NERVES OF STEEL

By John Hayden & Dan Finn

Production is underway at the new ThyssenKrupp Stainless USA and ThyssenKrupp Steel USA 3,700-acre processing complex near Mobile, Ala. The $5-billion project, which began the process of commissioning for production in July 2010, is a cooperative effort between the two business segments of the company's Materials Div., creating a unique production partnership that allows for cost-sharing in areas such as infrastructure, logistics and processing.

Latest treatment technologies safeguard environment at steel facility

Four ACTIFLO Turbo units, each with a design capacity of approximately 3,300 gpm, provide clarified water to the complex. Total treatment capacity for the process water system is 14.4 mgd.

ARTICLE SUMMARY

Challenge: The steel industry has faced tough challenges in the past regarding its water supply, usage and treatment.

Solution: Three major advanced conditioning and treatment systems are industrial supply, two-stage biological and physical/chemical metals polishing.

Conclusion: These advanced treatment technologies enable the production of high-quality water within a small footprint, compared to conventional systems.

The new carbon steel facility has an annual manufacturing capacity of 4.3 million metric tons of products that will mainly serve the automotive, construction and pipe and tube industries in addition to the appliance and service center industries. The new stainless steel plant initially will operate at 1 million metric tons of products annually. It is one of the only mills in North America with the capability to produce 72-in.-wide cold-rolled steel, which is often in high demand by the tank manufacturing industry because wider steel allows for fewer welds. The stainless steel facility will serve the appliance, tank, pipe and tube markets and service centers.

Advanced Treatment

One of the many highlights of the new state-of-the-art complex is advanced water and wastewater treatment. As a significant consumer of water, the steel industry historically has faced tough challenges regarding water supply, use and treatment. Applications in the industry typically involve high heat, critical non-contact cooling, high suspended solids, oil and grease contamination and complicated cascading. Significant amounts of water evaporation also occur from cooling towers and direct-contact cooling applications. Due to the large quantities of water required and the increasing emphasis toward sustainability and resource recycling, high-quality process water and stringent wastewater treatment are critical.

These challenges are being met at the new ThyssenKrupp Alabama complex through advanced conditioning and treatment systems. Three major systems include: 1) an industrial supply water treatment system that treats Tombigbee River water; 2) a two-stage biological treatment system that treats sanitary wastewater from within the production facilities, as well as industrial wastewater with concentrations of organic loadings; and 3) a physical/chemical metals polishing treatment system that processes effluent from the two-stage biological treatment system and inorganic industrial wastewater that has been pretreated at various production areas within the mills.

The treatment systems were designed and built by N.A. Water Systems, a Veolia Water Solutions & Technologies Co. Both the river water intake and wastewater treatment projects were completed in May 2010. The systems are operated by Veolia Water North America under a long-term contract.

Water Supply Treatment

Tombigbee River intake water is filtered through a passive screen to prevent aquatic life entrainment, and then solids are removed via coagulation, flocculation and ballasted settling in Actiflo Turbo systems before storage and distribution to the mill.

ACTIFLO Turbo is a high-rate flocculation and settling process that utilizes microsand as a seed for floc formation. The microsand also acts as a ballast or weight within the floc. Polymer solution is added to the units to aid in floc formation. The resulting floc settles quickly, allowing for compact clarifier design and short retention times. The use of microsand ballast enables the process to perform well under dramatically changing flow rates without impacting the final effluent quality and allows a unit to be brought online in a matter of minutes rather than hours.

Four Actiflo Turbo units, each with a design capacity of approximately 3,300 gal per minute, provide clarified water to the complex. Total treatment capacity for the process water system is 14.4 million gal per day (mgd). The current level of treated water in storage determines the flow rate of river water to the Actiflo units.

Wastewater Treatment Processes

The 5.8-mgd-capacity wastewater treatment facility consists of both biological treatment and physical-chemical treatment systems.

The biological treatment system primarily relies on a conventional activated sludge process, with some waste streams pretreated in an AnoxKaldnes moving-bed bioreactor (MBBR) for organics removal. Effluent from the biological treatment system is then treated in the physical-chemical treatment system, which includes a Turbomix reactor for hexavalent chromium reduction and metals precipitation/crystallization. This is followed by sand-ballasted clarification through two Actiflo Turbo package plants.

AnoxKaldnes MBBR technology is an aerobic biological treatment process that uses buoyant plastic media to grow the biofilm, which is retained in an aeration tank using media retention screens while an aeration system provides air to allow the bacteria/biofilm to provide the treatment required. The process is designed to handle extremely high loading conditions, yet the system will typically occupy only one-quarter of the space required by a conventional biological treatment plant with comparable capacity.

The Turbomix reactor is a proprietary design of a draft-tube reactor that combines the advantages of plug flow and complete mixing, reducing the reactor tank volume by minimizing dead zones and decreasing reagent loss by preventing short-circuiting. Solids are recirculated in the draft-tube reactor to support the quick growth of large crystals, resulting in a reduction of the retention time requirement.

These advanced treatment technologies, developed by Veolia Water Solutions & Technologies, enable the

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In the physical-chemical system, two ACTIFLO units separate non-dissolved metals and other matter from treated wastewater.

production of high-quality water within a very small footprint, compared to conventional systems.

Biological Treatment

The ThyssenKrupp mills will have internal emulsion-breaking processes for handling oily coolant and lubricant wastewater. Following these processes, wastewater is sent to two 53,760-gal MBBR aeration tanks operating in parallel, and the MBBR effluent flows are split and sent into two activated sludge systems operating in parallel. At the splitter box, pH is monitored and controlled by dosing with caustic. In addition, phosphoric acid and ammonium hydroxide are added to support biomass growth in the activated sludge process.

Other industrial wastewaters are pretreated using pH adjustment and free oil separation in coalescing plate separators. These streams are then delivered to the activated sludge process along with effluent from the MBBR process. An aeration system provides dissolved oxygen for microorganisms and mixing to maintain a uniform environment within the aeration tanks. From the aeration tanks, the mixed liquor flows to the two activated sludge clarifiers. Within the activated sludge clarifiers, quiescent conditions allow the biomass to flocculate and settle. Supernatant from the clarifiers is conveyed through two of three ultraviolet disinfection systems.

Physical-Chemical Treatment

Mill wastewater treated in the physical-chemical metals polishing process includes effluent from the biological treatment processes, contact cooling water blowdown, acidic wastewater from pickling operations as well as neutralized, pretreated wastewater from pickling operations.

The physical-chemical system includes five main unit operations:

1. Chemical and hydraulic equalization of waste streams;
2. Chemical reduction of hexavalent chromium to trivalent chromium;
3. Chemical addition and pH adjustment in a Turbomix reactor to reduce metals solubility via precipitation and adsorption;
4. Oxidation via aeration to treat unreacted sulfide and reduce residual iron solubility; and
5. Actiflo sedimentation to separate the undissolved metals and other particulate matter from the treated wastewater.

After sedimentation separation, the treated wastewater undergoes final pH adjustment. The stream is then combined with uncontaminated noncontact cooling water from the mills, passed through final effluent monitoring and discharged to the river through a multi-nozzle diffuser. WWD

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