12th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2008, Istanbul, Turkey, 26-30 August, 2008

PROBLEM OF WASTEWATER EMISSION FROM ZENICA STEELWORK

Mahmutović Aida, Muhamedagić Sulejman
Faculty for metallurgy and materials, University Zenica
Travnička cesta 1, 72000 Zenica, BiH

ABSTRACT
Steel production is an energy- and water-intensive process: large quantities of water are used for cooling, process and environmental-technical applications.
Wastewater emissions from coke oven plants, blast furnaces and basic oxygen furnaces are the most relevant emissions to water in this sector. The steel industry continues to make use of diverse technical options to improve its closed-loop water management practices.
Steelwork Zenica has been in existence for more than 115 years. The factory ceased its work during the war in Bosnia and Herzegovina from 1992 to 1995. The full re-initiation of the Steelwork is planned to take place in the summer of 2008 and raises the issue of future quantities and quality of wastewater and additional pollution of the Bosna river.
Keywords: BiH steel industry, wastewater treatment, water recycling

1. WORLD CRUDE STEEL PRODUCTION
In 2007 world crude steel output reached 1,343.5 million metric tons (mmt) for the first time - a new record. This is an increase of 7.5% on 2006. In 2007, the top three steel producing countries remained China (489.0 mmt), Japan (120.2 mmt), and the US (97.2 mmt). Steel production output in the EU (27) increases in 2007 with 210.3 mmt of world steel production [1].

Large amounts of water of differing quality are needed for the various steps in the production of steel. In total, approximately 100 m^3 of water are needed to produce a ton of steel.

Important challenge for steel producers in the new EU member states surrounds their ability to comply with the EU's environmental legislation. For instance, the steel industry will have to implement the Integrated Pollution Prevention and Control Directive (IPPC) and ensure that its operations, including energy efficiency, conform to BAT-best available techniques. It must also satisfy existing EU standards on wastewater treatment, air quality and waste management.

The steel industry continues to make use of diverse technical options to improve its closed-loop water management practices. The steel industry's water management in Germany effort is exemplified by the multiple uses of rinsing waters, the re-use of process water flows, and the introduction of slag granulation systems relying on process or cooling water. As a result of these activities, the industry's specific water consumption has decreased by 66% in the 1983 to 2001 period, Figure 1. Its absolute water consumption fell from about 1.2 billion m^3 to about 0.6 billion m^3 even as crude steel outputs rose from 35.7 million tonnes in 1983 to 44.8 million tonnes in 2001, [2].

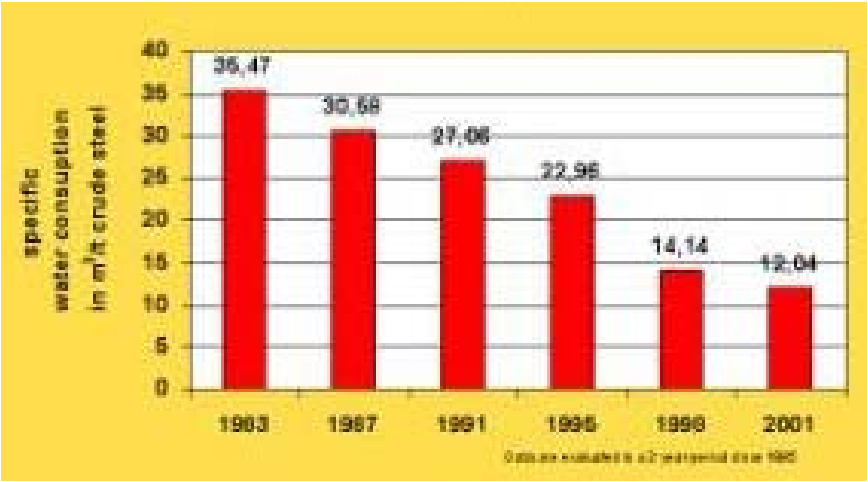

Figure 1. Specific water consumption in steelmaking in Germany [2].

Over the same period, wastewater volume were cut by about 45% although the water requirement of metallurgical processes remained virtually the same. Today, water is used eight times before it is discharged as waste.

Legislative requirements on wastewater quality are met through wastewater treatment:

- discharges should be avoided by using such operations (e.g. dry gas cleaning techniques) which cause no discharges to water;
- process water, polluted cooling water and polluted stormwater should be treated separately from unpolluted cooling water at each plant;
- installation of closed water systems should be developed for process water and polluted cooling water in order to reach a circulation rate of at least 95%;
- production processes, utilization of by-products, waste- and stormwater treatment technology should be developed in order to minimize discharges (e.g. slag granulation by process water);
- internal and external measures should be taken to minimize accidental discharges
- sludges and other solid waste should be utilized or when not possible disposed of in a manner causing minimal environmental hazard *(e.g.* preferably by treating and entering the sludges to the blast furnace, sintering plant or electric arc furnace*)*;

2. WASTEWATER EMISSION FROM ZENICA

Steelwork Zenica, BiH, has been in existence for more than 115 years. The factory ceased its work during the war in Bosnia and Herzegovina from 1992 to 1995. The full re-initiation of the Steelwork is planned to take place in the summer of 2008 and raises the issue of future quantities and quality of wastewater and additional pollution of the Bosna River.

For technological needs Steelwork Zenica obtains water from the Bosnia River. In the current work of the Steelwork Zenica technological wastewater is generated in the plants: forge, electric arc furnaces (100 t), rolling mills, maintenance, traffic-transportation, "Rača"-dump. Furthermore, commencement of integral starting production, foreseen during 2008, will include of additional plants: sinter plant, blast furnace, coke oven plant, BOF-plant and complete energetic. Recirculation systems of water supply with cooling and water purification systems were built in plants with larger water consumption (electric arc furnaces 100 t, rolling mills and steam power plant).

The water management in the Steelwork Zenica in the pre-war time primarily depended on the local conditions. Occasional analyses of wastewater were carried out in the work of the Steelwork Zenica. These mostly included data collection in relation to location quantity and analysis of wastewater. In this process, high degree of pollution was registered in regard to these proscribed limiting values [3]. There was no monitoring of wastewater from individual plants. The only analysis of wastewater is carried out at the level of entire factory in order to determine pollution of wastewater.

It is estimated today that wastewater in the pre-war time production of the Steelwork Zenica were twice more "polluted" when compared to 2001. Plants were working in full capacity and technology was less advanced. Additionally, ecologically unsuitable raw-materials and fuel were used. In the meantime closed loop water cooling system in the EAF steelmaking plant and rolling mill were developed and more advanced water purification systems were introduced (for example DSD system) so the level of pollution decreased.

A comprehensive approach to address technological wastewater of all plants of the Steelwork Zenica is based of the following:

- minimizing emissions by applying the best available technologies;
- conceptualizing the flow of wastewater with the maximum degree of return, i.e. recirculation;
- channeling wastewater in the separated sewage system with in-built devices for wastewater purification at the end of technological process in plant;
- continuous monitoring of wastewater in the sewage water discharged into Bosnia River;
- reduction of the pollutants in the wastewaters discharged into Bosnia River within the limits agreed by the BAT technology.

To address these issues, there should be made significant investment in production technologies and operating practices. Alongside efforts to conserve water resources, minimize wastewater generation and dispose of wastewater efficiently, it is becoming increasingly important to deal safely with water-polluting substances in all plants. The introduction of specialist department "Energetika" dedicated to dealing with the water management supports the maintenance of high environmental standards in Steelwork Zenica plants.

3. WASTEWATER EMISSION FROM COKE OVEN PLANT

It should be noted that coke oven plants have a relatively large number of emission sources. A number of water flows are generated during the coking process and coke oven gas cleaning. Major wastewater streams are generated from the cooling of the coke oven gas and the processing of ammonia, tar, naphthalene, phenol, and light oil. Wastewater treatment systems include screens and settling tanks to remove total suspended solids, oil, and tar; steam stripping to remove ammonia, hydrogen sulfide, and hydrogen cyanide; biological treatment; and final polishing with filters. Target wastewater loads per unit of production, presented in best available techniques reference document for coke manufacturing should be achieved [4].

Wastewater Treatment Plant in example of the Best Practice of Dunkerque is presented in Figure 2, [5] and includes:

- sand filtration: to eliminate the hydrocarbons and PAH from the water
- two stripping stills to eliminate: ammonia, cyanides and sulphides dissolved in the water
- biological treatment plant (nitrification and denitrification).

Application of advanced technology for wastewater treatment from the biological treatment station that the results are under European Directive, and achieving:

- Wastewater : Flow = 110m^3/h
- COD <150 mg/l and 60 g/t coke
- N Global < 100mg/l and 30 g/t coke
- SS < 35 mg/l & PAH< 10 µg/l.

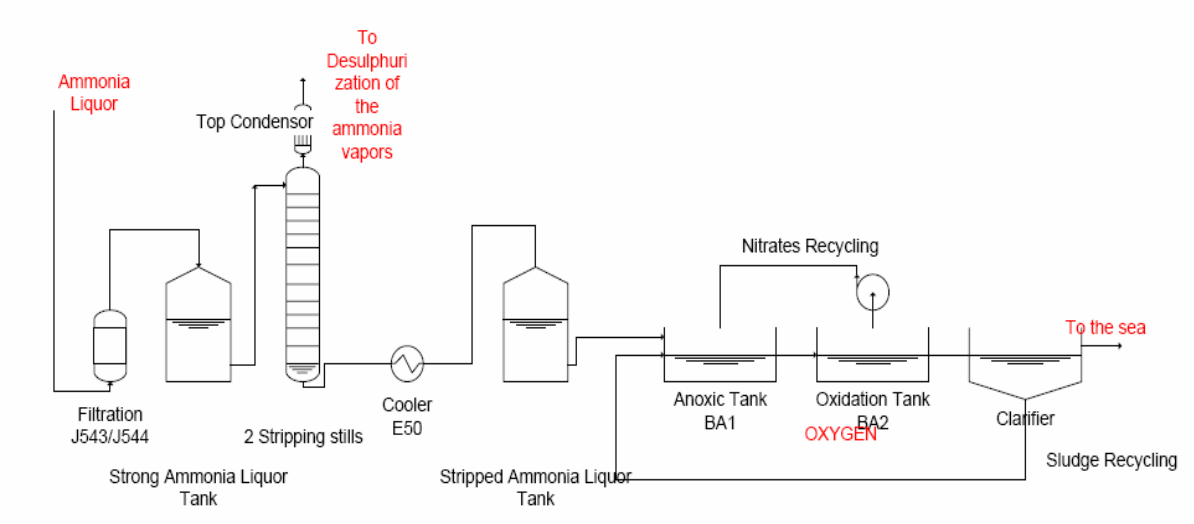

Figure 2. Process Flow Diagram -Wastewater Treatment Plant [5].

4. CONCLUSION

European steel industry will have to implement the Integrated Pollution Prevention and Control Directive (IPPC) and ensure that its operations, including wastewater treatment conform to best available techniques.

There was no monitoring of wastewater in the Steelwork Zenica in the pre-war time. Today pollution prevention of wastewater in the Steelwork Zenica is focused on reducing emissions, developing new steel-making techniques, continuous monitoring and control measures by applying the best available technologies.

5. REFERENCES

[1] The International Iron and Steel Institute (IISI) http://www.worldsteel.org/
[2] http://www.stahl-online.de
[3] Katastar zagadjivača otpadnih voda grada i industrije Zenica, Februar 1984, Izvještaj Metalurškog instituta Zenica
[4] Integrated Pollution Prevention and Control (IPPC)-Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001
[5] F. Honnart - Wastewater Treatment Plant – Best Practice of Dunkerque -Global Coke-making KMP 2007-Gent, Belgium