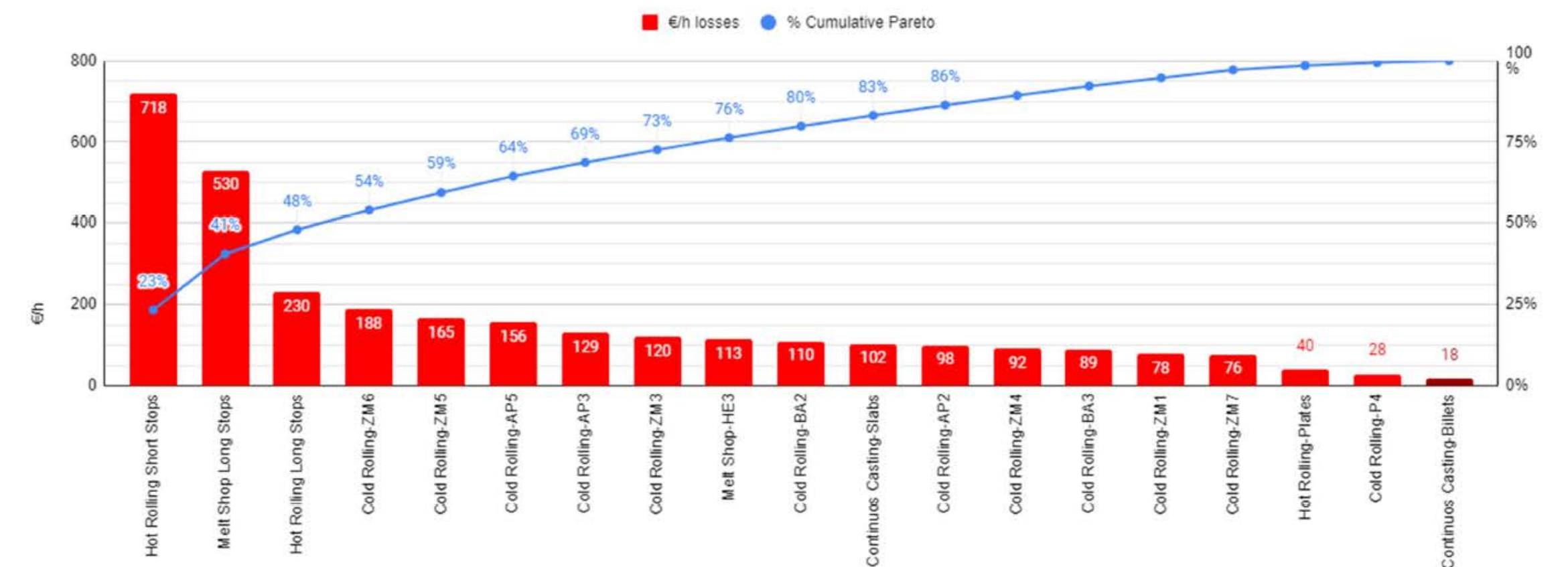
- 3. We avoid scope 2-CO₂ emissions: We have recorded, in 2021, savings of 4141730 kWh. With an estimate of 0.415 tCO₂e/MWh, we obtain emissions savings of 1719 tCO₂e.
- 4. The cost of electricity is, unfortunately, exorbitant. This makes these savings measures an important source of “income”. The savings accounted for in



Evolution of cold rolling protocols

2021 was €487571.

- 5. One of the best tools obtained with this work has been “the establishment of a loss map”. The Pareto diagram in the figure shows where we have to apply our greatest efforts.



Loss map



Stainless steel slag: 100 % Re-used

Member company

ACERINOX EUROPA S.A.U.

Category

Protection of scarce resources; Energy intensity reduction; Investment in new processes and products in order to deliver a defined sustainability benefit; Value to the customer

The Challenge

ACERINOX EUROPA is the great reference in the industrial sector in Campo de Gibraltar and, in turn, a model company in the European framework in environmental matters. Respect for the environment is one of its priorities, making it an example of a sustainable industry committed to the fight against climate change.

For this reason, the Environmental Section from ACERINOX EUROPA, has made a significant effort to reduce waste and

manage its recovery at all stages of the Stainless Steel production process, focused in the main waste of the mill: Stainless Steel Slag.

Why?

ACERINOX EUROPA, in its commitment to Sustainability, is totally convinced that the implementation of sustainable measures such as the mentioned circular activity is the best way to stop the global climate change problem.

Specifically, Environmental Section supports the project for the development and recovery stainless steel slag whose objective is to reuse them as for materials of concrete construction. In order to reduce/avoid the volume of this waste sent to landfill.

Needed Action

To use Stainless Steel slag* as a by-product instead of considering it as waste.

(*Slag after recovery the free metal by dry and wet process)

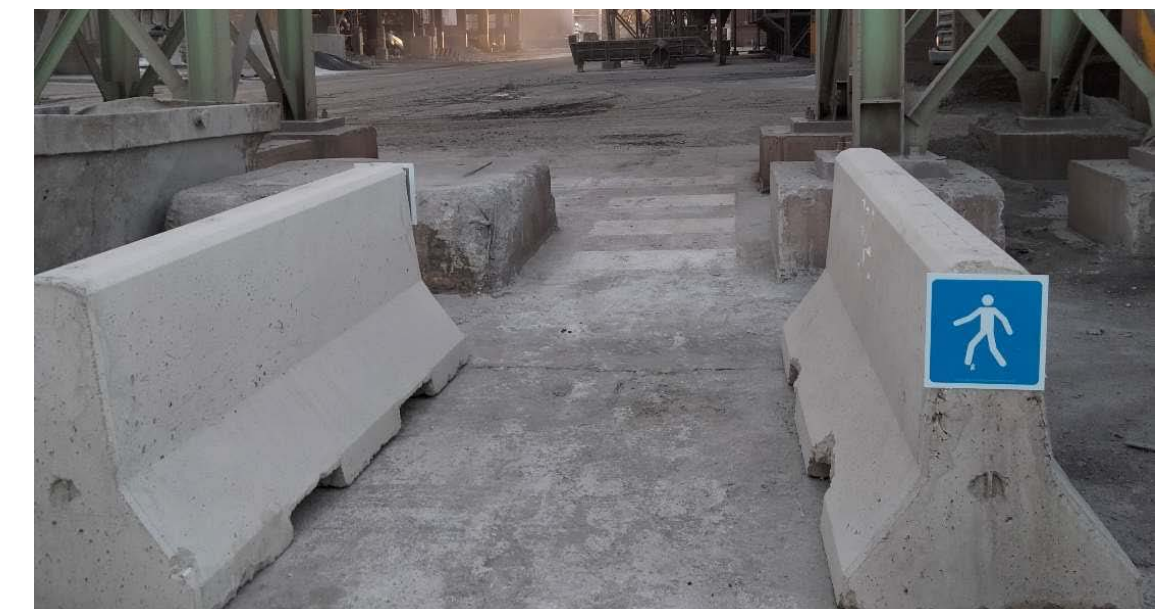
Quality tests for commercial concrete have been carried out for this use. Not only mechanical test but leaching tests as well in order to protect the environment. These products fulfil the regulations applicable to the construction and housing code.

Action Review

Specific; ACERINOX EUROPA is a model company in the European framework in environmental matters and Respect for the environment is one of its priorities.

Measurable: 30 "New Jersey concrete barriers", in a first phase, have been manufactured using the slag, and have been installed at Campo de Gibraltar factory, successfully.

Achievable:



Realistic: ACERINOX EUROPA considered both, the targets of the project and their implementation; realistic measures with which achieve sustainable benefits.

Time-bound: ACERINOX EUROPA consider starting this process with a first phase of manufacturing 30 units of “New Jersey concrete barriers” in December 2021.

Horizontal Expansion Capability

ACERINOX EUROPA will communicate it to all associated companies.

Outcome

- Using the slag as material for materials of construction reduce the volume of this waste sent to landfill.
- Greenhouse gas emissions are reduced.
- Reduces aggregate extraction.

Establishment of the new testing and evaluation systems under the high-pressure hydrogen-gas environment for accelerated development of stainless steel

Member company

AICHI STEEL CORPORATION

Category

Emissions reduction; Investment in new processes and products in order to deliver a defined sustainability benefit

The Challenge

Aichi Steel Corporation has invested 450 million Japanese yen (JPY) in its Seki Plant (Seki-shi, Gifu, Japan) and established the state-of-the-art testing and evaluation systems in which various testing can be executed under the high-pressure hydrogen-gas environment, aiming at development of new stainless steel as a material which supports to build a hydrogen-based society toward decarbonization.

Why?

Utilizing the newly established testing and evaluation systems which enable us to perform testing under the high-pressure hydrogen-gas environment, we will enhance our development capability of stainless steel, which assists to construct a hydrogen-based society and to eventually achieve decarbonization. Through offering these fundamental but innovative stainless steels to society, we would like to ultimately contribute for realizing a sustainable society.

We also strongly believe that our development activities of stainless steel will help to result in expanding demands for the world's stainless steel manufacturers.

Needed Action

Fuel-cell vehicles (FCVs) are commonly equipped with 70MPa high-pressure hydrogen-gas tanks in the world. So that, stainless steels have been widely selected

as materials, which are constantly exposed to high-pressure hydrogen-gas, due to their excellent high-pressure hydrogen-gas embrittlement resistance.

As a special steel manufacturer of the Toyota Motor Corporation group, we have developed the cutting-edge stainless steels for the use of high-pressure hydrogen machines and facilities ahead of other companies. And we have supplied our stainless steels as materials for parts and components which comprise high-pressure hydrogen equipments for FCVs and hydrogen fuelling stations.

The AUS316L-H2, our new stainless steel developed in-house has been adopted as a material for various high-pressure hydrogen equipments of hydrogen fuelling stations. This stainless steel has been used for several parts and components related to the high-pressure hydrogen systems of the Toyota MIRAI, the Toyota's first-generation FCV. Since then, the

The axial-load tensile and fatigue tester to be operated under the high-pressure hydrogen-gas environment.



AUS305-H2, another new stainless steel developed inhouse has been selected as a material for parts and components of the high-pressure hydrogen systems for the new model Toyota FCV MIRAI.

More and more, towards the future goal of carbon neutral, innovation and development of new stainless steels with higher strength, higher performance and more resource-saving characteristic are expected, in order that hydrogen energy systems are fully popularized in and penetrated through our society.

However, for designing and architecture of parts and components to be used for high-pressure hydrogen equipments, it is required to study and assess tensile, fatigue and fatigue crack growth properties of candidate and developed stainless steels under the high-pressure hydrogen-gas environment, likewise under the atmospheric environment.

In order to meet the needs for the testing

and evaluation, in 2019 we introduced the axial-load tensile and fatigue tester to be operated under the high-pressure hydrogen-gas environment, and we have conducted many studies and performed various assessment ever since.

On top of these activities, we have internally developed our own rotary bending fatigue test machine under the high-pressure hydrogen-gas environment of 90MPa, for the first time in the world, and launched test evaluation work with this test machine. This innovative tester enables us to execute a rapid fatigue test, compared to the conventional axial-load fatigue tester. With this new test machine, we are able to drastically reduce fatigue test time, which usually requires quite a long time, to less than 1/10, compared to before.

From now on, we expect that simultaneous use of the axial-load tensile and fatigue tester and the rotary bending fatigue test

machine will dramatically accelerate our development of stainless steels.

Action Review

Specific; For designing and architecture of parts and components to be used for high-pressure hydrogen equipments, it is necessary to test and assess tensile, fatigue and fatigue crack growth properties of candidate and developed stainless steels under the high-pressure hydrogen-gas environment, likewise under the atmospheric environment. Especially, time reduction of a fatigue test, which takes quite a long time, is a big bottleneck to overcome.

Measurable; The axial-load tensile and fatigue tester under the high-pressure hydrogen-gas environment, introduced in 2019, can implement test items for tensile, fatigue and fatigue crack growth characteristics with a max pressure of 140MP and at a test temperature of - 80°C



Developed our own rotary bending fatigue test machine under the high-pressure hydrogen-gas environment of 90MPa for the first time in the world.

to 90°C.

Additionally, the rotary bending fatigue test machine under the high-pressure hydrogen-gas environment, developed independently, can execute a fatigue test with a max pressure of 90MPa and at room temperature. And this test machine can even increase its test frequency, as

a result, we can reduce testing time of a fatigue test to 1/10, compared to the conventional axial-load fatigue tester. More specifically, we are capable to execute repeated fatigue test for 10 million times about in a week.

Achievable; By concurrently utilizing the axial-load tensile and fatigue tester and the rotary bending fatigue test machine, it has become possible to conduct speedy testing and evaluation for test items on tensile, fatigue and fatigue crack growth characteristics under the high-pressure hydrogen-gas environment, likewise under the atmospheric environment.

Realistic; Through the newly established testing and evaluation systems under the high-pressure hydrogen gas environment, Aichi Steel Cooperation has enhanced its development capability of stainless steel, which contributes for building a hydrogen-based society and for achieving decarbonization. In supplying our advanced stainless steel to society, we keep contributing to realize a sustainable

society.

Time-bound; Aichi Steel Corporation has invested 450 million Japanese yen (JPY) in its Seki Plant (Seki-shi, Gifu, Japan) and completed the innovative testing and evaluation systems where different kinds of tests are performed under the high-pressure hydrogen-gas environment in June 2021, aiming at excellence in stainless steel innovation and development which will contribute for constructing a hydrogen-base society. Currently, we are progressing development of new and advanced stainless steel with properties of high strength, high performance and resource-saving.

Horizontal Expansion Capability

In general, FCVs in the world are installed with 70MPa high-pressure hydrogen-gas tanks. As a result, a hydrogen fuelling station, which services hydrogen gas to FCVs, is required to be able to handle highpressure hydrogen-gas of 70MPa and above.

In addition, application of a fuel cell, which use high-pressure hydrogen-gas as its fuel, is expanding not only to trucks and busses but also to forklifts, vessels and trains and so on.

Therefore, understanding on mechanical properties of stainless steels under the high-pressure hydrogen-gas environment and improving their reliability as a material will lead to cultivate and create new markets for stainless steel, which will ultimately contribute for expanding production of the world's stainless steel manufacturers.

Outcome

Aichi Steel Cooperation has undertaken innovation and new development of stainless steels to be used under the high-pressure hydrogen-gas environment, ahead of other companies. The AUS316L-H2, the stainless steel newly and independently developed by our company has been adopted for parts and components of various high-pressure

hydrogen equipments at hydrogen fuelling stations. This new stainless steel has also been applied to several parts and components of high-pressure hydrogen systems for the MIRAI, the first-generation Toyota FCV model. Furthermore, the AUS305-H2, newly and internally developed stainless steel is also selected for parts and components of high-pressure hydrogen systems for the new model of the Toyota FCV MIRAI.

These activities and achievements are shared with our employees and well-known. We all are working hard and dedicating our effort on development activities and manufacturing operation with an aspiration for contribution to forge a hydrogen-based society.

Finally, the various test results on stainless steels so far have revealed and reconfirmed that stainless steels are suitable materials to be applied for parts and components of high-pressure hydrogen equipments and systems, more than we had previously perceived.



Environmental Portal Communication Platform

Member company

BAHRU STAINLESS SDN BHD

Category

Environmental management system (EMS) development / enhancement

The Challenge

To enhance the employees awareness for environmental and sustainability related matters. This platform is a big part of the actions to cultivate the sustainable organisational from all levels.

Why?

Lacking of an effective platform for environmental communication that concerned with environmental affairs and issues within the organisation.

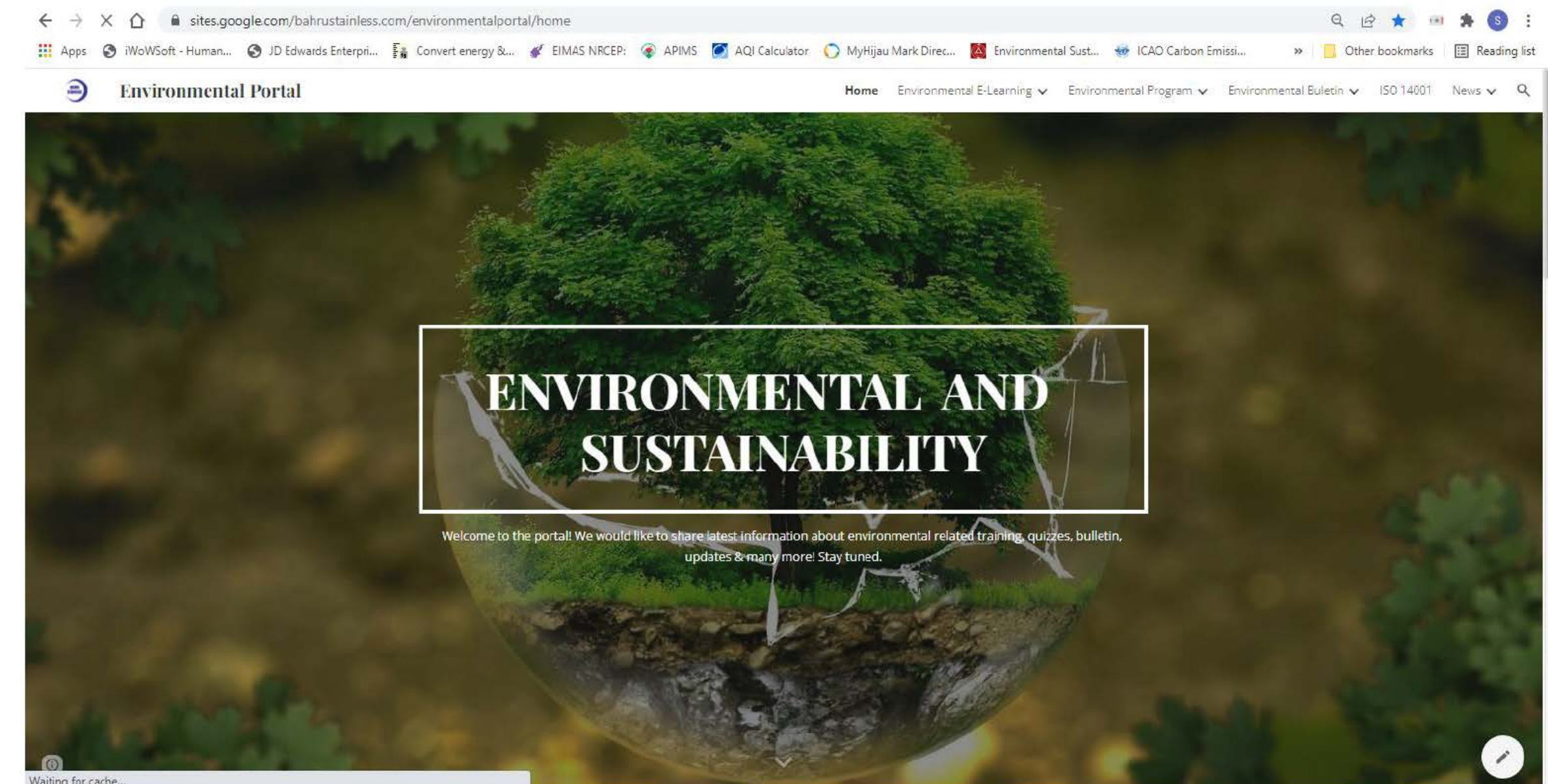
Needed Action

With the digitalisation transform strategies, BAHRU utilises the google platform to create an Environmental Portal to enhance the environmental communication within the organization.

Action Review

Specific; Environmental communication within the organization is enhanced with the implementation of an Environmental Portal. The environmental communications including for the environmental training, environmental performances, environmental programs, environmental management systems and news related to environmental and sustainability. The environmental portal also promotes the nature gallery where the photos of the plants were actually taken from the BAHRU premise as our green promotion.

Measurable; Effective environmental communication can be measured through



the total 1220 hours that have been achieved in 2021 via the environmental e-learning programs. Furthermore, BAHRU's Environmental Program had received positive supports from all the employees with the result of 1.06 Ton of household electronic -waste were collected and sent to the E-Waste licensed recovery facility in 2021.

Achievable; The Environment Portal has been effectively enhanced the environmental communication within the organisation as it's a platform to enable all members of the organisation to be able to be connected for the environmental and sustainability information sharing and updates.



Realistic; By harnessing the power of digital communication channels, its enables a large variety of people to group together, create value and connecting each other's.

Time-bound; Environment Portal developed in 2021 will be continuously implemented for the on-going environmental communications.

Horizontal Expansion Capability

The effective enhanced environmental portal had become model within BAHRU organisation to develop on the Safety & Health E-Learning Portal, 6S Portals and also the production portal as the tools of effective communication.

Outcome

The implementation of digital technologies not only increases the company's digital presence but also sparked the creation of new communication channels. BAHRU demonstrate an effective enhanced

environmental communication platform through the Google- Environmental Portal.

Effective communication is enhanced by developing the environmental portal as the effective communication platform especially during the pandemic time where the physical distances have becoming the barriers between peoples.



LOOK DEEP INTO NATURE

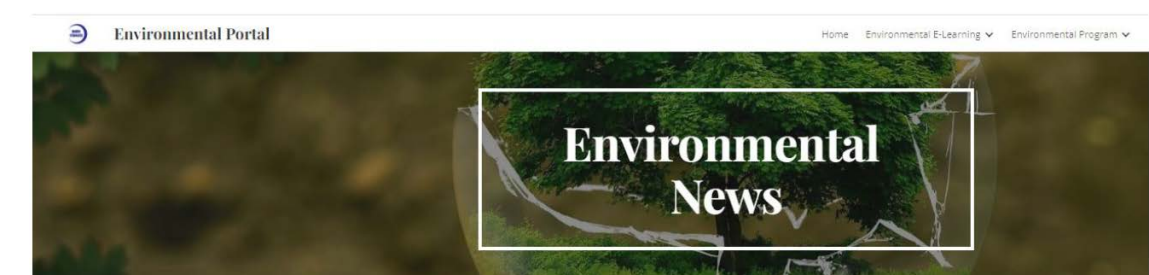
THE MOST BEAUTIFUL GIFT OF NATURE IS THAT IT GIVES ONE PLEASURE LOOK AROUND AND TRY TO COMPREHEND WHAT WE SEE – Albert Einstein.

HIBISCUS ROSA-SINENSIS, THE NATIONAL FLOWER

HIBISCUS rosa-sinensis is the national flower of Malaysia, called bunga raya (literally; great flower) in Malay...The red of the petals symbolizes the courage, life, and rapid growth of the Malaysian, and the five petals represent the five Rukun Negara of Malaysia.



In BAHRU, you can find Hibiscus: planted as scrub surround the office buildings and along the drainage.



ACERINOX REAFFIRMS ITS COMMITMENT TO THE CIRCULAR ECONOMY AND THE FIGHT AGAINST CLIMATE CHANGE

ACERINOX, a leader in the production of stainless steel, has reaffirmed its commitment to the circular economy and the fight against climate change. The company has implemented a series of measures to reduce its carbon footprint and promote sustainable practices. These include the use of recycled materials, energy-efficient production processes, and the implementation of a robust waste management system. By embracing the circular economy, Acerinox aims to minimize waste and maximize resource efficiency, contributing to a more sustainable future.



Stainless steel is among the best options in terms of materials for manufacturing sanitary utensils, especially in circumstances such as that generated by Covid 19, offering hygienic surfaces that are easy to clean and enhancing safety thanks to the material's minimal bacterial and viral retention.



Household Electronic Waste Campaign

Member company

BAHRU STAINLESS SDN BHD

Category

Protection of scarce resources;
Environmental management system (EMS)
development / enhancement

The Challenge

As known, E-waste is becoming a global environmental issue.

Existing Malaysia Environmental law focus on the practices of E-waste management by industries but lacking of the household E-Waste management.

Currently, household E-waste mostly ends up at informal sectors in Malaysia, through various channels of collection such as the NGO, door-to-door collectors, charity organizations, or some junk shops and recyclable buyers.

The level of public awareness of the local community (Malaysia) is still low and limited on the environmental problems constitute by the E-Waste.

Why?

Household E-Waste Campaign is a BAHRU initiative to educate and promote environmental protection responsibility to our employees.

We aim to enhance the sustainability and environmental awareness not only at the workplace itself, in addition to further encourage the employees to react environmental responsible from their routine daily living and community.

In conjunction with the Environmental Authority official launch every last Saturday of the month is National E-Waste Day, beginning Jan 2021, BAHRU had taken proactive approach to organise the Household E-Waste Campaign.

Needed Action

The first phase of the project involved dedicating an area at BAHRU's plant for the collection of household E-Waste from THE employees' homes and daily living communities. The collected household E-Waste was sent to the licensed E-Waste Recycler by the end of the Campaign in December 2021.

Many communications had been made for the campaign promotion including banners, bunting, E-Waste information and sharing, environment portal, E-Waste booth held by the E-Waste Recycler, Department competition and interactive quiz game.

The second phase will look into the Household E-Waste Campaign expansion, through Bahru's CSR programme, the collection of household E-Waste from the sponsored school and or the selected nearby community/neighbourhood.



Action Review

Specific; The Household E-Waste Campaign received positive feedback and support from employees from all level. The main purpose of promoting environmental awareness is met with the employee proactively take part in the Household E-Waste Campaign by willingness to

collect the E-Waste from their house and living neighbourhood and send to the Campaign's E-Waste collecting point.

Measurable; A total of 1.06 Tons of Household E-Waste had been collected on 22 Dec 2021 by the E-Waste licensed recycler. This includes more than 10 unit different sizes of old TVs, 4 broken washing machines and many other kitchen appliances, fans, computers, printers and others.

Achievable; The result of total 1.06 Tons of accumulated Household E-Waste received from the employee house and living community showed the hazardous waste awareness and the environmental concerns among the employees and extended to the families and friends has increase. BAHRU also conduct a Campaign Survey and received 100 % support from the employees to have the Household E-Waste Campaign held continuously as yearly program as an action toward

environmental and sustainability concerns.

Realistic; To promote and enhance the environmental awareness and sustainability, the employees will need to be educated, communicated to, and encouraged to proactively take part in any forms of environmental programs. The Household E-Waste Campaign is proven to be an effective environmental program and helps to cultivate the environmental responsible awareness for the employees, beginning from their routine living.

Time-bound; BAHRU launched the Household E-Waste program on April 2021. With the support from the top management and employees, this Household E-Waste Recycling program has continued in 2022 as the company continuous effort to promote the environmental protection and sustainability awareness.

Horizontal Expansion Capability

The approach for this Household E-Waste Campaign is not directly reflected in the environmental improvement relevant to the company manufacturing process and business models.

However, it's more towards demonstrating the company efforts in promoting the environmental awareness at all levels.

Outcome

The importance toward developing a sustainable organizational culture, with the principle to cultivate the employees with the recognition of everyone's role and take their part in society for environmental protection.

Looking at the outcome from the E-Waste management, recycling of E-waste is the most sustainable way to tackle this escalating waste problem, keeping harmful waste out of landfill and recovering old



materials to reuse in new products. E-Waste recycling saves the raw materials that can be repurposed by producing new devices.

As a result, energy is saved, pollution is reduced, and there are fewer greenhouse gas emissions released into the atmosphere.

Energy Efficient Cooking: Save80 rocket stove

Member company

Columbus Stainless

Category

Emissions reduction

The Challenge

Reduction in the global carbon footprint.

Many people in the rural Sub-Saharan African countries use wood and charcoal to cook. Many in the rural or remote households rely on the traditional 3-stone fires or open fires for cooking. These traditional cooking methods are energy inefficient and generate high levels of pollution. More energy efficient methods are therefore required – which is what is addressed by Atmosfair and its innovative cooking solution called the “Save80”.

Why?

Atmosfair, a Berlin-based climate protection organisation, is funded by companies and private donors who donate certain amounts to organisations or programmes dealing with the reduction of GHG emissions (carbon offset). A carbon offset is a way to compensate for your emissions by funding an equivalent carbon dioxide saving elsewhere; thus contributing positively to the plight of environmental sustainability. Atmosfair invests in sustainable technologies and is hereby committed to impart an “Energiewende” (i.e. transition to low carbon, more energy efficient and environmentally sound practices) in the global South.

We believe that deforestation and forest degradation due to the collection of firewood and further processing of charcoal is a major threat to the environment for the local population

and for the entire biosphere. That’s the motivation for the development of the Save80: to tackle the fast ongoing deforestation whilst at the same time improving the daily life of the stove’s users. The Save80 enables users to save around 80% of wood used in the cooking process compared to a 3-stone cooking fire.

Needed Action

Atmosfair, in partnership with a German-based car trailer manufacturing company, developed a stainless steel stove called the “Save 80”. The Save80 emits significantly less toxic smoke fumes than a traditional 3- stone fire.

Research has shown that nearly 3 billion people in the world still make use of traditional open fires for cooking. Through the use of the Save80 cooking method, households can reduce their firewood consumption by up to 80%; thus drastically reducing their carbon footprint whilst also



saving money and time spent on buying or collecting the wood. Because of the reduced amount of firewood required for the cooking process, fallen twigs and logs can be collected and used as the energy source, without the additional need to cut down healthy, living trees.

Atmosfair has seen some success in the past decade, with over 100,000 units sold in Rwanda and Nigeria alone. To enhance the drive for sustainability that Atmosfair embodies, stainless steel grade 430 is the chosen metal of construction. Stainless steel is seen as a sustainable product, being 100% recyclable and constructed predominantly from recycled raw materials.

Atmosfair has also taken the opportunity to expand its operations, to design and build two new large stove manufacturing factories in Rwanda and Nigeria. The growth plan is to increase the production capacity to over 100,000 units per annum.

These types of industry expansion initiatives contribute to the development of skills and employment opportunities within the developing countries in which the organisations operate.

Action Review

Specific; The Save80 cooking stove is specially designed to meet the needs of users in rural and peri-urban areas. Atmosfair has currently focused its invention in Nigeria and Rwanda.

Measurable; In order to issue CO₂ emission reduction certificates, each stove is registered under the United Nations “Clean Development Mechanism” and a random sample of stoves are monitored yearly. (Field testing on the efficiency of these stoves is done through the standard “Water Boiling Test”).

Achievable; Yes – since its inception, the Save80 has seen over a decade’s worth of successful applications. The expansion

of the company’s manufacturing facilities into both Nigeria and Rwanda (Africa), with production commencing in March-April 2022, further highlights the demand and potential growth opportunities for this energy efficient cooking solution.

Realistic; Yes. Atmosfair has developed, manufactured and distributed over 100,000 Save80 stoves in the past 10 years. The need and demand is growing rapidly; therefore it is realistic to achieve the projected growth of 100,000 more units within the next 5 – 10 years.

Time-bound; Ongoing. The organisation strives to reduce as much GHG emission as quickly possible.

Horizontal Expansion Capability

As a non-profit-organization, Atmosfair’s mission is to spread the knowledge and know-how about the production of the Save80 in the Sub-Saharan African countries. This can be done with



collaborative efforts with many other companies within the regions of growth.

The use of stainless steel as the metal of construction also contributes to the company's motto of sustainability, since stainless steel is 100% recyclable and can be made from recycled materials. The longevity of the stainless steel product ensures further reduction in the carbon footprint to the Save80 cook stove households.

Outcome

Through the growth and use of the Save80; households within Sub-Saharan countries (specifically Nigeria and Rwanda where the stoves are currently being distributed) are currently saving about 31,000 to 200,000 tons of CO₂ emissions annually. With the expansion of the manufacturing facilities within the African countries, over 20 new jobs (for 20 households) have been created. The potential for further job creation exists as the demand for the energy efficient cooking solution expands within other regions.



Recycling of interleaving paper

Member company

Columbus Stainless

Category

Protection of scarce resources

The Challenge

From an environmental footprint perspective, the use of interleaving paper in stainless steel cold rolling, annealing and final packing processes presents two challenges: Firstly in terms of the consumption of resources including considerations of embedded emissions, and secondly the final disposal volume of used paper.

The main challenges to effective implementation related to the following:

1. Internal recycling (re-use of recycled paper as substitute for new paper): Physical condition (width, creasing or other damage, cleanliness); collection

procedures (maintaining feed to recycling lines); and process control (joining to inner cores, joining of lengths, trimming, quality checks and completion of check sheets

2. External recycling (sale to downstream recyclers): Separating between dry and oil-containing interleaving paper; quality control of baling processes (density, binding, free from wet material); and in the case of oily paper administrative processes related to export permits and logistics.

Why?

The challenges have been addressed in the past, due to the concerns listed above as well as cost savings opportunities. Increasing focus within the organisation on resource preservation and footprint minimisation however, has led to further prioritisation of related initiatives. In the case of internal recycling procedures,

an additional processing line was commissioned in 2018 to ensure adequate processing capacity and also provide additional trimming options.

The two recycling routes are also linked in that after internal re-use, all scrapped interleaving paper subsequently reports to one of the two off-site recycling streams.

Needed Action

1. Internal recycling of interleaving paper is facilitated by the use of a dedicated production section within the Final Services and Distribution Department, using two re-coiling machines operating in parallel (Figures 1 and 2). Coiling, trimming and re-use of interleaving paper is standard practise in steel cold rolling operations, with the performance described in this entry derived from continued process and quality control rather than breakthrough technology options.

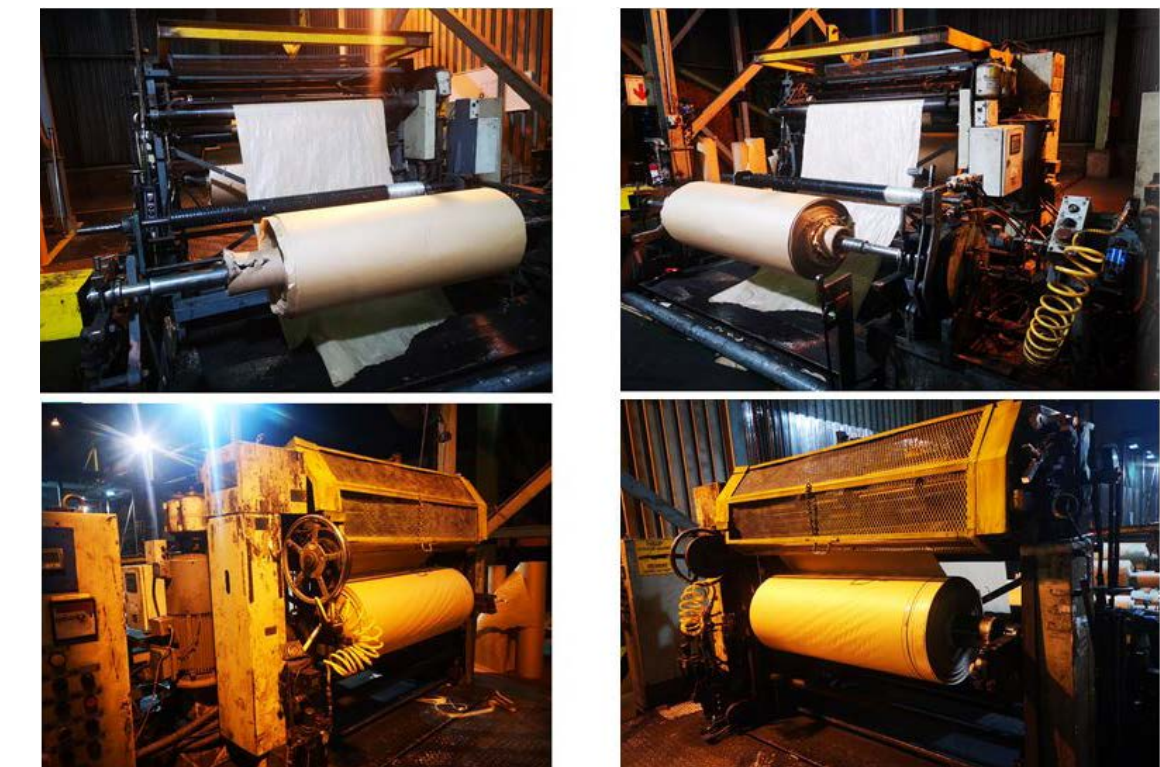


Figure 1: Goebels Line - Goebel Rapid-D (1994)



Figure 2: Zhongtai Line - ZTM-B1600 Slitter rewinder (2018)

Upon reaching the end of its useful life, paper coils are marked as scrap for transport to the sorting and external recycling process (see Figure 3).



| Figure 3: Scrapped paper rolls

2. Paper for external recycling is first sorted by an on-site contractor (Herwinning Galore). After initial separation between brown and white grades, as well as clean and oily condition, the separate streams are prepared for off-site transport. Clean

paper is coiled or baled, in accordance with the requirements of downstream processors, while oily paper is baled for packaging into export containers (Figures 4 and 5). Downstream consumption of clean paper include the use as masking material in automotive spray painting operations (coiled intact sheets), and re-pulping in the paper and packaging industry (damaged and subsequently baled material, see Figure 6).



| Figure 4: Baled oily paper



| Figure 5: Oily paper containerised for export



| Figure 6: Baled clean paper

Action Review

Specific; Yes, each component of the overall recycling initiative serves both a specific material and downstream customer.

Measurable; Measured in terms of recycling tonnage and financial saving to the company.

Achievable; The sustained achievement of paper recycling volumes since project implementation serves as evidence that it is achievable.

Realistic; The actions are realistic, particularly considering the continuous nature of opportunities being addressed. Impacts of the actions are making a significant contribution to both cost saving and footprint reduction.

Time-bound; Efficiency measured per shift (internal reuse), and impact reported on a monthly basis (both on-site and off-site initiatives).



Horizontal Expansion Capability

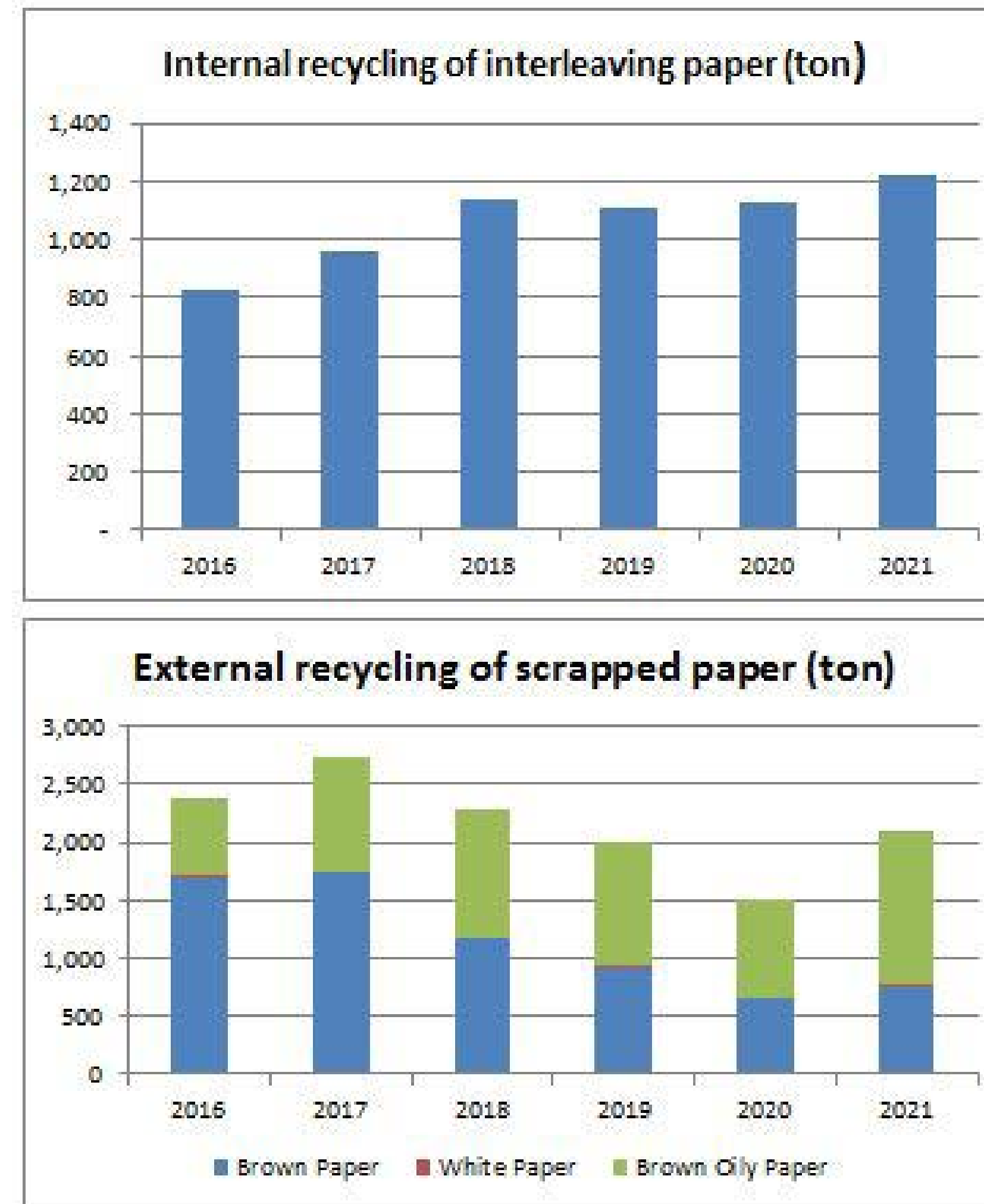
Within the organisation, the impact and reach of both initiatives could mainly be expanded by management of process parameters, for instance the prevention of handling damage during uncoiling operations for paper going to on-site reuse, and proper waste segregation where paper goes to off-site recycling.

When looking at other industries, both recycling routes discussed above involve the use of existing technology. Investment in the required equipment, training in its

use, and ongoing operational management and optimisation to local conditions are the major prerequisites.

Outcome

The combined effect of on-site and off-site paper recycling sees in excess of 3000 metric tons of paper recycled per year, thereby contributing to the circular economy drive of the company. Volume trends for the past 6 years are shown in Figure 7.



| Figure 7: Paper recycling volumes



Recycling of Dolomitic Brick

Member company

North American Stainless

Category

Material efficiency improvement

The Challenge

North American Stainless was disposing of dolomitic refractory brick in the municipal landfill. NAS needed to identify techniques to recycle dolomitic brick, thus reducing needed landfill space and costs.

Why?

For a short period, the brick was recycled by an outside company but due to fugitive dust generation at the recycling facility, the project was cancelled and the material was disposed again at the landfill. NAS had to find a crushing technique and method to control fugitive emissions from this operation.

Needed Action

Identified a method that could be used to crush brick indoors without generation of dust and developed a way to crush the brick in a manner to recover brick in a way that could be fed into the EAF.

Action Review

Specific; Crush the brick indoors and reduce dust generation and make bricks usable for recycling in EAF. Dolobrick can be bagged in supersacks and used as a source of dolomitic lime.

Measurable; Reduction in tonnage shipped to landfill and dust generation from the process.

Achievable; NAS is using a jaw crusher to crush brick. The crusher is equipped with a screener/conveyor to remove residual metal from the brick, and move the brick and fines to a hopper that feeds a supersack. A baghouse with a single

hood was modified to have multiple intake vents to capture emissions at the emission points to increase capture efficiency.

Realistic; Expected to be accomplished with basic equipment and general labor.

Time-bound; Results expected to be immediate.

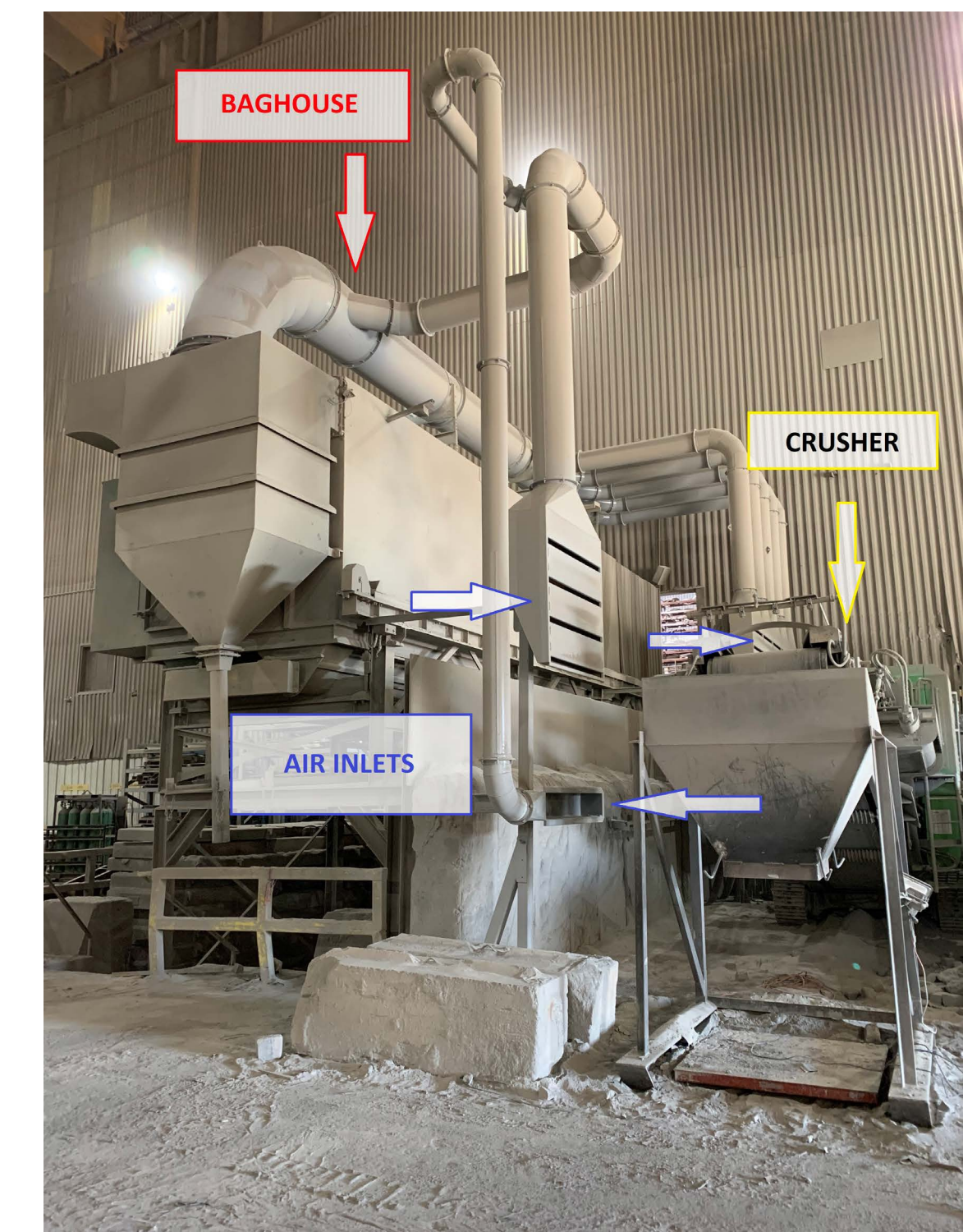
Horizontal Expansion Capability

The approach encompasses all dolomitic brick that is used in the Melt Shop and the concept may be usable to member companies.

Outcome

NAS has actualized substantial economic savings in reduced dolomite purchases and landfill fees. Additionally, NAS has made the steel melting process more sustainable without requiring additional dolomite to be mined, calcined, processed and trucked to the Melt Shop. The emissions from this operation are

significantly reduced and controlled using the modified baghouse.



| Brick crusher

Flange of Gasoline Injection High Pressure Fuel Pump

Member company

NIPPON STEEL Stainless Steel Corporation

Category

Emissions reduction

The Challenge

The flange of the gasoline injection high-pressure fuel pump is typically assembled by welding multiple parts. In order to increase stiffness and efficiency, we formed the flange integrally, which reduced the number of welding points.

Why?

- In order to improve fuel efficiency of gasoline direct injection engines and reduce emissions, it is necessary to further increase fuel injection pressure.
- It is also necessary to enhance the stiffness of the flange for it to withstand the increased fuel pump pressure.

Needed Action

Flanges need properties such as a high level of plastic workability, easy machinability, corrosion resistance, strength, and weldability with other parts. NSSC180 is a ferritic stainless steel which can meet these requirements. Using NSSC180, we were able to form the flange integrally by identifying the appropriate processing conditions. As a result, we were able to mass-produce and market pumps that can withstand the increased pressure

Action Review

Specific; The biggest concern was strength. Therefore, before development, we calculated the maximum stress on the flange and identified its position when the discharge pressure of the pump was at a maximum. We then identified the target strength (hardness) as a component and its measurement position.

Measurable; We evaluated that the flange

itself meets the required strength (hardness), and we also verified the operation of the entire high-pressure fuel pump system.

Achievable; Realistic; Time-bound; The project was launched in December 2016. With the cooperation of material manufacturers, processors, and product designers, issues were identified, shared, and verified. Development was completed in



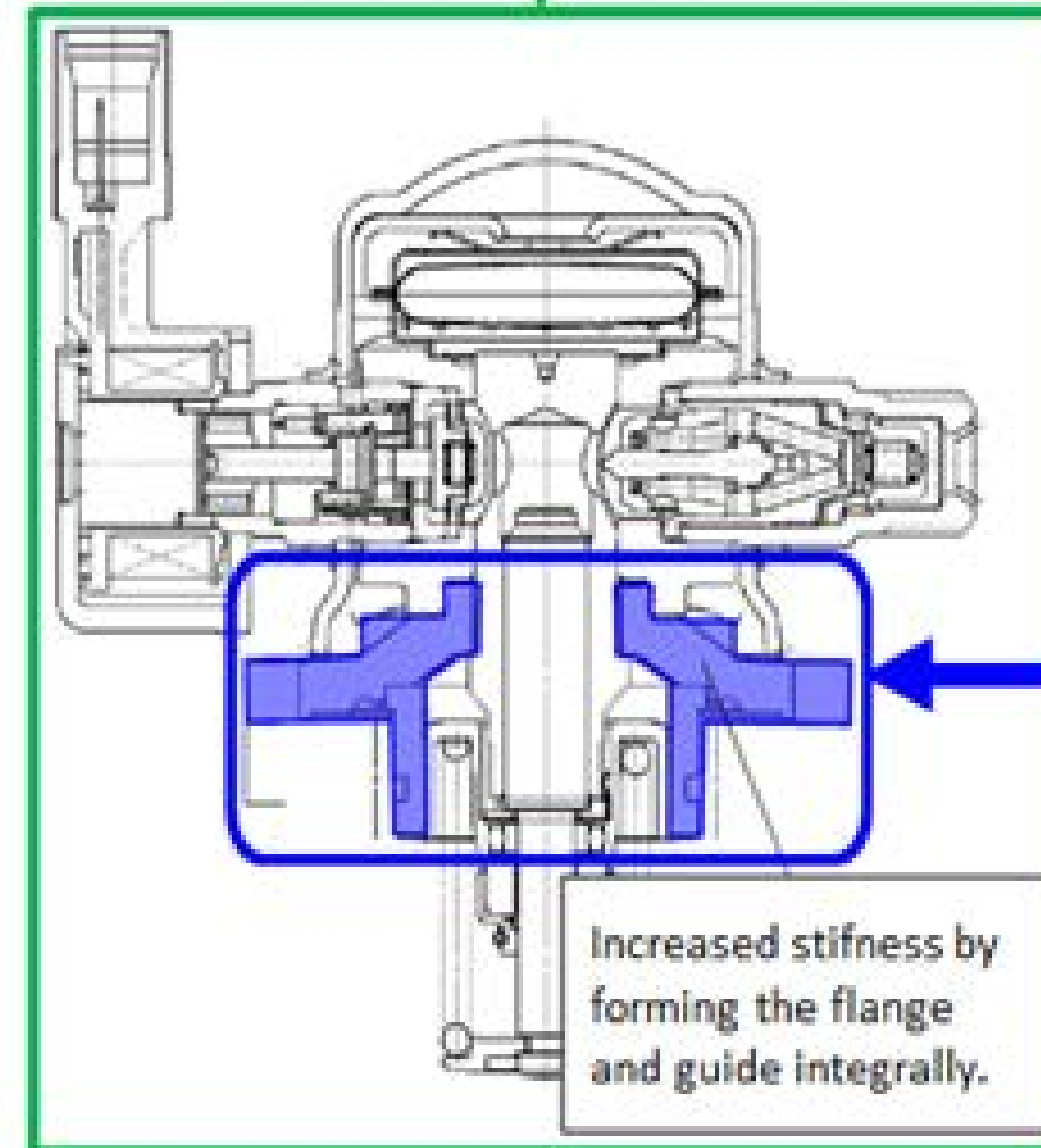
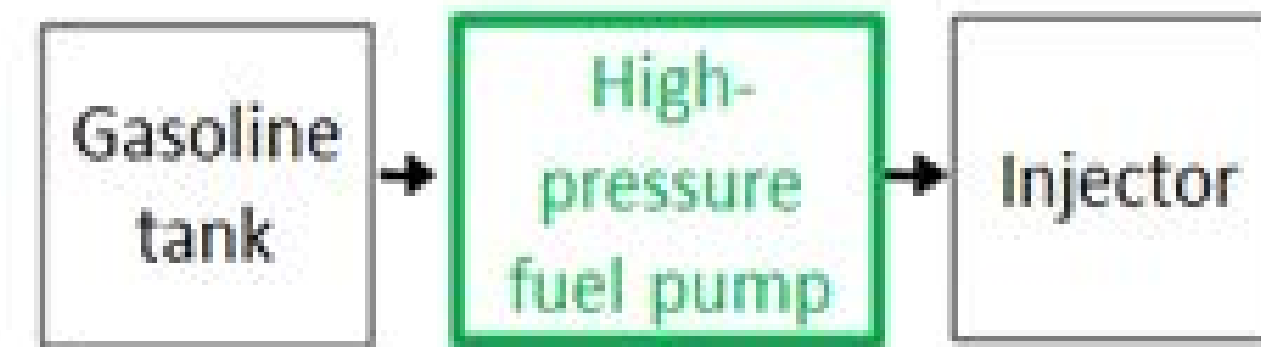
January 2018. We were able to begin mass production in September 2019 as originally planned.

Horizontal Expansion Capability

- DENSO has already adapted the design for use in many other types of high-pressure fuel pumps.
- It is recognized as being an applicable technology by Denso's competitors.

Outcome

A high-pressure fuel pump that can withstand the target fuel pressure has been commercialised and mass-produced.



Conventional Technology

- Fuel injection pressure : 20Mpa
- The component is assembled by welding the flange and guide.



flange

guide

Developed Technology

- Fuel injection pressure : 45-60Mpa
- By using high-purity ferritic stainless steel (NSSC180), we form the flange and guide integrally, which can reduce the number of welded parts and increase stiffness of the component.
- This technology helps to reduce the impact on the environment.



Rehabilitation of hydroelectric power plant

Member company

NIPPON STEEL Stainless Steel Corporation

Category

Emissions reduction; Energy intensity reduction; Material efficiency improvement; Value to the customer

The Challenge

Recently in Japan, hydroelectric power plants that have been shut down due to aging facilities, are being rehabilitated. In order to restore the function of the power plants, it is necessary to improve the water intake facility.

We decided to draft a proposal for resource-saving stainless steel as the main material used in the restoration of water intake facilities of Makinokuchi Plant of Kyushu Electric Power Co., Inc. We were able to persuade the electric power company that it is possible to extend the

service life of the machinery by 50 years or more, even if rockfalls are taken into consideration.

Why?

While there are concerns about power shortages in Japan, it is difficult to further increase the number of thermal power plants, as they emit a large amount of greenhouse effect gases. So there is now interest in relying more on hydroelectric power. However many hydroelectric power plants have had to be temporarily or permanently shut down due to problems with ageing equipment.

The construction of a new dam takes decades, so it makes sense to improve existing dams. Rubber weirs and carbon steel equipment were often used in these old power plants. We believe that using stainless steel for new weirs and equipment could extend the life of the dam.

Needed Action

We explained the benefits of using the resource-saving stainless steel, such as LCC, to a consultant who designs rehabilitation work for hydroelectric power plants, and showed how its properties were used successfully in other applications.

Action Review

Specific; Using data-based evidence, we explained that the use of stainless steel can extend the service life to 50 years.

Measurable; Using abrasion resistance and corrosion tests, we proved the superiority of stainless steel over other materials such as rubber or carbon steel.

Realistic; We gave examples of our resource-saving stainless steel being used in multipurpose dams or seawalls.

Time-bound; While we had only half a year to consider using stainless steel, we were



able to make the decision within the time frame.

Horizontal Expansion Capability

Rehabilitations of hydroelectric power plants are in progress all over Japan. In many cases, water intake facilities need to be restored and stainless steel expected to be used for them.

In addition, stainless steel began to be used also for bell mouths and penstocks in piping systems.

Outcome

Increasing renewable energy is extremely important not only in Japan but worldwide. We are proud to be able to contribute to this challenge by supplying materials. The consultants and electric power companies that used our materials were also very satisfied with this project.

As for the power generation business, it is expected that stable profits will be obtained in the future by taking advantage of the Japanese government's feed-in tariff (FIT).



Ecological dual circulation management of TISCO water system

Member company

TAIYUAN IRON & STEEL (GROUP) CO., LTD.

Category

Emissions reduction; Protection of scarce resources; Environmental management system (EMS) development / enhancement

The Challenge

To introduce urban sewage and Municipal Reclaimed Water as production water sources, reduce the normal water consumption, and build an ecological dual circulation management of water system, form an internal virtuous cycle water ecological management system, develop high-quality reclaimed water for external supply to urban wetland parks, and realize the utilization of social resource.

Why?

The need of integration with the city: Taiyuan is a key city for water pollutant reduction and a water-deficient city. With the development of the city, it is not only facing the pressure of domestic sewage collection and treatment, but also building a Fenhe River wetland park with a length of about 6 KM, which needs perennial ecological water replenishment. Adhering to the road of “integration with the city”, TISCO has not only achieved harmony and win-win in the introduction and utilization of municipal sewage and reclaimed water, but also used the high-quality drainage after the bid lifting as reclaimed water for ecological water replenishment of urban wetland parks, creating a model of “integration with the city”.

The need of resource recycling: with the accelerating process of industrialization and the rapid development of social economy, it brings a large number of

industrial wastes such as waste liquid, which not only needs high treatment costs, but also causes environmental pollution that is difficult to control. The large cycle of resource socialization is the key way to solve the problem, it will promote the exchange and utilization of waste resources between enterprises and between enterprises and society, and improve the efficiency of resource utilization through chain symbiosis, mutual supply of raw materials and resource sharing.

Needed Action

1. Build an internal virtuous cycle of water ecological management system

Within the enterprise, guided by process water saving, cascade water use, water control by quality, system coupling, dynamic optimization, high efficiency and intensification, TISCO adheres to the two wheel drive of technological innovation



and management innovation, deeply taps the potential of water conservation and emission reduction, and continuously improves the utilization efficiency of water resources and the performance level of water environment. In recent years, the water recycling utilization rate of TISCO has remained stable at more than 98%, which has greatly alleviated the restriction of water resources.

2. Using unconventional water sources as production water

The domestic sewage treatment facilities of TISCO are used to collect and treat the domestic sewage of residents in the surrounding areas of the enterprise, which is used to replenish the production water of the enterprise; TISCO will use the reclaimed water treated in the urban sewage treatment plant to produce high-quality demineralized water by configuring membrane treatment facilities.

3. Connection of internal and external circulation

In terms of acid control, the acid control at the source of each process is forced by the control of wastewater discharge from the steel rolling process. Each process realizes the discharge of waste acid according to the standard by issuing the concentration control standards of acid for different varieties and units, reduces the use of acid at the source and indirectly reduces the salt discharge.

TISCO has mainly done three tasks in terms of series connection and recycling of waste acid water. First, the series connection utilization of sulfuric acid pickling has been carried out; Second, the reduction of saline wastewater is promoted; Third, the recycling of waste hydrochloric acid in cold rolling process is focused on.

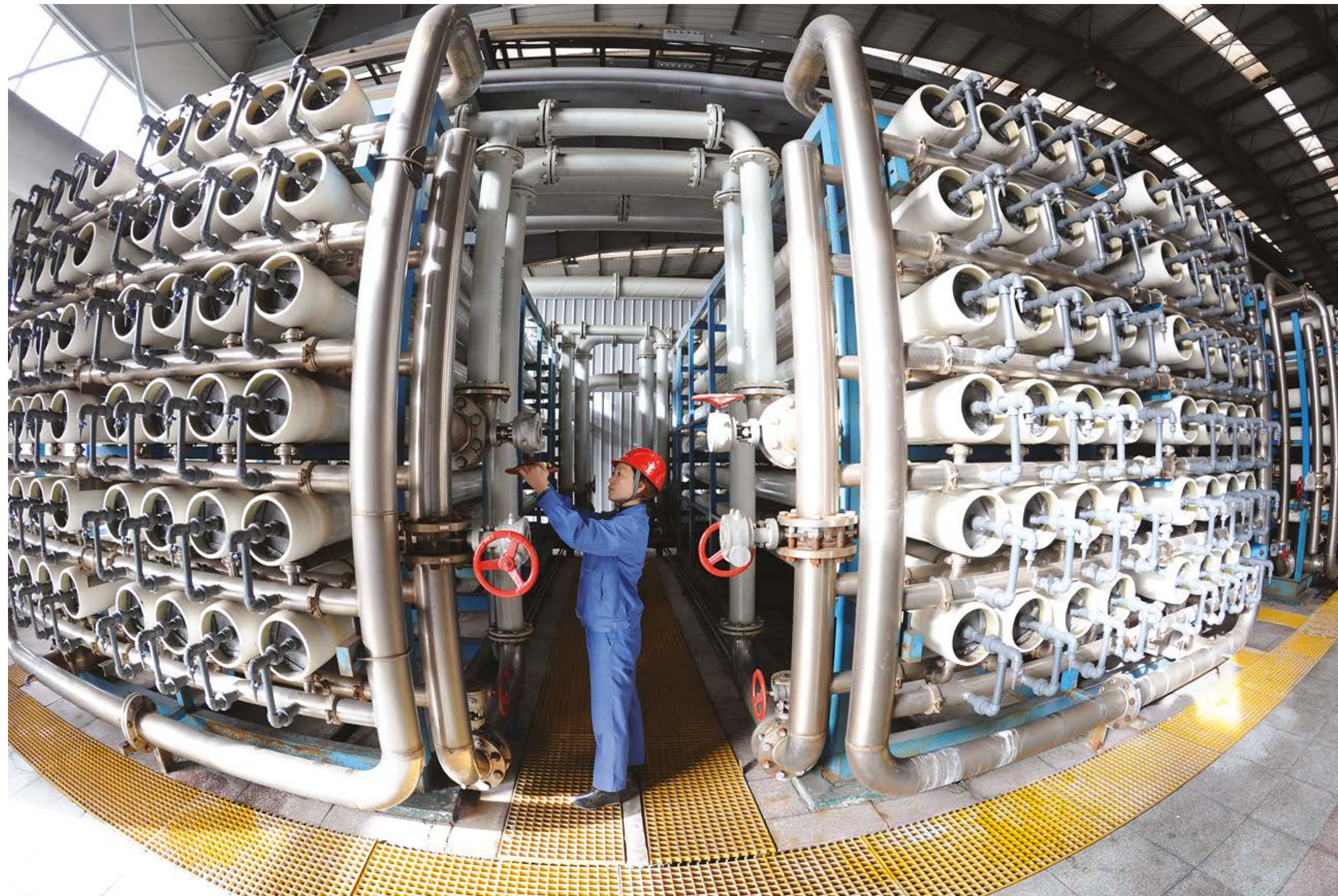
In terms of emission reduction, TISCO has mainly carried out the consumption



and treatment of low-quality water and optimized the allocation of wastewater resources.

In terms of water saving, it mainly

implements high-quality drainage and nearby utilization projects.



4. Social recycling of external water system

Outside the enterprise, according to the concept of circular economy, municipal

sewage, which is "urban waste", is regarded as a valuable water resource for enterprises; The "enterprise waste" of drainage will meet the relevant standards

after recycling and treatment, and will be used as a valuable urban water resource.

After waste exchange, it can be transformed into their own available resources, which improves the overall utilization efficiency of water resources and realizes the harmonious integration of enterprises and cities.

Action Review

Specific;

Since the implementation of the ecological dual circulation management system of water system, a series of fruitful work has been carried out and good results have been achieved. The main work includes:

1. Build an internal virtuous cycle of water ecological management system

Through the investigation and analysis of water quantity and quality of various water sources and drainage of coking, sintering, ironmaking, steelmaking, steel rolling

and water system of the whole company, combined with water balance analysis, the disadvantages and bottlenecks of water system process are determined and optimized.

In accordance with the principles of system planning, key management and control, classified disposal and economic efficiency, TISCO has formulated a water system process optimization scheme, focusing on the "salt extraction" of the water system, separating the high salt water and severe pollution sources originally hidden in the large circulation system from the circulation system, and directly discharging them into the end treatment system reconstructed and constructed by the external drainage upgrading standard of TISCO in 2019 through "short connection", Make full use of the treatment process and capacity of the system to realize high-quality and up to standard discharge of external drainage; At the same time, the original circulating system has been further

improved, the salt content has been reduced, the concentration multiple has been increased, the water replenishment has been reduced, and the operation cost has been reduced. In addition, due to the reduction of treatment difficulty, the effluent quality index has been greatly improved, and the internal circulation of the water system has been operated healthily.

As high salt water and bad pollution sources are recognized as water treatment problems in the industry, in order to ensure the standard discharge of external drainage, TISCO has implemented the connection of internal and external circulation with “salt control, emission reduction and water saving” as the main content around the source treatment of sewage.

2. Connection of internal and external circulation

2.1 Salt control

Through the laboratory analysis, the acid discharge and acid treatment of the rolling system is the main factor affecting the change of salt content in water, and there are two aspects of salt control have been done as below.

2.1.1 Acid control

The improvement space and implement the measures are found out by the quantitative comparison of acid consumption index of pickling.

However, TISCO’s mixed line and hot line have taken the lead in changing to HCl + mixed acid (HNO₃ + HF) in the industry. The pickling process is unique. The use of HCl has greatly increased the salt content in the water treated by the neutralization station (acid ion SO₄²⁻ can be combined and precipitated, while Cl⁻ cannot be neutralized and removed by

lime). Measures need to be taken urgently. Through the benchmarking analysis, it is considered that the pickling consumption of some treatment lines is relatively high, and the high acid consumption means the increase of salt content in the water system, so it is very necessary to control the acid consumption; After the hot line is changed to HCl + mixed acid (HNO₃ + HF), Cl⁻ in the neutralization station increases, resulting in an increase in the salt content of the effluent from the neutralization station, which must be treated separately.

2.1.2 Series connection and recycling of waste acid water

TISCO has mainly done three works in terms of series connection and recycling of waste acid water. First, the series connection utilization of sulfuric acid pickling has been carried out; Second, the reduction of saline wastewater is promoted; Third, the recycling of waste hydrochloric acid in cold rolling process is focused on.

2.2 Emission reduction

In terms of emission reduction, the following work has been done:

2.2.1 Treatment of inferior water

The transformation of alkali injection of blast furnace gas in the No.3 and No.6 blast furnaces and the project of using the wastewater from the South plant area in the processing plant for slag stewing, dust suppression and water pumping are organized and completed, and the absorption and treatment of some discharged inferior water is realized.

2.2.2 Optimization of the allocation of wastewater resources

Combined with the new project, the rational allocation of water resources of the whole company shall be considered as a whole. While meeting the water demand of the new project, the post-treatment drainage of TISCO Jianshan mine and the drainage of 1549mm rolling line turbid circulating water shall be deeply



treated and reused. At the same time, the 1549mm rolling line sodium ion exchanger shall be replaced and eliminated to prepare soft water process, and the part of membrane concentrated brine shall be used for watering and dust suppression in the raw material yard to realize the reuse and emission reduction of wastewater.

2.3 Implements of high-quality drainage projects nearby

A number of long-standing key and difficult projects are organized and implemented, such as constant drainage recovery of 300MW unit boiler, constant drainage and continuous drainage recovery of CDQ boiler, steam condensate and sewage recovery of converter in north area of No. 2 steelmaking mill, AOD waste heat boiler, heating condensate recovery in cold rolling wide area, realized the nearby utilization of high-quality drainage, made significant progress in emission reduction of the company's water system, and realized water saving of 855m³ / h. Through

water-saving management, the new water volume per ton of steel in TISCO is 2.4% lower than that before implementation.

3. Building a water ecological management system with external virtuous circle

TISCO is equipped with a 50000 TONS / DAY domestic sewage treatment system, which is mainly used to treat the urban domestic sewage in the area in and around TISCO.

MSBR treatment process is adopted for domestic sewage treatment. The sewage is separated from large impurities by coarse grid and then flows to the water collecting well by itself. Then, it is lifted by the submersible sewage pump to the grit chamber through the fine grid to remove the inorganic sand particles in the sewage, and then flows to the oil separation sedimentation tank to remove the heavy particle suspended substances and some oil. The effluent from the oil separation

sedimentation tank flows automatically to the MSBR reaction tank for biochemical reaction. MSBR is an improved continuous flow sequencing batch reaction process, which degrades organic pollutants through the growth and reproduction of various dominant bacteria and microorganisms in domestic sewage, and achieves the purpose of nitrogen and phosphorus removal through biochemical processes such as nitrification and denitrification of ammonia nitrogen in sewage, release and absorption of phosphorus. The MSBR effluent is filtered through the fast filter to further remove the residual suspended solids and COD in the water. The filtered water flows into the clean water tank by itself. The water pumped from the clean water tank is disinfected by the ultraviolet sterilizer, and all the disinfected effluent is reused. The effluent is filtered through the fast filter to further remove the residual suspended solids and COD in the water. The effluent goes through the

reverse osmosis membrane (secondary membrane) for advanced treatment and reuse. It can reduce more than 5000 tons of CODs and reuse more than 1800 tons of municipal sewage for the city every year.

TISCO has built an ultrafiltration system + reverse osmosis system for the production of high-quality demineralized water from reclaimed water. The function of ultrafiltration system is to remove suspended solids in water, including colloids, bacteria and other impurities, and provide qualified influent for reverse osmosis: ensure that the turbidity of reverse osmosis influent is less than 0.2ntu and SDI is less than 3; Ensure the safe operation of reverse osmosis system. The ultrafiltration system includes: ultrafiltration water distribution channel filter screen, ultrafiltration unit, ultrafiltration water production suction pump, ultrafiltration cleaning unit, ultrafiltration backwashing unit, ultrafiltration drug preparation and



dosing unit, ultrafiltration product pool and process compressed air storage tank. Reverse osmosis system: the water treated by the ultrafiltration system enters the reverse osmosis system. The primary reverse osmosis device is selected for the reverse osmosis system, and the membrane products are selected with wide inlet channel, strong anti-pollution ability, high desalination rate and stable membrane performance.

After the combined process of “anaerobic anoxic aerobic denitrification nitrification biological activated carbon filter high-density sedimentation tank V-shaped filter contact disinfection” for the end water treatment of the external drainage of TISCO, the drainage water quality is further improved, which fully meets the requirements of the special discharge limit of water pollution of iron and steel enterprises and the standard of urban landscape water, and meets the requirements of environmental protection

discharge, It has created conditions for realizing the great cycle of social resources.

In 2020, the construction of Fenhe River Wetland project will be completed, the whole line will be connected, and the water supply will be successful. While helping Fenhe River to have abundant water, good water quality and beautiful scenery, it also provides a set of brand-new solutions for zero discharge of wastewater from iron and steel enterprises, so as to solve the problem of water discharge from enterprises at the lowest cost and solve the water problem of Taiyuan, a water-deficient city, It is an initiative of the ecological dual circulation management system of TISCO.

Measurable; Over the past two years, the salt content in the external drainage of TISCO has been reduced by more than 35%, the external drainage per ton of steel has been reduced by 7%, and the new water per ton of steel has been reduced by

2.4%; TISCO's reclaimed water reuse Urban Wetland Park project has been completed in 2020, with successful water delivery, realizing the social resource utilization of TISCO's wastewater regeneration.

Achievable; TISCO implemented the water system improvement project with “salt control, emission reduction and water saving” as the main work content by optimizing the disposal process of the water system, so as to realize the benign operation of the internal circulation of the water system; By improving the drainage quality and promoting the “transfer from drainage to supply” of the external drainage of TISCO, the external drainage that has fully met the special discharge limit of water pollution of iron and steel enterprises and the urban landscape water standard will be returned to the wetland of Fenhe River for the replenishment of urban landscape water, so as to participate in the socialized large cycle system, so as to further strengthen the inclusive

development with the city, Realize the win-win situation of internal circulation of steel plant and external circulation of social resources.

Realistic; According to the concept of green and low-carbon cycle development, TISCO carefully examines the shortcomings of the water system. After research, TISCO innovates the water system management and decides to build an ecological dual circulation management system of the enterprise water system, so as to form a virtuous cycle water ecosystem involving production, reuse, treatment, discharge and reuse, running through multiple upstream and downstream processes and spanning the enterprise and society.

Time-bound; The project has been implemented in 2020, which effectively utilizes urban domestic sewage and reclaimed water, and normalizes the treated high-quality water for the wetland of Fenhe River.



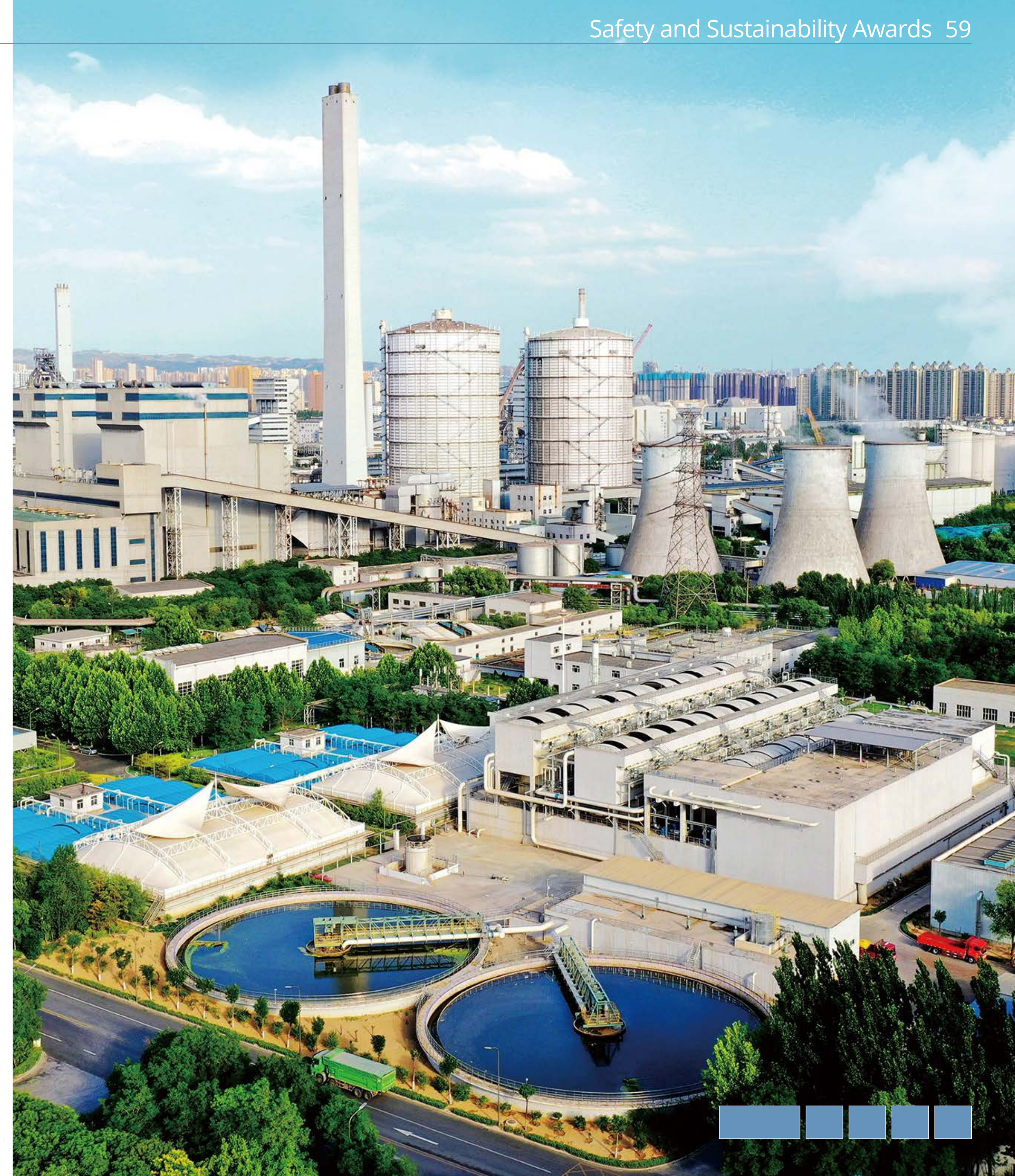
Horizontal Expansion Capability

Ecological dual circulation management of TISCO water system effectively reduces the consumption of new water, and treats the wastewater as high-quality water to feed back to the wetland. It provides a model for water conservation and emission reduction in water deficient areas, and the measures and application concepts adopted can be extended to other water deficient areas.

Outcome

By constructing the ecological dual circulation management system of enterprise water system, 12.12 million cubic meters of urban reclaimed water will

be used and 16.04 million cubic meters of urban sewage will be treated in 2021. Over the past two years, the salt content in the external drainage of TISCO has been reduced by more than 35%, the external drainage per ton of steel has been reduced by 7%, the new water per ton of steel has been reduced by 2.4%, and the operation cost has been reduced by 11.25 million RMB/year; TISCO's reclaimed water reuse Urban Wetland Park project was also put into operation in 2020, with successful water delivery, realizing the renewable resource utilization of TISCO's wastewater, and supplying 30000 tons of high-quality water to the wetland park every day.



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worldstainless is a not-for-profit research and development association which was founded in 1996 as the International Stainless Steel Forum.

Its primary roles are to undertake stainless steel industry beneficial tasks that are better coordinated centrally in the fields of

- Promoting industry and material sustainability benefits
- Conserving resources and promoting the circular economy
- Providing economic and industry-leading statistics
- Support industry health & safety needs and developments
- Outlining market development and expansion opportunities
- Maintaining brand reputational positioning
- Materials education

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