

SWEDISH STEEL PLANT GOES GREEN AND AVOIDS CLOGGING WITH CONTINUOUS SAND FILTERS

By Steve Minett, PhD

A major steel plant on the east coast of Sweden has recently installed a new rolling mill. In conjunction with this, they've introduced the principle of 100% recycling of both the process water and slag resulting from the cooling process. As part of their effort to implement this, they've installed a DynaSand filtration plant.

They now take in less water than they did before they built the new mill and the water they do discharge is cleaner than the river water they take in. In addition, they have no clogging problems in the thousands of nozzles used in their low-pressure cooling system.

SSAB Oxelösund is a subsidiary of SSAB Svenskt Stål which is one of the biggest manufacturers of commercial steel in northern Europe. Steel is produced and processed at three main locations in Sweden; heavy plates and slabs are manufactured in Oxelösund, steel sheets in Borlänge and slabs in Luleå. The heavy plate production range includes plates with a thickness between 4 mm and 155 mm, widths up to 3.4 m and lengths up to 18 m. SSAB has concentrated on the development of quenched and tempered steel and produces two 'branded' forms of steel; HARDOX, an extremely wear-resistant type of steel and WELDOX, structural plates with yield strengths above 400 N/mm². These products are used wherever high wear-resistance and strength must be combined with good weldability and formability properties.

SSAB's Oxelösund plant is currently the world's leading manufacturer of quenched and tempered wear and structural steels. Steel making in Oxelösund is fully integrated with heavy plate being produced by the continuing casting process. Oxelösund is situated 110 km south of Stockholm and has excellent connections for shipment by road or rail or by sea from its own harbour. The Oxelösund plant has just built a new rolling mill. Its original rolling mill dates from 1960 and the



The outlet from the Växjö treatment plant.

new one has been built in the same line. The old mill is 12 m high and weighs 1000 tons. The new mill is 17 m high and weighs 2000 tons. The total cost of the new mill was approximately SEK 1650 million. The new mill has been designed to improve product quality and offer new opportunities for process and product development. It will also ensure adequate capacity for the more time consuming Hardox and Weldox products. The project started in 1995, commissioning began in late 1997 and full operation at the end of 1998.

Why Dynasand?

When asked why SSAB Oxelösund decided to install a DynaSand water filtration plant, Jan-Erik Bengtsson, Project Leader for the water treatment

plant for the new mill, explained that: "We had two main motivations. First and foremost was our environmental policy: with the establishment of our new mill, we introduced the principle of 100% recycling. This means that our goal is to recycle all the cooling water used and all the slag produced by the cooling process. Consequently, following cooling we have to separate the slag from the water, clean the water for reuse and return the slag to the blast furnace, where it is an excellent raw material."

"Our second motivation was of a purely technical nature. The cooling water we use needs to be of a very high standard of purity. This is because during the last stage of the steel plate production pro-

cess known as the Direct Cooling stage we use an advanced cooling system which requires very clean water: the equipment consisting of 37,000 nozzles, with a diameter of approximately 4 mm and about 100 mm in length. Water is discharged through these nozzles under very low pressure, more or less just gravity. The nozzles can easily become blocked, especially because the water passing through them is under very low pressure.” It has been calculated that the minimum requirements for water quality for this process are as follows; there should be less than 10 mg of suspended solids per litre and the content of oil or grease should be under 2 mg per litre. (Oil and grease tend to leak into the cooling water from the rolling mills’ lubrication systems.) The plant’s Direct Cooling stages requires up to 15,000 m³ of water per hour and, as far as Jan-Erik Bengtsson knows, it’s the only one (or one of very few) currently in operation in Europe.

The principle of the Dynasand filter

The great advantage of the DynaSand filter is its elimination of the problem of downtime for backwashing. This problem has conventionally reduced the efficiency of sand filters. The DynaSand filter has overcome it by eliminating backwashing: fouled sand is continuously removed from the filter bed, washed and recycled without interruption to the filtration process. The DynaSand filter is based on the counterflow principle. The water to be



The filter hall at Växjö treatment plant.

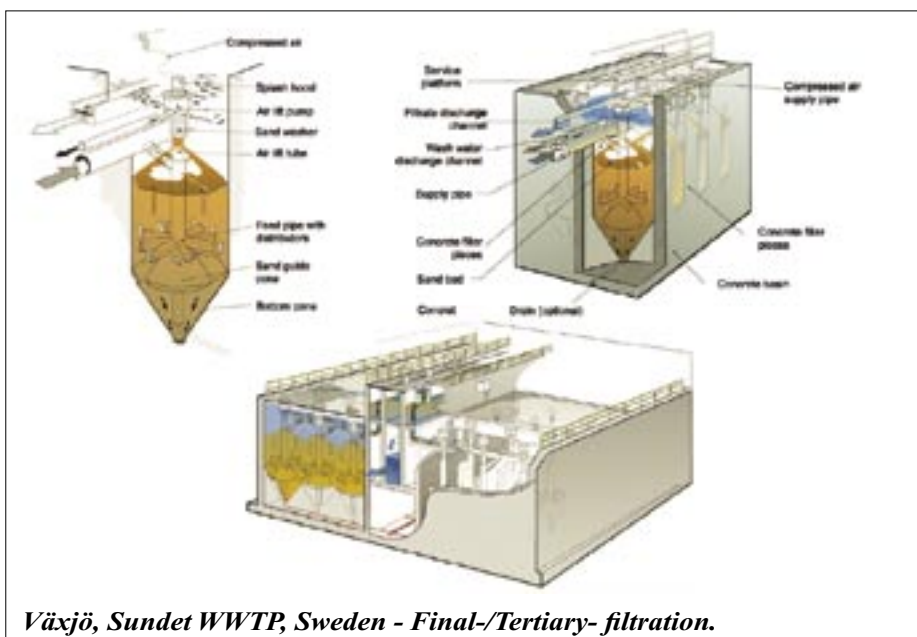
treated is admitted through the inlet distributor (1) in the lower section of the unit and is cleaned as it flows upward through the sand bed, prior to discharge through the filtrate outlet (2) at the top. The sand containing the entrapped impurities is conveyed from the tapered bottom section of the unit (3), by means of an air-lift pump (4), to the sand washer (5) at the top. Cleaning of the sand commences in the pump itself, in which particles of dirt are separated from the sand grains by the turbulent mixing action. The contaminated sand spills from the pump outlet into the washer labyrinth (6), in which it is washed by a small flow

of clean water. The impurities are discharged through the wash water outlet (7), while the grains of clean sand (which are heavier) are retained to the sand bed (8). As a result, the bed is in constant downward motion through the unit. Thus, water purification and sand washing both take place continuously, enabling the filter to remain in service without interruption.

Turnkey project

“Apart from the building which houses the equipment, the DynaSand plant at SSAB Oxelösund was constructed as a turnkey project by Nordic Water Products (which is part of the Water-link Group). It currently consists of 20 DynaSand units, although it is designed to accommodate up to 30 units, should future expansion be required,” explains Bo Andersson, Nordic Water Products’ project manager for the Oxelösund DynaSand plant.

All of the units are in continuous operation 24 hours a day. Precipitation is brought about inside the DynaSand units by adding a chemical coagulant, polyaluminium chloride (know commercially as Mitfloc 1093). The function of this coagulant is to form flocs from the oil and finer particles. The coagulant is added at the inlet to the DynaSand units and then the flocs are filtered out by the DynaSand’s sand-bed. As regards the performance of the DynaSand units at Oxelösund, the



Växjö, Sundet WWTP, Sweden - Final-/Tertiary- filtration.

suspended solid content of the filtered water is down to around 5 mg per litre and the oil and grease content is also significantly reduced.

Slag and water recycling

The Oxelösund plant's recycling process operates as follows: there is a basin under the rolling mill which collects both the cooling water and the slag formed on the surface of steel by the roller cooling. This basin empties by gravity to a large sump, which receives about 1,000 m³ per hour of the slurry formed by the cooling water and slag particles. Slag recovery is achieved in three stages. For the first stage a crane with a bucket jaw mechanism is positioned above the sump. Periodically it is lowered into the sump and to extract the large pieces of slurry. The crane deposits these in a container, which is removed and eventually emptied into the raw material feed for the blast furnace.

The finer slurry is pumped up to two sedimentation basins where the slurry is sedimented out. The slag which settles out here is removed and returned to the blast furnace. This is the second stage of slag recovery. The water from the sedimentation basins, containing the finest slag particles, goes into the DynaSand plant. Having been filtered out of the water, these finer slag particles, together with the oil and grease



The Växjö plant has a population equivalent of 85,000 of which 25,000 is from industrial sources.

removed by the DynaSand filters, are compressed into a brick-like form and returned to the blast furnace. Prior to the installation of the DynaSand plant these finer slag particles would have been simply discharged in the plant's wastewater.

The cleaned water from the DynaSand plant is channeled into two large underground rock-cavern storage facilities. These have a total capacity to store 57,000 m³ of water. All the process water for the plant is drawn from these storage caverns. The raw water for the plant is originally taken from the nearby Nyköping river. This can contain up to 14 mg of suspended solids per litre. In addition to the 15,000 m³/hr required by the plant's Direct Cooling system, between 600 to

800 m³/hr of process water is required by the rolling mills themselves and all these flows have to be maintained 24 hours a day. Of the water which passes through the DynaSand filter plant about 80% goes directly back into the plant's water recycling system. The remaining 20% is diverted into longer term storage. While the principle of more or less 100% recycling of the cooling water is maintained, the plant has other process water systems which do discharge water. Consequently, the plant still has a significant intake from and discharge to the river.

Discharge cleaner than intake

However, Jan-Erik Bengtsson makes the following points about this: "Firstly, by implementing our new philosophy of water recycling we've been able to reduce our exchange of water with the river despite building a second rolling mill in the plant - which has obviously significantly increased our consumption of process water. Secondly, - and I would say remarkably - the quality of the water which we're discharging from the plant is now actually higher than the quality of the water which we're taking in from the river. The DynaSand filters have certainly helped us to achieve these results." <<

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