Waste Minimisation and Water Use Efficiency Audit
(Medium Sections Mill, Tremorfa, Cardiff)

VERSION CONTROL RECORD

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1.0 INTRODUCTION

1.1 BACKGROUND

CELSA Manufacturing (UK) Limited is required to undertake a waste minimisation and water efficiency audit of the Medium Sections Mill (SM) installation in accordance with Environmental Permit BV0767IT (formerly Pollution Prevention and Control PPC), permit requirement 2.4.1.2:

"carry out periodic waste minimisation audits and water use efficiency audits. If such an audit has not been carried out in the two years prior to issue of this permit, then the first audit shall take place within two years of its issue. The methodology used and an action plan for increasing the efficiency of the use of raw materials or water shall be submitted to the Agency within two months of completion of each audit and a review of the audit and a description of the progress made against the action plan shall be submitted to the Agency at least every four years thereafter."

As such, the waste minimisation and water use efficiency objectives include identifying opportunities to eliminate waste at source, identifying recycling and recovery opportunities and reduced cost disposal options for unavoidable wastes.

1.2 SCOPE OF THE STUDY

The waste minimisation and water use efficiency study relates to the permitted installation and technically connected activities only, as covered by the Environmental Permit (EP). These include:

- Medium Sections Mill incorporating billet hot rolling;
- Water management systems;
- Water cooling systems;
- Re-heating furnace;
- Descaling;
- Roughing;
- Cooling;
- Raw material handling and storage;

- Product handling and storage;
- Engineering workshops; and
- The handling and storage of wastes.

1.3 WASTE MINIMISATION AND WATER USE EFFIECIENCY STUDY

A waste minimisation and water use efficiency audit was undertaken at the Medium Sections Mill permitted installation. The audit was effectively a two stage audit. The first stage involved the collation of data (for 2018) from the installation, including the quantification of process input materials (raw materials and water), identification and quantification of generated waste materials, wastewater characteristics, and the fate of these materials. The second stage involved a walk through of the facility to identify in broad terms the main raw material and water consuming areas of the permitted process and those areas that generate wastes and wastewater. This was necessary to assess the success of waste minimisation practices currently in practice at the installation and to identify further opportunities following the principles of the waste hierarchy i.e prevention – preparing for reuse – recycling – recovery – disposal.

1.4 REPORT STRUCTURE

This report is structured as follows:

- *Section 2.0 discusses the key waste minimisation study findings;*
- *Section 3.0 discusses the key water use efficiency study findings; and*
- *Section 4.0 provides the overall conclusions and details the action plan for both waste minimisation and water efficiency usage*.

2.0 WASTE MINIMISATION STUDY FINDINGS

2.1 RAW MATERIALS

The main process inputs into the installation are, by the very nature of the process, limited and are typical of a steel hot rolling facility. Raw materials are periodically reviewed for improved performance capabilities and environmental impact as part of the facility's Environmental Management System (EMS), which was re-certified to ISO 14001: 2015 Standard in July 2017, as well as for their efficiency and effectiveness, which is key to the efficient operation of the installation. A comprehensive inventory of raw materials used at the installation is maintained.

The main process materials consumed within the SM include:

- Natural gas;
- Steel billets;
- Oils – hydraulic and lubrication oils; and
- Water (towns water, commercial water (untreated water supply from reservoirs).

Note that water usage is discussed in more detail in Section 3.0.

Ancillary materials, which are used on a much smaller scale, include:

- Solvents (degreasing of engineering parts);
- Greases; and
- Water treatment chemicals (biocides, flocculants, corrosion inhibitor).

The raw materials used at the installation are discussed in detail below, with the quantities used for 2018 presented in *Table 2.1.1*. An exception to this is water usage and effluent generation, which are discussed in Section 3.0.

2.1.1 Natural Gas

The principal user of natural gas is the reheat furnace. The furnace has been operational since 1963 but has undergone the retrofit of energy saving technology. This technology allows for the efficient operation of the furnace. Energy loses are further minimised by a fixed door at the feed inlet and at the exit point a pneumatically operated door which remains closed until a billet is ready for discharge form the furnace onto the rolling stage. Optimal combustion is achieved by controlling the correct volume of air (oxygen) combusted with fuel to minimise excess air, although the furnace runs with a small amount of air to ensure complete combustion thus minimising fuel wastage and smoke generation. The zonal air/gas rates are electronically metered with closed loop feedback of temperature. Combustion air is preheated by means of a flue gas recuperator, this being a horizontal section of the flue gas duct which transfers heat to the incoming combustion air, to further maximise energy efficiency. An exception to this is the pre-heat zone burners, which have waste gas regeneration. The furnace pressure is controlled automatically by a flue damper, which is controlled by a closed loop feedback of furnace pressure to ensure the efficient use of fuel and to maintain optimal furnace conditions.

Energy reduction objectives and targets including natural gas are set each year as part of CELSA's EMS. Associated action plans are developed and implemented. Energy reduction is also being undertaken as a company-wide strategic objective for 2018 and 2019, and CELSA have worked in conjunction with the Carbon Trust to achieve reductions in energy consumption.

2.1.2 Steel Billets

Steel billets of various lengths are delivered to the installation in the main by rail from the melt shop and to a lesser extent by road. The rate at which the billets move through the furnace is PLC controlled to ensure sufficient residence time and to achieve uniform temperature (>1050°C) in the billets.

The input billet lengths are carefully controlled to ensure that an exact number of bars of the required length can be formed. This avoids excessive losses in trimming and left-over undersized bar ends. Any 'crop ends of billets' from the process are recycled back into the steel making process as is any steel scrap accumulated over the site. Yield loss is closely monitored each month to minimise any loss.

2.1.3 Oils

Oils used at the installation include hydraulic and lubrication oils. These are mineral oils and glycol based oils, which by their nature are biodegradable. The oils used in the installation are considered to be optimal for the process. The majority of oils are bulk delivered to the site by one supplier. The oils are stored in bunded storage tanks at the installation. Smaller volumes of ancillary oils used for maintenance purposes are delivered to site in drums. The drums are stored in bunded storage areas.

The oil storage tanks have high and low level alarms and floats to minimise the risk of leaks and of overflow during filling and leaks. The tanks also have hydrostatic pressure transducers in their bases to constantly measure the volume in the tank. These transducers are monitored by a controlling PLC. This ensures that in the event of a rapid loss of oil, for example from a detached delivery hose, that the automatic shut-off of pumps occurs, thus minimising excessive oil losses.

In addition to the minimisation of oil losses, the monitoring of tank volumes also ensures that oils are ordered from the supplier on a needs only basis. This ensures that oil deliveries to and movements across the site are minimised.

Delivery of bulk oil is supervised by an appointed maintenance craftsman to minimise any potential loss.

As part of the maintenance programme regular inspections of all oil systems are conducted throughout the shift to identify any leaks or anomalies. Issues that cannot be repaired immediately due to rolling demands will be added to the SAP worklist for the next scheduled maintenance period.

During scheduled maintenance periods and prolonged roll change periods, maintenance inspections are also undertaken and damaged hoses, corroded/leaking pipework replaced and damaged fittings repaired throughout the mill. Oil consumption over the period 2017 to 2018 increased, this increase was due to a number of leaks and issues with engineering works. The incidents were investigated and actions addressed.

2.1.4 Light Fuel Oil (re-heat furnace back-up fuel)

Light fuel oil is no longer used as a backup fuel due to an uninterrupted gas supply from the grid.

2.1.5 Solvents

Solvents are used for maintenance purposes for the degreasing of mechanical parts. Solvent degreasing is undertaken on a small scale in dedicated solvent degreasing baths, supplied under contract by a number of companies, for example, PureSolve. Solvent is re-circulated through the degreasing system until it is rendered ineffective. The solvent used is a non-chlorinated aqueous-based solvent.

2.1.6 Greases

Relatively small volumes of greases (mineral based) are used at the installation for the lubrication of general plant. Due to the nature of the heavy mechanical equipment at the installation the greases used are considered to be the best available for the process.

2.1.7 Water Treatment Chemicals

Water treatment chemicals used in the water circuits include biocides, flocculants and corrosion inhibitor.

The water treatment plant is managed by a third party contractor on behalf of CELSA. The quantity of chemicals added to maintain the system is very variable, dependant on levels of production and dilution of the system as a result of passive rainfall input via the scale pit and cooling tower well, however the overall quantities are small. The concentration of these chemicals is carefully monitored to ensure that the optimal concentration in the water circuits is maintained.

Raw Material	Quantity Used 2018
Natural Gas	112,352 MWh
Steel billets	261,519 tonnes
Hydraulic & Lubrication Oil	171,493L
Light fuel oil	0 L
Solvents & Greases	142069.5
Biocides	20,000L
Flocculants	15,000 L
Inhibitor	12,000 L

Table 2.1.1: Raw Material Quantities 2018

2.2 RAW MATERIAL MINIMISATION

Raw materials are purchased on the basis of their performance, environmental effects and quality in accordance with the Environmental Management System (EMS), Quality Management System (QMS) and Safety Management System (SMS)/COSHH requirements. Raw material consumption at the installation is carefully monitored and is regularly reported, in accordance with the CELSA's EMS. Material consumption is reviewed against production to allow for the investigation of any abnormalities.

Monthly spot-check audits of the installation are undertaken to identify and resolve any issues on the shop floor. This proactive approach ensures that any wasteful activities are dealt with quickly and efficiently, thus avoiding potential long-term losses of raw materials.

The raw material optimisation techniques employed at the installation are summarised below:

- The selection of raw materials is periodically reviewed for improved performance and environmental effects;
- Full automation of the mill to ensure optimal operation, the minimisation of out of specification products and optimal energy usage;
- Careful control over the selection of billet length to ensure minimal number of leftover end-pieces, which require reprocessing;
- Careful control over the selection of billet length to ensure that the maximum number of final product lengths are obtained with the minimal number of leftover end-pieces, which require reprocessing;
- The dosing regime of water treatment chemicals is undertaken automatically using a redox auto control system, with a weekly dip slide measurement of the system to cross reference the dosing system effectiveness;
- Chlorine levels in the cooling water are continuously monitored, optimising the use of chlorine dioxide;
- Roll life is extended by roll cooling. The reduced wear of the rolls minimises the production of out of specification materials and cobbles and minimise energy usage;
- Work roll lubrication systems are used to reduce roll wear thus extending the life of the rolls and minimising energy consumption;
- The finishing train (Pomini stands) are fully automated by the use of loopers to ensure that mill runs tension free. This minimises out of specification materials and cobbles and minimise energy usage

- Operating procedures are regularly reviewed to ensure the optimum and efficient use of raw materials.
- CELSA operates a preventative maintenance programme which ensures the minimisation of raw material and energy losses through equipment failure and downtime.
- Personnel are trained in operational procedures. This in turn minimises raw material usage and energy consumption

2.3 WASTE STREAMS

The main waste streams generated by the installation are limited and are typical of a steel production facility. The main waste streams include:

- Effluent (discussed in detail in Section 3.0);
- Scale;
- Steel scrap; and
- Oils.

Other wastes, generated on a much smaller scale, include:

- General wastes; and
- Solvents,

The raw materials and generated wastes at the installation are discussed in detail below, with the quantities used for 2018 presented in *Table 2.3.1*. An exception to this is water usage and wastewater generation, which are discussed in *Section 3.0*.

2.3.1 Steel Scrap

Steel is one of the predominant waste streams generated at the site. Scrap metal arising from quality control failed product or from the cutting/trimming of the final products, along with other non-process generated scrap metal, is collected in dedicated scrap metal skips, which are colour coded and labelled, for recycling at CELSA's New Melt Shop.

Steel roll turnings are collected separately in skips. The waste metal is returned for use in the on-site electric arc furnace.

2.3.2 Scale

Mill scale is generated on the surface of the steel following heating in the furnace. The initial scale build-up is removed by the spraying of water from high pressure water jets onto the hot metal surface i.e. the descaling process, although some scale can become detached in the furnace. Subsequent scale build-up is removed by cooling water in the rolling operations. The scale/water mix is directed to the water treatment plant, where it is removed in the scale pits. The scale is then transferred to the central scale weathering area. Scale that has collected in the furnace is collected in a dedicated colour coded labelled skip. Mill scale is then transferred to CELSA's mineral site for bulking up and further dewatering and weathering prior to collection by a licensed waste contractor.

The mill scale has numerous downstream uses such as use as counter-weights in washing machines, sinter charge mix, cement clincker and production of iron sulphate for water treatment.

2.3.3 Oils

Hydraulic and lubricating oils are required in the installation for mechanical processing within the installation. The oils are mineral and glycol-based and are used in the hydraulic systems of mobile plant and for machinery. Waste oils are collected in tanks, sumps and drums. The oils are collected by a licensed waste contractor for off-site recovery.

In addition to these oils, oil skimmings from the clarifiers, which form part of the cooling water treatment process, and from the interceptor, through which wastewater passes prior to authorised discharge to sewer.

Oil skimmings from the clarifier is collected in a tank. When required, the tank is pumped to tanker by a licensed waste contractor for off-site recovery.

Oil skimmings from the interceptor are collected in a waste oil tank. This is removed by a licensed waste contractor when required for off-site recovery.

2.3.4 Solvents

Solvents are used for maintenance purposes for the degreasing of mechanical parts. Solvent degreasing is undertaken on a small scale in dedicated solvent degreasing baths. Solvents are recycled through the degreasing system until they are rendered ineffective. Solvents are replaced by on a regular basis with any waste solvent recovered off site.

2.3.5 General Wastes

General wastes produced at the installation include cardboard, plastic and wood. These wastes are segregated into specific labelled, colour coded skips. General wastes segregated and recycled are paper, cardboard, wood. All waste streams are collected, handles and sent for recycling by a licenced waste contractor. Only when the recyclates are removed are waste is collected by a licensed waste contractor for disposal to landfill.

The quantity of wastes generated at the installation in 2018 are summarised in *Table 2.3.1* below.

Waste	EWC Code	Quantity Generated in 2018 (tonnes)	Recovery/Disposal Option
Scrap metal	200140	17,291.12	R4 - Recycling/reclamation of metals and metal compounds
Millscale	100210	3907.36	R5 - Recycling/reclamation of other inorganic materials
Oil from oil/water separators	130506	18.0	R9 - Oil re-refining or other reuses of oil
Absorbents, filter materials, wiping clothes, protective equipment	150202	73.98	D10 - Incineration on land
Solvents	110113	6	R13 - Storage of wastes pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced)
General wastes	200301	65.39	D1 - Deposit into or onto land (e.g. landfill, etc.)

Waste	EWC Code	Quantity Generated in 2018 (tonnes)	Recovery/Disposal Option
Mixed paper/cardboard	200101	15.12	R5 - Recycling/reclamation of other inorganic materials
Wood	150103	20.46	R5 - Recycling/reclamation of other inorganic materials

Table 2.3.1: Waste Quantities 2018

2.4 WASTE MINIMISATION

CELSA characterises and quantifies each waste stream generated at the installation. CELSA clearly follows the following the principles of the waste hierarchy i.e prevention – preparing for reuse – recycling – recovery – disposal options for waste and actively strives for continual improvement. The majority of wastes generated at the installation or re-used and recycled, with only general wastes and small volumes of various ad-hoc hazardous wastes being disposed to landfill.

CELSA has adopted a number of waste minimisation approaches:

- As part of CELSA's EMS, waste minimisation audits are undertaken annually, with monthly spot-check audits of the installation undertaken to identify and resolve any issues on the shop floor. This proactive approach ensures that any wasteful activities are dealt with quickly and efficiently, thus avoiding long-term losses that may only be picked up during the annual audit.
- As part of the EMS personnel are trained in environmental and waste issues and as well as environmental and waste minimisation initiatives/programmes.
- The prevention – preparing for reuse – recycling – recovery – disposal options for waste materials generated at the facility are regularly reviewed.
- The use of a single waste management contractor to manage the majority of wastes generated at the site ensures a good overall understanding of the requirements of the site in terms of waste and ensures that maximum volumes of waste are transported from the site by the minimal number of vehicle movements.
- Scale from non-oil contaminated areas, such as the furnace, are collected separately and are not mixed with potentially oily process wastewater.

- Waste materials are segregated to avoid cross contamination. Waste skips are colour coded and labelled.
- Waste furnace gases are used to preheat furnace input air. This minimises energy usage and gaseous discharges to atmosphere.
- Waste materials are segregated to avoid cross contamination. Waste skips are colour coded and labelled.
- EMS objectives and targets are set each year. For example, the objectives and targets for 2018 included the reduction of gas by 3% compared with 2017.

3.0 WATER USE EFFICIENCY STUDY FINDINGS

3.1 WATER USAGE

3.1.1 Water Inputs

There are two water sources for the installation:

- Commercial water, supplied from Lisvane Reservoir; and
- Towns water.

Water usage at the installation, due to the nature of the process, is high. There are four main water circuits for the installation:

- Furnace closed circuit cooling system;
- Hydraulic closed circuit cooling system;
- De-scaling and mill cooling water system; and
- Cooling bed stock evaporative cooling system.

The two closed cooling circuit systems require only small amounts of top-up water. This water is supplied from the towns mains supply.

The mill re-circulatory system is primarily to cool the mill rolls and to transport mill scale from the surface of the hot stock to the water treatment plant. Water supplied to the de-scaling and mill cooling system is from the commercial water supply and is used to make up losses as a result of evaporation. The system is recycled through the water treatment plant to remove scale and oil from the cooling water. The 'clean' water is subsequently cooled via the cooling tower and reused in the system. The use of the re-circulation system minimises the requirement for excessive top-up with commercial water due to evaporative losses, water loss through scale removal and during times of maintenance should the system require draining. In addition, water is also recovered from the scale by use of a centrifuge, which concentrates the sludge to a relatively dry scale and returns the water in to the system.

The fourth system is the cooling bed stock evaporative cooling system. This consists of a storage tank, pumps and spray jets, which spray water onto hot stock in order to cool it. The spraying process is carefully controlled to ensure that the correct tensile strength of the material for straightening is achieved and to minimise water losses. Commercial grade water is used in this system.

Dedicated steam cleaners are used in roll preparation. Scraping and moping is used in preference to hosing. Where wash water is needed hoses are fitted with trigger controls, hand lances and other washing equipment.

Rainwater is no longer harvested from the buildings, instead it is directed to the sewer. However, during times of heavy rainfall, the volume may exceed evaporative losses in the mill cooling water system and thus will give rise to water discharge from the cooling tower cold water well to sewer, via an interceptor.

The quantity of water used in 2018 is summarised in *Table 3.3.1* below.

Water Source	Quantity Used for 2018 (m^3)
Commercial	27,249
Towns water (Domestic)	6,046

Table 3.3.1: Water Use Quantities 2018

3.1.2 Wastewater

There are a number of wastewater discharges from the process, namely:

- Water drained from the mill cooling water system as a result of maintenance purposes, is discharged to sewer via an interceptor. This is an intermittent discharge; and
- During times of heavy rainfall, the volume of rainfall entering the mill cooling water circuit may exceed evaporative losses and as such will result in the discharge of water from the cooling tower to sewer, via an interceptor. This is an intermittent discharge. The management of this practice will be improved to minimise losses via the interceptor meter.

In addition to wastewater generation, there are fugitive evaporative losses throughout the process but it is not possible to quantify these.

The small volume of wastewater from the process is discharged, under a trade effluent discharge consent, to sewer. There is no process wastewater discharged to surface water. The volume of wastewater discharged to sewer in 2018 was 1889m^3.

3.2 WATER USAGE AND WASTEWATER MINIMISATION

CELSA, as part of their EMS, has adopted a number of water usage minimisation techniques at the installation. This has resulted in decreases of raw water used in the installation and wastewater discharged to sewer compared with 2012.

Key water usage minimisation techniques include:

- The monthly monitoring of water usage and wastewater volumes against production, with any abnormally high volumes of water usage and wastewater generation being investigated.
- The water treatment plant is operated by trained personnel and the plant is regularly maintained, as part of the preventative maintenance programme, to prevent leaks from pipework and pumps and is monitored for operational efficiency.
- The recirculation of water in the water circuits, with only top-up water being required as a result of evaporative losses and during maintenance, should the systems be drained.
- Minimisation of effluent discharges to sewer as a result of the recirculation of water in the mill cooling water system and the discharge of other sources of wastewater (dewatering of mill scale) into this system. The reduction of effluent discharged to sewer will also result in reduced effluent discharge costs.
- CELSA continue to monitor and target commercial water usage. Weekly monitoring is undertaken and the Section Mill has achieved a significant reduction in water consumption. In 2018, the Sections Mill reduced the water consumption by 38% compared with the previous year. Combining data analysis with site process knowledge has refocused targeting and analysis to identify further areas for reducing water consumption.

4.0 SUMMARY AND ACTION PLAN

4.1 WASTE MINIMISATION, WATER USAGE AND WASTEWATER MINIMISATION

In summary, it is apparent that CELSA proactively seeks ways to optimise raw material and water usage and to minimise waste and wastewater generation.

As part of CELSA's Environmental Management System, CELSA has identified all of its potentially signficant environmental impacts and addresses these impacts throughout all stages of the process, from the procurement of raw materials and water through to the reuse\recycle\disposal options for generated wastes. Objectives and targets are set on an annual basis to deliver continual improvement in the management of these environmental aspects.

CELSA's governance of environmental issues goes beyond compliance with regulatory requirements and the company commitment to EMAS is evidence of this strive to operate our business in an environmentally responsible manner. This is demonstrated through the setting of targets that deliver continued environmental performance.

In addition, through waste minimisation there are many cost savings in adopting a sustainable approach, which in the volatile steel manufacturing industry is paramount to the viability of the company and as such is also a key driver in waste minimisation at the installation.

Through CELSA's procurement process, process design and operation, raw material, water, wastewater and waste monitoring programmes a number of waste minimisation and water usage minimisation techniques for the installation have been implemented, namely:

- Raw materials are carefully monitored and managed, with more efficient and environmentally beneficial raw materials purchased, where possible.
- The process is computer controlled to improve process efficiency and CELSA has implemented a preventative maintenance programme to minimise the risk of equipment failure and material losses.
- The majority of wastes generated at the installation cannot be eliminated and as such the reuse, recovery or recycling of these materials is undertaken, where possible, the option of disposal being the final resort. Currently CELSA recover or reuse over 95% of waste generated and the remaining 5% is sent for disposal, with

a small fraction of solid waste that is sent to landfill. Only small volumes of general waste are disposed to landfill.

- The majority of wastes are segregated to avoid contamination of waste streams.
- Consultation is undertaken with the waste management contractor to highlight areas of improvement and long term strategies.
- Water usage is minimised through the use of water recirculation circuits, which as a result minimises supplied water usage and wastewater generation.
- Consultation is undertaken with water treatment specialists to highlight areas of improvement and long term strategies.
- Where possible generated wastewater is directed back into the water recirculation system.

It is clear that CELSA is already running a substantially optimised process and all of the main opportunities for waste minimisation and process efficiency have been taken.

However, there are a number of generic waste minimisation options that may have further opportunities associated with them. These are detailed in the action plan as presented in Section 4.2 below.

4.2 AREAS FOR POTENTIAL IMPROVEMENT

The following generic waste minimisation and water usage minimisation options will be kept under review by CELSA over the next four years.

(i) Concerning raw materials and waste generation, a renewed focus on reducing oil consumption within the closed system circuit. The obvious benefits include that of less spill, less drum waste (which would include production of oily rags and gloves) and a cleaner mill.

(ii) For water/wastewater, improvements will be made to the continuous monitoring and metering of water within the ‘closed’ mill water system. In addition, CELSA will reduce their effluent discharge through effective management of water usage, balanced with evaporative losses. The combination of which will reduce the cost of water consumption and improve the environmental impact.