76th Meeting of the GDMB Copper Committee

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The 76th Meeting of the GDMB Copper Committee took place in Wroclaw in Poland from October 16 to 18, 2017 with a total of 44 participants. The conference day on October 17 was divided into four sessions with ten presentations from research institutes, universities and companies (Figure 1).

Stephan Steinacker from the Austrian Christian Doppler Laboratory for Optimization and Biomass Utilization on Heavy Metal Recycling presented a hydrometallurgical treatment of a copper-iron-molybdenum alloy for the separation of two phases by a selective leaching process. The challenge is to establish a separate treatment for the recovery of copper with impurities and the production of a molybdenum-rich and clean ferromolybdenum product. A fractional factorial design was applied for leaching tests with sulfuric acid. Molybdenum showed insufficient removal rates from the metal phase with the chosen parameters, therefore process adaption for further tests were proposed and an alternative pyrometallurgical approach was suggested.

Fig. 1: The conference started with ten presentations
The second presentation held by Dr. Ilkka V. Kojo from Outotec Oyi, Finland, discussed sulfur dioxide emissions on a global basis and the emissions from copper smelting that is rapidly decreasing since 1990 despite the sharp increase in copper production. Satellites have been tracking the sulfur dioxide emissions on a daily basis since 2004. Evidences have been shown in the presentation that the emission data obtained from the satellites have a satisfying accuracy for evaluation of improvement measures in copper smelters.

Professor Jolanta Niedbala from IMN presented modern challenges of tankhouses to reduce the silver and hydrogen content of copper cathodes to improve the cathode quality and ingot quality after cathode melting. The influence of selected electrorefining parameters like current density, electrolyte temperature, additive dosing, the silver content in the anodes and the addition of iodide and bromide ions was investigated. It was found that the continuous adsorption of electrolyte impurities on an active carbon bed or the addition of bromide and iodide led to the production of copper cathodes with a reduced silver content. A low hydrogen content in the cathodes may be realized by low inhibitor concentrations.

The fourth presentation held by Dr. Zdzislaw Miczkowski discussed selected features of KGHM Polska Miedz S.A. pyrometallurgical modernization e.g. flash slag cleaning in a new rectangular electric furnace and a new method to remove lead from the process. The decopperization is found to be mainly influenced by carbon dioxide bubbles that flow through the slag layer, the kinetic energy of the slags during pouring and the electromagnetic force induced by the flow of the alternating current. The additional reduction of the slag from the CuPbFe alloy converting allowed the additional removal of a significant amount of lead from the smelters material cycle.

Dr. Ryszard Prasznar from IMN presented a study of the smelting process of the low-quality copper concentrate in an experimental TSL furnace. This alternative technology instead of the processing in a shaft furnace is favored due to its smaller environmental footprint and lower operational as well as capital costs. A total recovery of 97% Cu in the copper matte is achieved and volatile elements such as Pb, Zn and As are effectively recovered from the offgas at low copper losses. The produced silicate slag showed a very low average heavy metal content.

The sixth presentation was held by Lukasz J. Wierzbicki from IMN about the technology of manufacturing bronze rods and tubes for fittings. Different process parameters from the preparation of material step, the refining process, the melting and the casting processes were determined and related to the quality and mechanical properties of the semi-finished products. With the research that has been carried out within the Project INNOTECH financed by the National Centre for R&D the level of production of semi-finished products was increased three times and the technical downtime was shortened by over 30%. Furthermore the level of scrap materials was significantly reduced and the proportion of scrap materials and blocks was optimized.

After lunch the seventh presentation held by Dr. Bernhard Hanusch introduced advanced solutions for the processing and recycling of copper and precious metals with the Maerz-TSL furnace technology. The advantages of the presented TSL furnaces include essential lower investment volumes, included material charging systems and environmental friendly offgas treatments. The TSL furnaces are equipped with a submersible lance that can operate with different atmospheres: oxidative, reductive, neutral and oxygen enriched. The individual engineering by Andritz Maerz also includes the process design of the smelting and refining steps and the development of new strategies for the processing of complex primary and secondary raw materials.

Dr. Ross Haywood presented two modelling tools that are commonly used for process optimization in smelting processes. The modelling tools DEM (Discrete Element Modelling) and CFD (Computational Fluid Dynamics) have been used for the design and evaluation of modifications of furnace equipment contributing to a better understanding of combustion, gas dynamics and solid dynamics in feed systems and flash smelting furnaces. Dr. Haywood showed the exemplary development of a swirl injection system for concentrate that has been developed for a DBF furnace with inefficient combustion.

The ninth presentation was held by Leszek Garycki from KGHM Glogow about the pyrometallurgical modernization program at the Glogow 1 Copper smelter. The smelting business at KGHM started in 1971 and the lead plant was taken into operation at 1973 followed by the precious metals plant in 1993. The presented pyrometallurgical modernization project started in 2010 and after the engineering stage in 2011 the construction stage started in 2012. After an intensive construction phase in 2014 and 2015 the equipment of the furnace was installed in 2016. The pyrometallurgical modernization including the first blast furnace, a new flash smelting furnace and a second blister copper smelter was successfully completed at the end of 2016. During all construction work the production of copper with the old shaft furnace was continuously run.

Timm Lux presented projects realized by UrbanGold which is a joined venture of METTOP and PolyMet Solutions. The UrbanGold Technology for the recycling of WEEE fractions is aimed to efficient and fast copper and precious metals recovery solutions. UrbanGold plants are engineered both as integrated plants into existing copper plants and as greenfield developments. One of the presented projects is called the ILTEC technology implementing a new cooling liquid that is non-explosive, non-flammable and neither harmful nor corrosive. ILTEC can replace cooling water as a safer cooling measure.

The conference day ended with a visit of the UrbanGold plant in Glogow.
The next day started with an early departure to the Glogow Copper Smelter KGHM PM S.A. After a warm welcome in the headquarters all participants were equipped with safety measures and headphones and the bus took the two groups to the 195 hectare grounds of the Glogow smelter 1 (Figure 3).

KGHM has spent US-$ 150 million for environmental measures to meet the strict EU requirements concerning the gas and the slag and as presented the day before many modernization projects have been realized within the last years, namely the new flash smelting furnace that is the most modern production line worldwide with a smelting capacity of 1 million t/a, a new steam drier for copper concentrates, a new rectangular electric furnace for flash slag cleaning including a new process gas treatment plant and a new technology to process the slag from CuPbFe alloy.

Our trip started at the flash smelting furnace with combined electric furnace at the highest level at 27 m. Both national concentrate (100 t/h) and imported South American concentrate (10 t/h) is processed. The national concentrate shows different copper contents of 11 % and up to 35 % and is therefore mixed after drying to 0.3 % moisture and grinding. Parts of the national concentrate are pretreated by roasting because of the naturally high carbon content of up to 9 %. The roasted concentrate can balance the heat in the furnace that is produced by the high carbon content and slows the process. The gravity force is used for the 10 m transfer from the flash smelting to the electric furnace. On the roof of the electric furnace a big combustion chamber and the cleaning gas devices are installed.

The next stop was at 13 m on the level of the tapping hole of the flash smelter. The reaction chamber consists of the settle zone and the gas shaft. At the long wall the copper is tapped at a different level than the slag at the short wall of the furnace. The slag that still contains 13 % of copper and high iron and lead concentrations is tapped at 1300 °C before the copper. The slag tapping holes are put in manually for four runners by two to three persons. The blister copper (98.5 % Cu) that is tapped by three to five persons typically shows a high sulfur content that is recovered as sulfuric acid from the offgas that contains 15 % of SO₂. One cycle produces 100 t of copper and 28 cooling elements are needed.

The electric furnace has a rectangular shape challenging the heat distribution. The electric furnace has six electrodes that treat the slag for eight hours in the furnace in the three steps filling, reduction at 1400 °C and tapping of a CuPbFe alloy that is transferred to the converter and of the slag with a final concentration of 0.3 to 0.5 % Cu. The tapped slag runs in a single line and is granulated in water and sold to the building industry. A spare tapping line is provided for unplanned shut downs of the furnace. 200 t of water are needed for the cooling of the reaction shaft and the same amount for the rest of the furnace.

The copper is transferred to the two rotary anode furnaces that are fed within twelve hours to a total volume of 600 t. After five hours of refining the copper is tapped within four hours with the help of two anode casting wheels. Each casting wheel is equipped with eighteen forms and 1200 t of copper can be casted within one casting. Every anode weighs around 275 kg and is cooled in water before transferred to the tankhouse.

The copper scrap and the CuPbFe alloy are further treated in one of the three operating converters. Another converter is used as a tank. Three types of slag are produced: slag with high silica content, slag with high limestone content and slag with high zinc and lead contents. The last one is transferred to the lead plant.

The last stop of the plant tour before lunch was the visit of the new control plant that has been modernized in October 2016. All processes of the smelter are monitored and adjusted in this department.

Thanks to the good organization by GDMB and the support by IMN and KGHM the interesting presentations of the 76th copper committee meeting and the informative plant tour at KGHM allowed lively discussions and the exchange and communication between research institutes, universities and companies in the non-ferrous industry.

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