PERT ENVIRONMENTAL TECHNOLOGIES

Born as an industrial applications engineering company, **PERTECO** is now able to address most of the **ENVIRONMENTAL ISSUES** that can occur, for both **INDUSTRIAL AND CIVIL SCOPES**. From normative advice to the supply of "Turn Key" plants, these are **PERTECO** main fields of activities:

- ENGINEERING
- PROJECT MANAGEMENT
- SUPPLY OF EQUIPMENT
- SUPPLY OF TURN-KEY PLANTS

PERTECO expertise is focused on the engineering and supply of:

INDUSTRIAL WATER TREATMENT PLANTS

- Water treatment plants for direct reduction plants
- Water treatment plants for steel making shops (EAF, LF, continuous casting machines)
- Water treatment plants for hot and cold rolling mills
- Water treatment plants for drains recovery
- First rain treatment

INDUSTRIAL DEDUSTING AND AIR PURIFICATION PLANTS

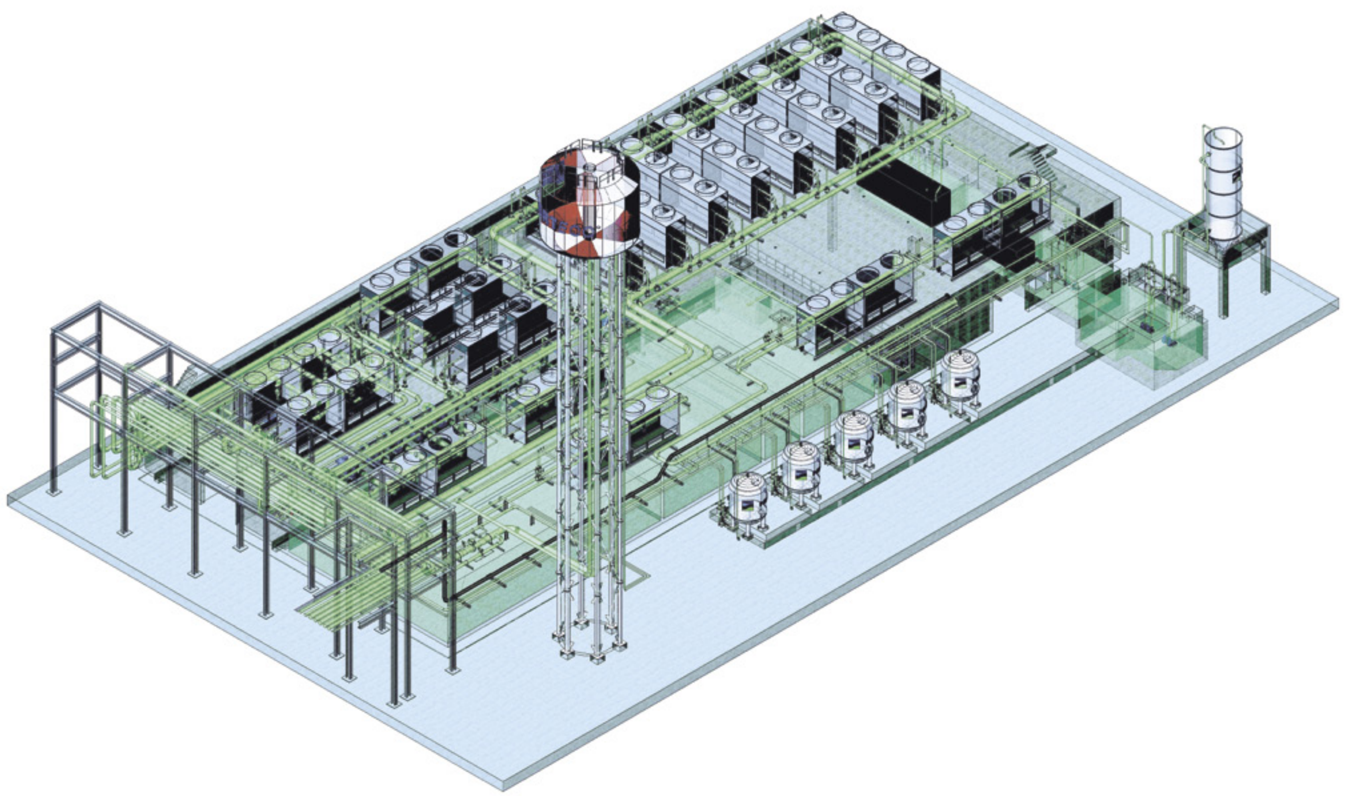
- Dedusting plants for Blast Furnaces and EAF based Meltshops
- Bag filters for Vacuum Degassing Process (VD/VOD)
- Dust collection, handling and transportation systems

OTHER TECHNOLOGIES

- Odour control systems
- Noise evaluation and acoustic insulation

WATER TREATMENT PLANTS

Industries that produce metals, wood, paper, chemicals, gasoline, oils, and most other products all use water in some part of their production process. Industry depends on water, and industrial reliance on water makes it essential to preserve water in every aspect possible and make sure water pollution is kept at minimal levels.



The importance of water in the steel making plants and rolling mills is obvious, especially for the direct cooling circuits where the polluted water is treated in order to reuse it in the plant.

No water no steel: without water, steel could not be produced.
Our mission is to help our Customers in order to improve the quality of the steel products, to guarantee a long life of the equipments and to fight against the environmental consequences reducing the amount of makeup water and waste water at an attractive cost.

Our most important goals are to obtain high reliability, to guarantee low maintenance and low water consumption, to respect the environmental thresholds, and, of course, to respect the technical and quality requirements.

In the steelmaking process, water can be classified as indirect or direct water. Indirect application means the use of water for general purposes where water does not contact the steel in process. Direct water includes all applications of water directly used on the steel process.

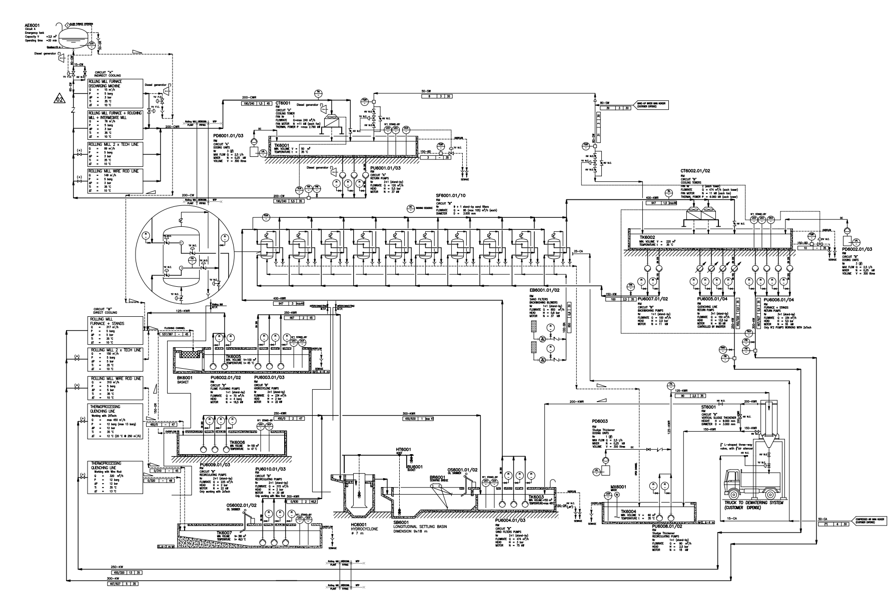
PERTECO gained a lot of experience in the steelmaking water treatment plants such as WTP for:
ELECTRIC ARC FURNACES: the EAF is an extensive user of water, especially indirect. Indirect water applications include water cooled duct, panels, roof, electrode clamps and arms. Direct cooling water is used for slag cooling and for spray cooling system (quenching tower).

LADLE FURNACES: water used in LF is similar to the EAF. Indirect water is used to cool the roof, arms, clamp and other equipments.

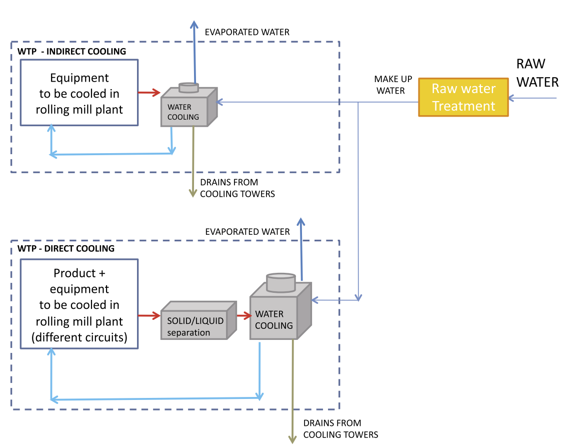
VACUUM DEGASSER: when the vacuum is generated by injecting steam, the steel exhaust emissions are in contact with the steam and the condensate water is polluted by particulate (direct circuit). For indirect circuits, water is used to cool the equipment, depending on different VD design.

CONTINUOUS CASTING: water use and quality are very important in the continuous casting process. Water used in the caster machine is divided in: primary (mould – indirect closed), secondary (spray – direct) and tertiary (auxiliary equipment – indirect open). The primary cooling system needs a very high quality water in order to pass through a copper mould. The spray cooling (secondary) is used at the exit of the mould where allow the cooling of the steel surface. In the tertiary circuit water is used to cool the equipments.

HOT ROLLING MILLS: on the contrary of what happens the EAF, in the rolling mills the greater consumption of water is due to the direct circuits. Indirect water is used for cooling some parts of the reheating furnace (mainly for walking beam and walking heart furnaces), for hydraulic and lubrication units and for water cooled electrical motors. Direct water is used generally on the stands where rolls are cooled in order to prevent surface damages caused by thermal shocks. Adequate cooling water quantity and quality ensure an high grooves working life, reducing the downtimes of the plant due to rolls changing operations. Direct water is also used for inline thermomechanical treatment of the rolled stock, in order to improve the final product quality.



Typical process flow diagram for a rebar & wire rod mill water treatment plant.

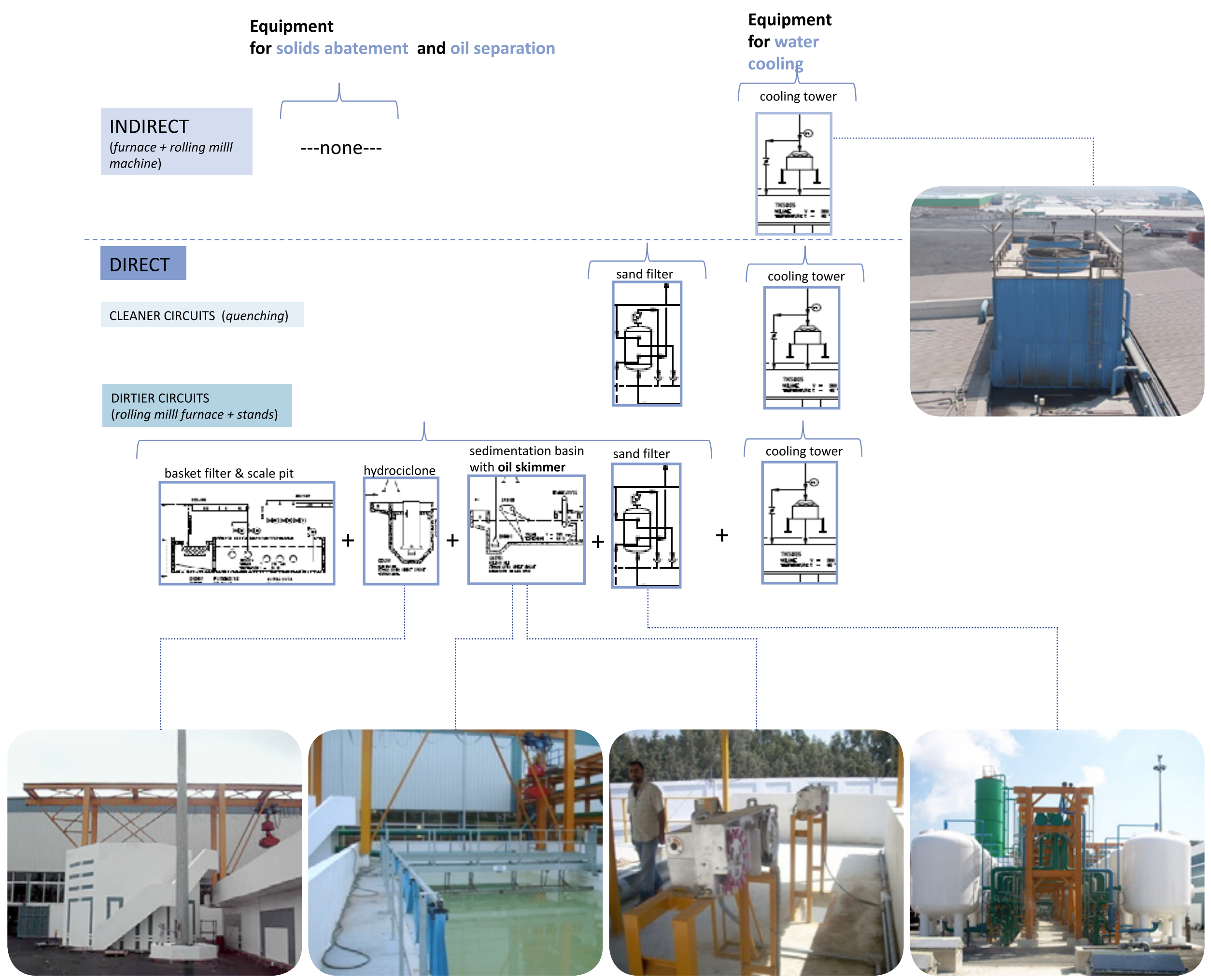


Schematic view of WTP direct and indirect circuits.

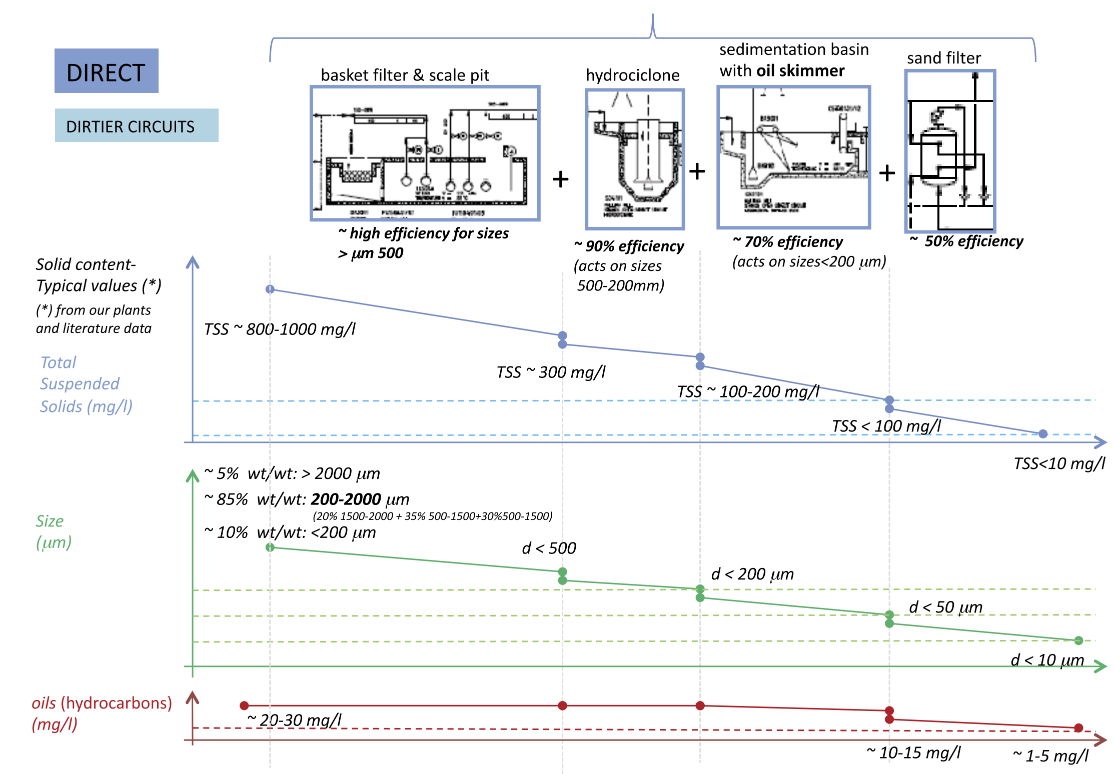
The main equipments installed in a WTP are:

- Horizontal and submersible **pumps**
- Evaporative **cooling towers** for both direct and indirect opened cooling circuits
- **Heat exchangers** for indirect closed circuits
- **Settling basins** (Rolling Mill direct circuits)
- **Filters** (CCM sprays and Rolling Mill direct circuits)
- **Sludge thickeners** and **dewatering systems** (CCM sprays and Rolling Mill direct circuits)
- Dosing units for chemicals addition
- Oil skimmers for oil removing from wastewater

Regarding the cooling water processes, **PERTECO** studies dedicated solutions according to the environmental conditions and the required quality of water.



EFFICIENCY IN SOLIDS AND OIL SEPARATION



For the elimination of suspended solids **PERTECO** has developed an innovative filtering system based on special self-cleaning filters. They substitutes the traditional sand filter, which, anyhow **PERTECO** offers and realizes on the base on its own engineering. Self-cleaning filters have grate advantages, such as a reduced space of installation, lower costs of management and maintenance and a perfect control of the outlet water. This filtering system has a perfect application in the revamping, where the available space is a very important element.
Since the excellent results achieved, **PERTECO** suggests this system also in all the new productive installations.
According to the qualitative and quantitative characteristics of the contaminated water, **PERTECO** is able to study the more suitable type of self-cleaning filters.

Pumping station

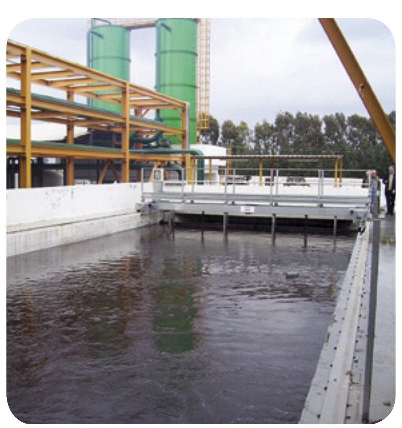
Submergible pumps

Cooling towers

Heat exchangers

Sand Filters

Sludge thickeners



Settling basin

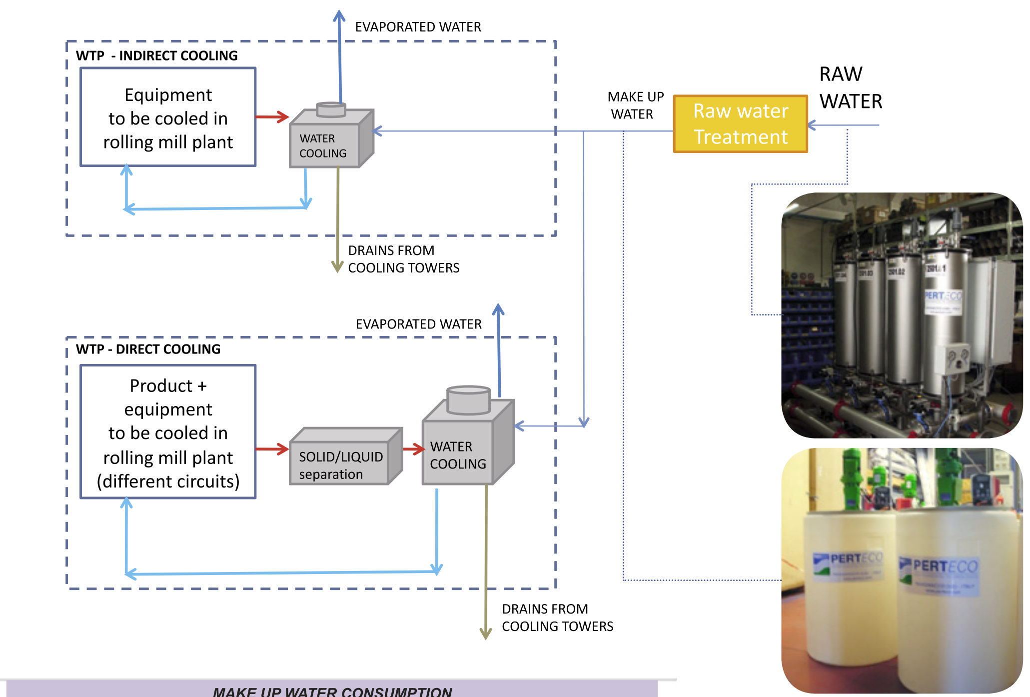
Hydraulic bucket

Electrical&Automation

RAW WATER TREATMENT PLANT

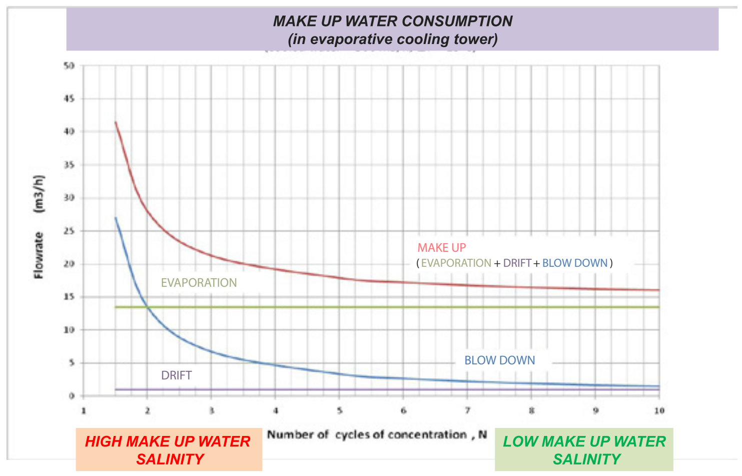
In most cases, the water available on site, is not suitable for direct use as cooling water and must be pre-treated in order to achieve adequate chemical parameters, mainly low water hardness and corrosivity index. The aim of the raw water treatment plant is not only to produce the water of adequate quality, to be used inside the cooling circuits, but also to decrase the water consumption, producing make up water with low levels of salinity. Raw water source can be:

- Sea water
- River or lake water
- Well pits
- Public water supply



FILTRATION AND R.O. UNIT

DOSING UNITS



The use of make up water with low salinity (after being treated with raw water treatment) reduces the water consumption.

PERTECO SOLUTIONS FOR MAKE-UP WATER ULTRA LOW CONSUMPTION

A conventional WTP uses open cooling circuits, with the use of cooling towers and consequent evaporative water loss. For large steel plants evaporative cooling towers are traditionally and widely adopted. This equipment exploits the phenomenon of evaporation of part of the same circulating water for cooling.
The evaporative water loss through such equipment leads to increased salinity within the cooling circuits. This necessitates periodic purging of high-salinity water (drains or blow down) before proceeding with the make-up of lost water (make up water). The flow of make up water must compensate evaporation losses, losses through drains and losses (typically negligible) through dragging implemented by air (drifts).

In order to minimize the consumption of make-up water, the solution was found by acting on two fronts:
- Selection of appropriate equipment for water cooling such as closed circuit cooling equipment (dry coolers and hybrid cooling towers)
- Recovery of discharges of the WTP for re-use within the same WTP after appropriate treatment.

REAL CASE: WTP FOR TPY MELTSHOP (MIDDLE EAST)

COOLING WATER NEED:
approximately 10.300 m^3/h
of cooling water flowrate

THERMAL POWER TO BE REMOVED:
approximately 200 MW

MAKE UP WATER:
Approximately 120 m^3/h

USERS:
- **170 tLS EAF**
- **170 tLS LF**
- **CCM (6 strands)**
- **Air separation plant**
- **Melt shop FTP**
- **Other Users (CA Station, SVC)**

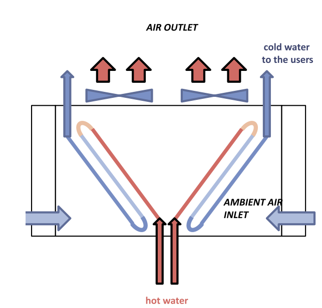
The equipment to be adopted has been selected as follows: DRY COOLERS for cooling of the FTP (B2 circuit). HYBRID TOWERS for all other circuits

	Flow rate (m^3/h)	T_{in} (°C)	ΔT (°C)	P_t (kW)
circuit A 1 (EAF, LF)	318	35	13	4,807
circuit A 2 (Air Separation Plant)	765	35	10	8,895
circuit B1 (EAF, LF, Auxiliaries)	2,425	35	~16	43,988
circuit C1 (CCM indirect)	732	35	15	12,767
circuit C2 (CCM mould)	1,000	40	8	9,302
circuit D (CCM direct)	560	35	15	9,767
Total	5,800			89,526
circuit B2 (FTP)	4,530	55	20	105,348

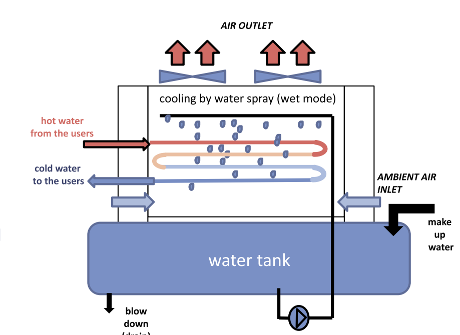
COOLING TOWERS WITH CLOSED CIRCUIT: DRY COOLERS AND HYBRID-COOLING TOWERS

The dry coolers and hybrid-cooling towers represent viable alternatives to reduce water cooling consumption.
In fact the dry coolers cool the water circulating in a closed coil without leakage. Cooling occurs by heat exchange through forced flow of ambient air, with the use of fans included in the cooling equipment.

The hybrid-cooling towers represent an intermediate solution between the traditional cooling towers and dry coolers and can operate in either wet or dry mode depending on climatic conditions. Even in such equipment the water intended for the cooling of Users circulates in a closed coil. Cooling can be performed by spraying cooling water (wet) from the outside or by forced ventilation only (dry).



DRY COOLER (example)

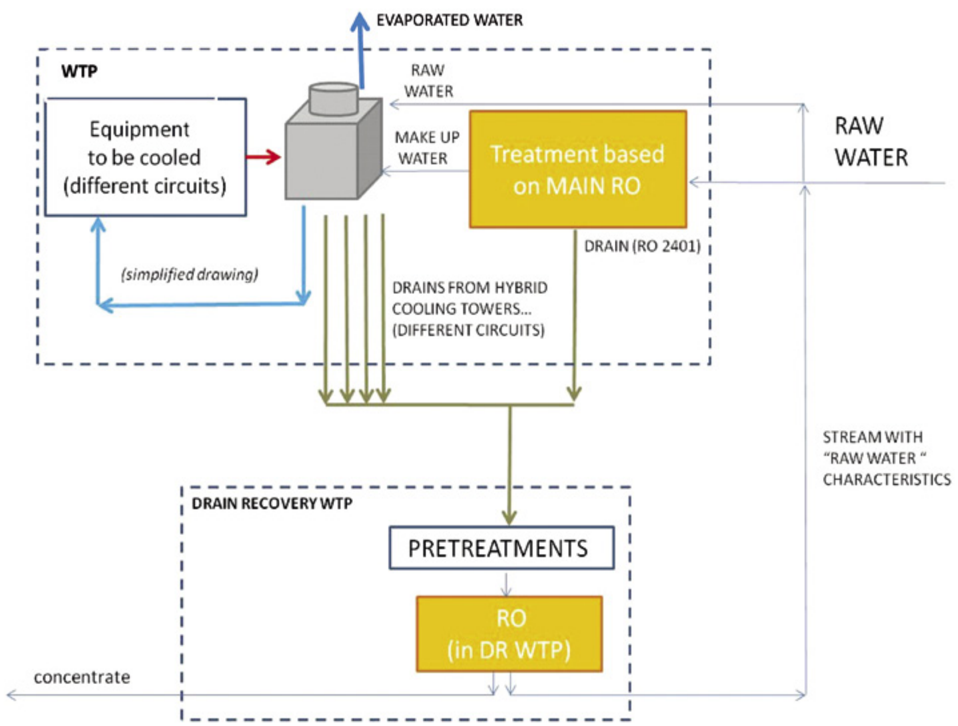


HYBRID COOLER (example)

CLOSED CIRCUITS

PROCESS IMPROVEMENT: DRAIN RECOVERY WTP

The drains from hybrid cooling towers and the concentrate discharged from the reverse osmosis, can be treated to produce water with quality similar to raw water. Much more than 50% of the discharges can be recovered from the recovery system, through adequate pre-treatment and dedicated reverse osmosis.
This recovered flowrate corresponds to the raw water saved by adopting the DR-WTP.



>50% OF TREATED DRAINS ARE RECOVERED

PERTECO SOLUTIONS FOR MAKE-UP WATER ULTRA LOW CONSUMPTION

ADDITIONAL ADVANTAGES: LESS CHEMICALS CONSUMPTION AND LESS WASTEWATER TO BE DISCHARGED

COMPARISON WITH THE TRADITIONAL SOLUTION

	WATER (design conditions)					
	RAW WATER consumption - daily average (m^3/h)	MAKE-UP WATER fed to cooling towers -daily average (m^3/h)	WTP footprint (m^2)	Volume of WTP concrete tanks (m^3)	POWER INSTALLED in WTP (kW)	Chemical conditioning consumption for MAKE-UP WATER (kg/h)
Reference case (only traditional evaporative cooling towers)	~ 600	~ 430	4,050	6,885	6,280	12,5 kg/h dosing 30 ppm in make up water
Adopted solution (hybrid and dry coolers + DR-WTP)	~ 120	~ 160	9,300	4,590	7,999	5 kg/h dosing 30 ppm in make up water
Variation (adopted/ reference)	~ 1:5	~ 1:2.5	~ 2.5 :1	~ - 35%	~ + 25%	~ 1:2.5

REFERENCE WATER TREATMENT PLANTS

Steel Meltshop
Water Treatment Plant
(Middle East)

PROJECT HIGHLIGHTS
- Plant Capacity: 1'500'000 tpy
- Total flow rate: 10,000 m³/h
- Raw water treatment plant
- Drains recovery
- Dry coolers and Hybrid cooling tower

Steel meltshop VD / LF circuit
Water Treatment Plant
(Europe)

PROJECT HIGHLIGHTS
- Plant Capacity: 1'000'000 tpy
- Total flow rate: 550 m³/h
- Heat exchanger and cooling tower units
- Horizontal pumps
- Automatic dosing unit system

DRAIN WATER RECOVERY > 90 %
MAKE UP WATER (WELL WATER) SAVING
~ 30%

Steel Meltshop
Water Treatment Plant
(Middle East)

PROJECT HIGHLIGHTS
- Plant Capacity: 800'000 tpy
- Total flow rate: 6,300 m³/h
- Raw water treatment plant
- Drains recovery
- Dry coolers and Hybrid cooling tower

DRI Based Steel Making Complex
Water Treatment Plant for drains recovery
(Africa)

PROJECT HIGHLIGHTS
- Plant Capacity: 2'000'000 tpy
- Total flow rate: 280 m³/h
- Elimination of any liquid discharge

Steel Meltshop
Water Treatment Plant
(Middle East)

PROJECT HIGHLIGHTS
- Plant Capacity: 650'000 tpy
- Total flow rate: 5,100 m³/h
- Raw water treatment plant
- Evaporative cooling towers

Rebar and Wire Rod Mill
Water Treatment Plant
(Middle East)

PROJECT HIGHLIGHTS
- Plant capacity: 480,000 tpy
- Direct circuits: 1,600 m³/h
- Indirect Circuits: 550 m³/h
- 6 Sand Filter 5,000 mm diameter

Rebar and Wire Rod Mill
Water Treatment Plant
(Middle East)

PROJECT HIGHLIGHTS
- Plant capacity: 350,000 tpy
- Direct circuits: 1,400 m³/h
- Indirect Circuits: 350 m³/h
- 14 Sand Filter 3,000 mm diameter

Rebar and Wire Rod Mill
Water Treatment Plant
(South-East Asia)

PROJECT HIGHLIGHTS
- Plant capacity: 300,000 tpy
- Direct circuits: 1,100 m³/h
- Indirect Circuits: 300 m³/h
- 10 Sand Filter 3,000 mm diameter

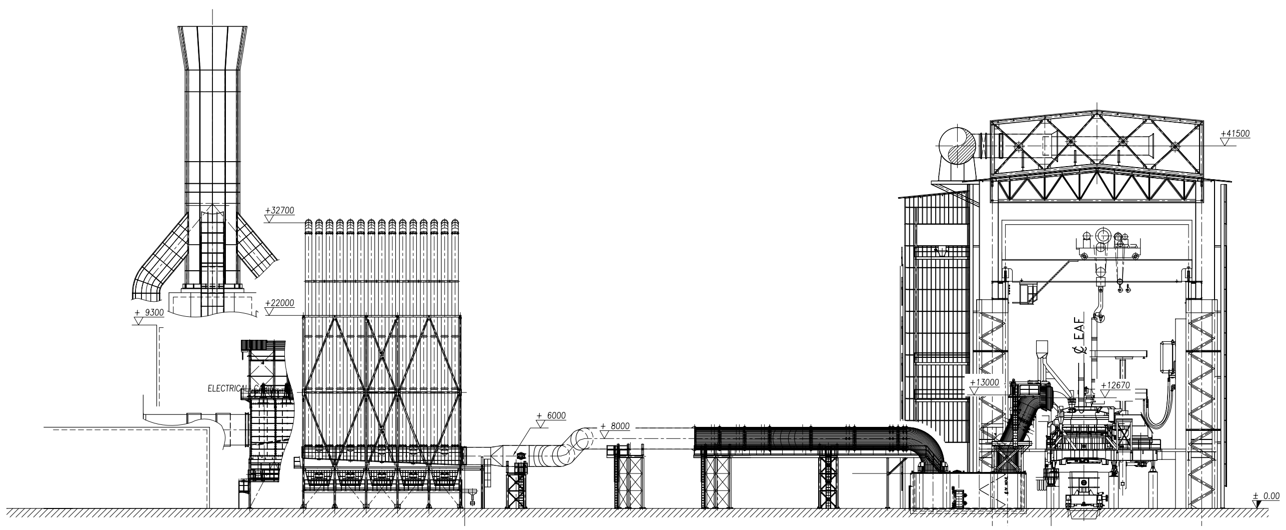
FUME TREATMENT PLANTS - GENERAL

The FTPs have the aims of:
- Collecting fumes efficiently, maintaining a healthy indoor ambient inside the steelwork
- Treating fumes before the final discharge to the atmosphere, to comply with the local emission limits.

Mainly the concentration of dust and micro-pollutants (including "dioxins") has to be efficiently abated in FTP. Plants with high performances that have to respect stringent regulations usually comply with the following environmental requirements:

- Indoor air quality: 5 mg/Nm³ in the EAF working platform zone
- Emissions at the stack: max. 10 mg/Nm³ of dust and max 0,1 ng-ITEQ/Nm³ of dioxins.

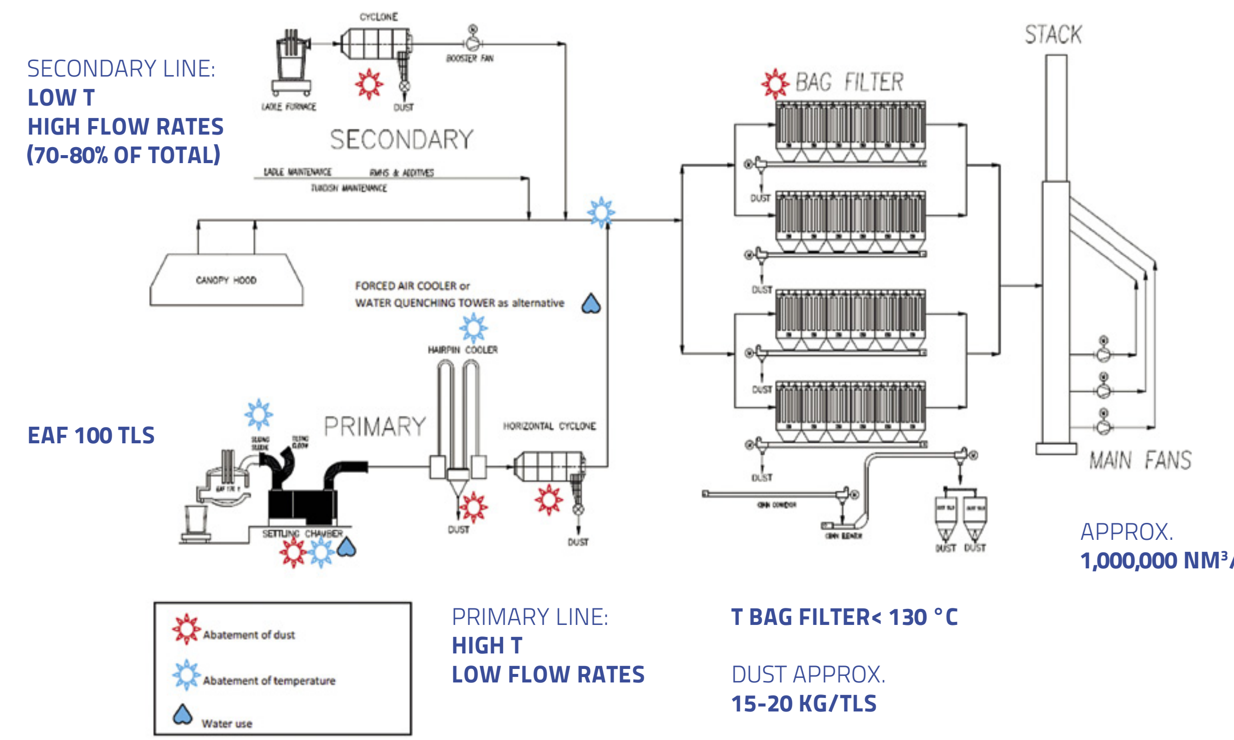
Plants sized to respect the limits at the stack easily comply with all other stack limits, regarding other pollutants like SOx, NOx, metals and so on. In fact a key factor for good performances is the abatement of dust. It also contributes to the abatement of most micro-pollutants and metals present in the solid phase in the final part of FTP before the stack.



Key factors that affect the FTP design.

FACTOR	EFFECTS ON FTP
Plant size and operation parameters	General size
Kind of charge (scrap and its pollution by organic materials-plastics and oil-, DRI), charging mode (batch by buckets or continuous)	Size of hood and suction from Secondary Line Sizing of Primary Duct: Clean scrap: ↓Primary; ↓Secondary; Intermediate cleaning scrap: ↔Primary; ↔Secondary Dirty scrap: ↔ Primary ; ↑Secondary DRI: ↔ Primary; ↓Secondary
Environmental limits at the stack	Filter bag size Choice of cooling equipment Possibile adoption of micro-pollutants abatement special devices
Environmental limits for indoor air quality inside the steelwork	Hood size
Steelwork internal layout	Hood Primary Ducts path and Secondary suction lines path (e.g. LF.)
Site layout	Path for ducts, pressure losses, fans size, choice of single equipment
Water availability on site	Primary Ducts characteristics (e.g. WCD working mode, cooling equipment selection) FTP characteristics linked to WTP
Energy requirements Customer interest in energy recovery	Energy recovery system in first part of Primary Line

TYPICAL PROCESS FLOW DIAGRAM



The main dedusting plant areas for steel Meltshop are:

Primary line: the off-gas produced during the melting phase are evacuated by means of a water cooled duct trough a settling chamber, where heaviest particles are settled, till a cooler unit. The main and most utilized cooler units are: **Hairpin Cooler** (HPC), **Forced Draught Cooler** (FDC) and **Quenching Tower** (QT). After the cooler units the fumes are collected to a mixing unit where is possible the mix with the secondary fumes line. Secondary line: the fumes produced during all the furnace phases, especially during the charging, are evacuated by means of a canopy hood installed on top of the furnace and the trough a series of ducts are collected to a mixing point here below described.

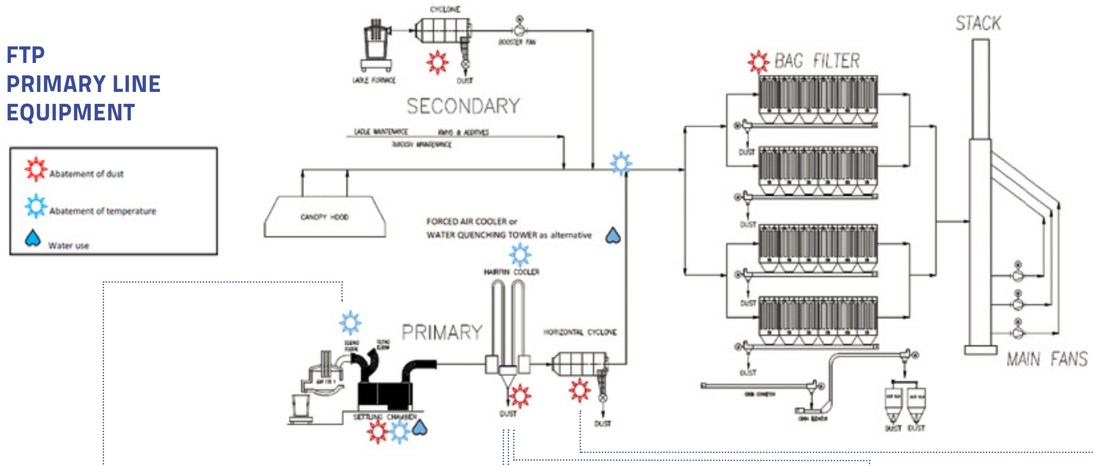
Auxiliary line: the fumes produced in the **Raw Material Handling System** (RMHS), in the **Ladle Furnace** (LF) and in all the other **suction points** (e.g. maintenance areas) are collected in the secondary line by means of a dedicated **booster fan**.

Common line: after the mixing point the cooled fumes are collected to the **filter unit** (pulse jet bag filter) through a **spark arrestor** (axial cyclone). After the filtration the fumes are let in the atmosphere. The aspiration of the fumes is possible by means of a series of **axial fans** located after the filters and before the **chimney**.

Dust transport system: all the dust evacuated from the single machines (hairpin cooler, axial cyclone and filters) are transported by one set of chain conveyor and stored in a storage silo.

FUME TREATMENT PLANTS

FTP PRIMARY LINE EQUIPMENT



WATER COOLED DUCT

HAIRPIN COOLER

WATER QUENCHING TOWER

AIR FORCED COOLER

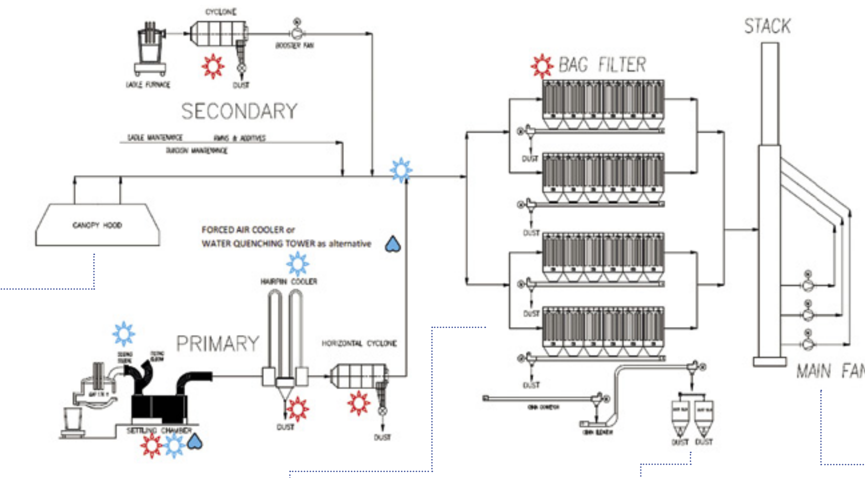
HORIZONTAL CYCLONE

WCD cools down fumes to a temperature allowed by single wall ducts steel, that is around 600 °C. The diameter of the WCD is usually defined limiting fumes speed to 40÷50 m/s, while water in each single pipe has a velocity of approximately 2 m/s. The WCD is sized to remove desired thermal power from fumes.

Phases Hairpin Cooler: fumes dry cooling by natural convection.
Water Quenching Tower: fumes quick cooling by water injection.
Air Forced Cooler: fumes dry cooling by forced convection (using fans).

Axial cyclone is foreseen in order to stop high temperature particles not stopped by settling chamber and hairpin cooler, avoiding that these particles could contact filtering bags with subsequent burning and holes formation.

FTP SECONDARY LINE EQUIPMENT



CANOPY HOOD

BAG FILTER

DUST SILO

MAIN FANS

For traditional EAF, discontinuously charged with frequent roof opening, the hood must be positioned and dimensioned to intercept nearly all fumes exiting the EAF during the charging operation. The Canopy hood volume will be regulated according to maximum flow rate foreseen, allowing fumes to be retained by the hood for nearly 10 seconds.

The filtering unit is typically a Bag Filter with Pulse Jet Cleaning, using cylindrical bags as filtering surface. The material is usually polyester felt, with adequate surface density. Special materials are also available, for high temperatures or special treatments for resistance to sparks (self-extinguishing).

Dust collected from the cooling equipment, cyclone filter and bag filter is discharged and conveyed by a set of chain conveyors and chain elevators in a vertical dust silo.

The main centrifugal fans necessary for fumes suction in the FTP are installed around the concrete plenum where they receive fumes free of dust (maximum 10 mg/m³), so the impellers can be more efficient, without any risk for erosion problems. The number of fans varies from two to four according to the required flow rate and pressure head.

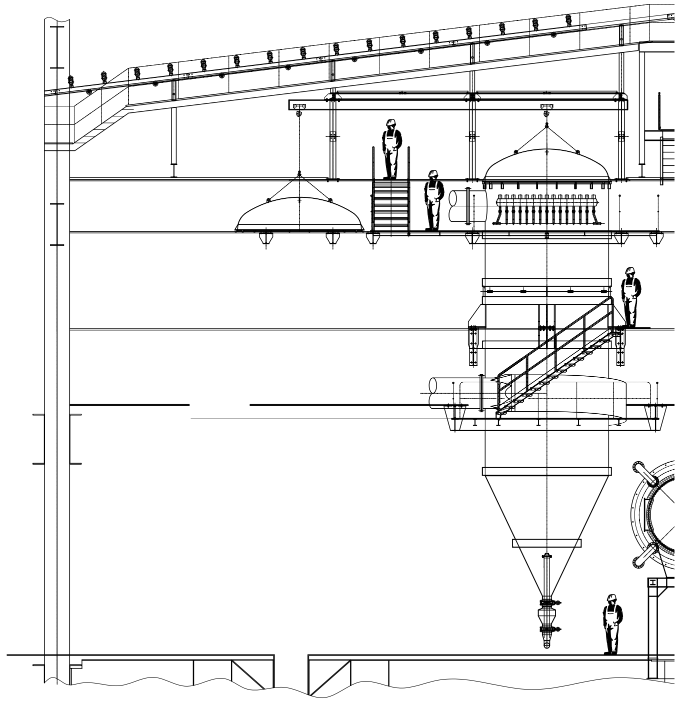
Lignite Injection System

The Lignite Injection System is considered as BAT for dioxins abatement, both if added to cooling with QT or alone. It consists in a cylindrical silo where fine lignite dust is stored, and from which it is injected into fumes, just upstream the bag filter. Lignite particles will contact PCDD/F ("dioxins") molecules and will adsorb them. Subsequent deposition of lignite on the filter surface will also remove PCDD/F from fumes. For optimum dioxins removal, together with minimum lignite concentration in fumes, a minimum distance between the lignite injection point and the bag filter must be granted.

VACUUM DEGASSING BAG FILTERS

Steelmaking is divided in primary metallurgy (melting furnace) and secondary metallurgy (tapping ladle). Secondary metallurgy is a necessary step to obtain the required characteristics of steel before casting.
In the production process of high quality steel production, the degassing process is essential in order to assure a high standard of quality.
When the vacuum is generated by means of mechanical pumps, before them and after the stationary tank, a Vacuum Bag Filter is an essential equipment in order to assure an higher reliability to the vacuum pumps.

Other advantage related to the vacuum pumps is that these pumps does not require steam generation, so the water treatment plant size is therefore reduced.
Starting from the technical and metallurgical data **PERTECO** is able to supply or to design the **VACUUM BAG FILTER**.



REFERENCE FUME TREATMENT PLANTS

Steel Meltshop Dedusting Plant
(East-Europe)

PROJECT HIGHLIGHTS
- EAF, LF and RMHS dedusting plant
- Plant capacity: 800.000 tpy
- Charging flow rates: 1.800.000 m³/h
- Melting flow rates: 920.000 m³/h
- Filtering surface: 18.810 m²

Steel Meltshop Dedusting Plant
(Asia)

PROJECT HIGHLIGHTS
- EAF, LF and RMHS dedusting plant
- Plant capacity: 1.000.000 tpy
- Charging flow rates: 2.050.000 m³/h
- Melting flow rates: 1.320.000 m³/h
- Filtering surface: 24.000 m²

REFERENCE FUME TREATMENT PLANTS

Steel Meltshop
Dedusting Plant
(Middle East)

PROJECT HIGHLIGHTS
- EAF, LF and RMHS dedusting plant
- Plant capacity: 650.000 tpy
- Charging flow rates: 1.500.000 m^3/h
- Melting flow rates: 940.000 m^3/h
- Filtering surface: 15.056 m^2

Steel Meltshop
Vacuum Degassing Bag Filter
(Europe)

PROJECT HIGHLIGHTS
- Vacuum process dedusting system
- Flow rate: 145.000 m^3/h
- Filter diameter: 3.600 mm
- Filtering surface: 330 m^2
- Automatic discharge for pyrophoric dust

Steel Meltshop
Dedusting Plant
(South East Asia)

PROJECT HIGHLIGHTS
- EAF, LF and RMHS dedusting plant
- Plant capacity: 1.200.000 tpy
- Charging flow rates: 2.500.000 m^3/h
- Melting flow rates: 1.000.000 m^3/h
- Filtering surface: 26.000 m^2

Steel Meltshop
Vacuum Degassing Bag Filter
(South-East Asia)

PROJECT HIGHLIGHTS
- Vacuum process dedusting system
- Flow rate: 465.000 m^3/h
- Filter diameter: 3.800 mm
- Filtering surface: 510 m^2
- Automatic discharge for pyrophoric dust

REFERENCE FUME TREATMENT PLANTS

Steel Meltshop Dedusting Plant
(Europe)

PROJECT HIGHLIGHTS
- EAF, LF and RMHS dedusting plant
- Plant capacity: 600.000 tpy
- Charging flow rates: 1.000.000 m^3/h
- Melting flow rates: 800.000 m^3/h
- Filtering surface: 13.000 m^2

Steel Meltshop Dedusting Plant
(Middle East)

PROJECT HIGHLIGHTS
- EAF, LF and RMHS dedusting plant
- Plant capacity: 1.150.000 tpy
- Charging flow rates: 2.400.000 m^3/h
- Melting flow rates: 1.200.000 m^3/h
- Filtering surface: 26.000 m^2

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