ISASMELT™-based Reconstruction of a Lead Plant

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Abstract

In 2010-2013 Engineering Dobersek GmbH was involved in a new project to modernize a lead smelting plant for a metallurgical producer in Kazakhstan with an annual production of 100,000 tons of refined lead ingots. The existed lead smelting process was upgraded by the replacement of the traditional sinter plant to a blast furnace operation through the modern TSL technology.

Engineering Dobersek GmbH was responsible for the general design of the smelter plant and the basic and detail engineering as well as the supply of the following auxiliaries:

- feed preparation
- cooling water system
- gas cleaning system
- smelter shop ventilation and heating system
- slag casting machine
- lead bullion discharging system

Also the erection management, commissioning of the delivered equipment and staff training was included in the project scope.

One of the core components was the lead slag casting machine which produces the slag pigs to charge the existing blast furnace for the reduction step. The full automatic two lines casting machine was designed by Engineering Dobersek GmbH with a casting capacity of 45 - 60 t/h. The casting temperature of lead slag is approx. 1,150 °C. The slag is air-cooled by natural convection, then by means of forced convection and at the end of the machine by means of water spray in order to cool the briquettes below 300 °C. The off-gas of the lead smelter is captured very effectively, cooled, cleaned and sent to the sulphuric acid plant. The modernization of the lead plant has accompanied with a significant reduction of harmful emissions into the environment.

Objective: Full-Scale Extraction of own Raw Materials and complete Off-Gas Utilization

Introduction

Kazzinc is a major fully integrated zinc producer with considerable lead, gold and silver credits located in Kazakhstan. Along with increased base of raw materials currently developed by the company the percentage and importance of copper in the entire polymetallic raw material structure increases, too. With the decision to create a copper smelter and a copper refinery plant in order to produce a saleable copper concentrate shipped to the consumers as semi-finished product, the New Metallurgy Project also included the upgrade of the existing lead smelting process by the replacement of the traditional sinter plant to a blast furnace operation through the modern TSL technology.

The New Metallurgy Project

The New Metallurgy Project implemented by Kazzinc was intended to do away with raw material-oriented copper production through construction of two metallurgical plants: a copper smelter and a copper refinery. The 3rd step of this project was the reconstruction of the existing lead plant.

Figure 1: View on Plant in Ust Kamenogorsk

The goal of this project was to reduce the total output of harmful gases and dust into atmosphere with simultaneously increasing the production of valuable products.

Former Lead Production Process

Prior to implementation of the Lead plant in the New Metallurgy Project a standard process including sintering of Lead, gravity and Gold-bearing flotation concentrates, blast smelting of sintered agglomerates and reverts, pyrometallurgical refining of Lead bullion and ingots casting was used at the existing Lead plant. This process was closely linked with the Zinc plant processes, i.e. processing of middlings produced at the Zinc plant.

The following middlings were produced by sinter and reverts smelting: Zinc-bearing slag for fuming, matte for processing in Peirce-Smith converters and Lead bullion for refining.

Zinc oxide after slag fuming was processed at the Zinc plant with Zinc extraction while waste slag was disposed in the waste stockpile.

Minor amounts of Copper blister after matter converting were shipped to the consumers.

Lead bullion was refined, Copper, Tellurium, Arsenic, Antimony, Bismuth, Gold and Silver were removed and the ingots were shipped to the consumers.

The produced quality of Lead metal is 99.985 %.

The precious metals refinery which is an integral part of the Lead plant uses the following process: production of Dore alloy from silvery crust skimmed during Lead refining; hydrometallurgical or electrolytic treatment of Dore with production of Gold, Silver and PGM.

Gold is produced in ingots whereas Silver in ingots and powder. The refined 99.95 % Gold and Silver ingots produced by Kazzinc comply with LBMA Standard “DEER” brand.

Upgraded Lead Production Process and Plant Description

Implementation of the New Metallurgy Project eliminated the following imperfections in the Lead production process:

- large-scale consumption of imported coke
- impossibility to treat Copper-bearing products (Cu cement) from the Zinc plant with their accumulation jeopardizing the local ecology
- generation of lean sulfuric gases and their release to the atmosphere due to inefficiency of their utilization.

ISASMELT™ process was introduced at Kazzinc as a part of the New Metallurgy Project. This process broadened the line of treated Lead-bearing products as opposed to sinter roasting. In addition, the higher-grade slag could be now treated in the blast furnace which is infeasible with high-grade sintered agglomerates due to its melting in the blast furnace. Complete sulfur removal prevents matte generation in the blast furnace.

Process-wise the new plant can be described as follows:

Quite simple feed preparation system designed for processing of concentrates with up to 14 % moisture and consisting of bins, conveyors, feeders and a mixing drum. After the autogenous oxidizing smelting of prepared feed high-grade Lead slag is continuously discharged to the tilt bowl and further to the 2-lines slag casting machine which is shown in figure 2.

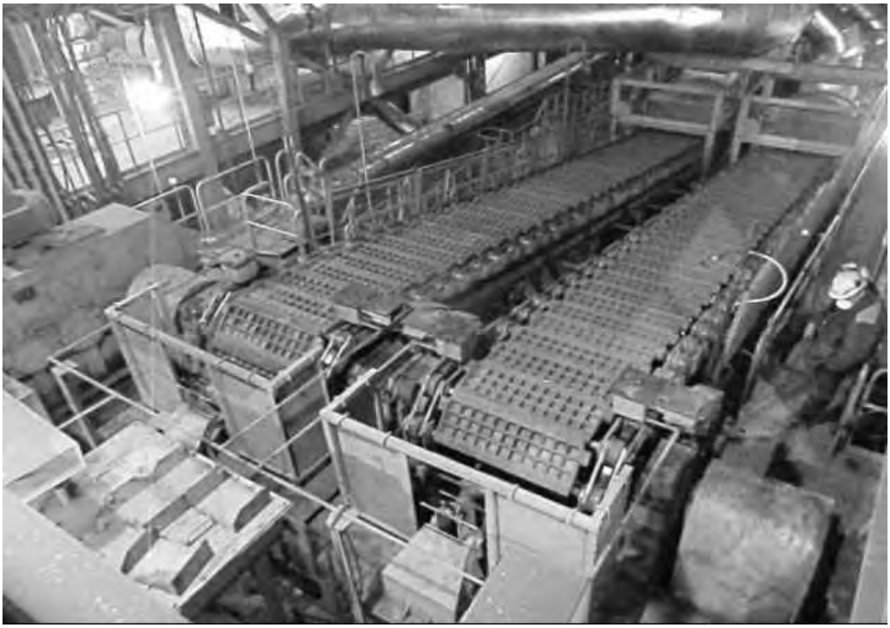

Figure 2: Slag casting machine designed by Engineering Dobersek GmbH

This machine, one of the core components in the new Lead plant, was designed by Engineering Dobersek GmbH and was already the focus of a project for an European noble metal producer. It produces the slag pigs to charge the existing blast furnace for the reduction step. The full automatic two lines casting machine was designed for a casting capacity of 45 - 60 t/h. The casting temperature of Lead slag is approx. 1,150 °C. The slag is air-cooled by natural convection at the beginning of the casting machine, then cooled down by means of forced convection with air blowers to decrease the temperature of about 500 °C and at the end of the machine by means of water sprayed by 20 nozzles each from above as well as from bottom in order to cool the briquettes below 300 °C.

A 3-D view is given in figure 3. Spatial constraints predetermined the design of the machine. The project was implemented in quite space-limited surroundings with production ongoing. After the slag is cooled to the design solidification temperature the pigs are transported to the existing blast furnace for reduction smelting with production of Lead bullion and waste slag.

Rich gases after oxidizing smelting in ISASMELT™ furnace are cooled in the waste heat boiler, purified in the dry electrostatic precipitator (ESP) and supplied to the acid plant. A view into the production hall with the ESP is given in figure 4.

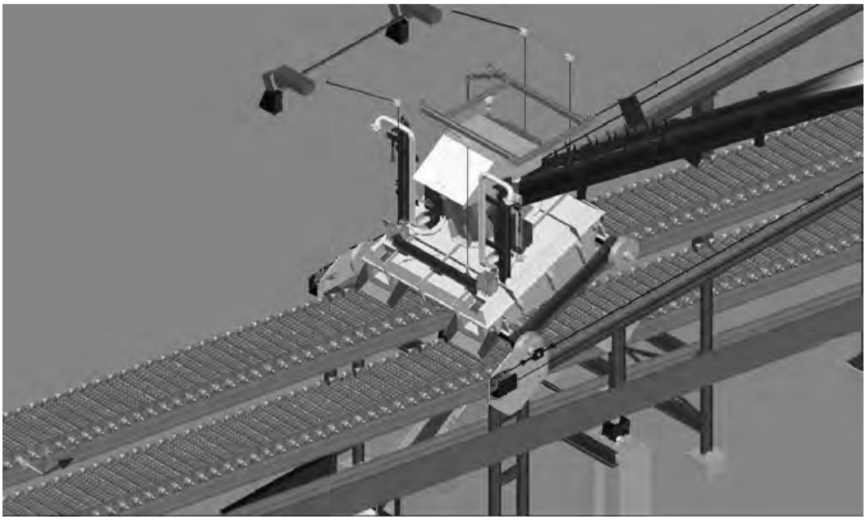

Figure 3: A 3-D view of the slag casting machine

Aspiration gases are captured at source and purified in the existing bag filters.

The modernization of the lead plant has accompanied with a significant reduction of harmful emissions into the environment.

Figure 4: ESP in the Lead plant

Conclusions

Implementation of three segments of the New Metallurgy Project, as the construction of the new copper and acid plants and the reconstruction of the existing lead plant contributed to reduction of air pollution by the metallurgical complex in Ust-Kamenogorsk. Minor emissions from the new copper smelter were more than offset by almost complete utilization of gases from the state-of-the art lead smelter in sulfuric acid production. Previously these diluted gases were released into the atmosphere.

In addition, Kazzinc enjoys a broader product line and higher production output, which along with complex utilization of raw materials and more flexible production processes contributed to higher net profits.

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