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Contenu

Tungsten Beneficiation from Scheelite and Wolframite

Schmidt Steffen, 2012

Tungsten production is based on the mining and dressing of scheelite and wolframite. Both presents high density and brittle character, however wolframite differs from scheelite by its property of being paramagnetic. These particularities significantly determine the design of ore-processing flow-sheet, equipped with gravimetric and magnetic separator. First, brittle character of scheelite and wolframite is responsible of high formation of fines during crushing and conducts to “overgrinding”. This term means that the particles are finer than the required liberation size, which leads to ore-mineral losses and then to a reduced ore-mineral recovery. In order to prevent overgrinding, adapted sizing techniques minimizing formation of fines, are required; otherwise, pre-concentration techniques are also employed as hand-picking, optical sorting or x-ray sorting. After crushing, grinding and milling steps, gravimetric separation is relevant into scheelite and wolframite concentration. The following techniques are thus common: spiral concentrators, jigs and shaking tables. In some specific case, dense-media separation is also needed. Wolframite is afterwards cleaned from ferromagnetic minerals by low magnetic separation and separated by highly magnetic separator. Concerning scheelite separation, flotation with fatty acid is efficient and can also remove contaminant like sulphides such as arsenopyrite and galena, especially. Moreover, flotation can be carried out at higher temperature (Petrov’s process) in order to increase the selectivity.

References: From Deposit to Concentrate: The Basics of Tungsten Mining. Part2 : Operational Practices and challenges. International Tungsten Industry Association. Available online on www.itia.info .

Benoit DUCELLIER

Namibie: Shaw River se dote d’une nouvelle usine pour du manganèse plus enrichi à Otjozondu

Agence Ecofin, 3/04/15

Shaw River Manganese Ltd a annoncé le 5 juillet 2013 avoir signé, avec Atlas Iron Ltd, un accord de facilité de prêt non garanti dans la perspective du développement évolutif de son projet de manganèse qu’elle détient à 75,5% à Otjozondu en Namibie à l’époque. Le projet Otjo recèlerait 17 millions de tonnes de ressources dans une zone à fort potentiel où du manganèse à haute teneur a été exploité pendant plus de 50 ans. Shaw River Manganese détient, outre cette mine, le projet de Baramine en Australie et le projet de Butre au Ghana. Le 6 Mars 2015, elle espère réceptionner une usine pré-fabriquée en Afrique du sud et dont l’installation et le commissioning se feront dans les semaines qui suivent afin de traiter un stock de 85 000 tonnes de matières recelant du manganèse. Début avril 2015, Otjozondu Mining (Pty) Ltd achèvera au bout de quatre semaines l’essai de production de sa nouvelle usine de traitement de 100 tonnes/heure dans le projet de manganèse Otjozondu. Cette filiale à 100 % de Shaw River Manganese Ltd espère également arriver à optimiser, au cours de la même période, la programmation de l’usine pour le traitement d’une variété de minerais de différents niveaux de qualité, rapporte le 1er avril la maison-mère. Les premières productions de la période d’essai ont montré, a-t-elle précisé, une extrême efficacité de l’usine et un niveau de production et de qualité de minerai au-delà des attentes. La société minière Shaw River, filiale détenue à 53,45% par Atlas Iron Ltd, rapporte avoir achevé son exploitation d'essai à une profondeur de 5m sur trois sites miniers de Labusrus, un gisement recelant des ressources à 23,3% de manganèse et qui offre toutes les opportunités pour une exploitation à ciel ouvert. Selon Shaw River Manganese Ltd, un stock d'environ 80 000 tonnes de minerai est déjà constitué.

References: www.agenceecofin.com/manganese/Namibie_Shaw_River_Usine

William FRESSER

Abstract of the paper « Optimum mining method selection using fuzzy analytical hierarchy process–Qapiliq salt mine, Iran »

Karimnia Hamed, Bagloo Heydar, 2014

The most critical problem in mine design is mining method selection. It has a significant influence on the all of the mine decision making problems. It depends on some parameters such as geotechnical and geological features and economic and geographic factors including shape, thickness, depth, slope, RMR and RSS of the orebody, RMR and RSS of the hanging wall and footwall. To calculate the priorities of factors and select the best mining method for Qapiliq salt mine in Iran, fuzzy analytical hierarchy process (AHP) technique is used. They calculated polls, slope and weight vector by eigenvector method based on the geometric mean of the results of the expert's viewpoint for each method. After a comparison, between the four mining methods including area mining, room and pillar, cut and fill and stope and pillar methods, the stope and pillar mining method was selected as the most suitable method to this mine.

References: Optimum mining method selection using fuzzy analytical hierarchy process–Qapiliq salt mine, Iran » Karimnia Hamed, Bagloo Heydar, ScienceDirect, 2014.

Laurie MALHEIRO

Treatment of polymetallic nodules

HOFFERT M., 2010

Many methods have been studied for the **treatment of polymetallic nodules**. Initially these processes were aimed at recovery of **nickel, copper and cobalt**. After 1978, **manganese** was also extracted for improved the financial balance. This reduced the number of possible processes: **hydrometallurgical processing**: which consists of separating metals from nodules by leaching with acid reagents (hydrochloric or sulfuric acid) or alkaline (ammonia) (or sulfuric leaching) and **pyrometallurgical processing**: which consists of a reduction of hydroxides (by elimination of oxygen) followed by separation of the molten metal by gravity (or fusion). Each of this process has three phases: the **concentration** for extract and separate the various metals in concentrate, the **refining** of concentrated and finally the **manufacture** of ferro-alloys manganesiferous....

Hydrometallurgy based on different treatments in acidic or basic media, which allow to successively separate the manganese (as the sulfate), copper (as oxide) and nickel and cobalt (sulfides). The pure metals are obtained by leaching and electrolysis. Examples: hydrochloric leaching process Cuprion, ammonia leaching sulfuric leaching. **Pyrometallurgy**: nodules can be treated according to a melting methodof then after drying and calcination, the rich slag in manganese and an alloy of iron-nickel-copper-cobalt. This alloy is refined in a converter and addition of sulfur, this yields a "matte" containing nickel, copper and cobalt. This "matte" can be treated by various methods used in the nickel industry (crushed and dissolved by oxidation). The metal is extracted by ion exchange and electrolysis.

References: HOFFERT M., 2010. « Chapitre VIII – Traitement métallurgique » issue du livre « Les Nodules polymétalliques - Une extraordinaire aventure minière et scientifique sous-marin », 2008. [En ligne], disponible sur : http://wwz.ifremer.fr/drogm/Ressources-minerales/Nodules-polymetalliques

Emilie GALHAUT

Microplaty hematite ore in the Yilgarn Province of Western Australia: The geology and genesis of the Wiluna West iron ore deposits

Desmond Lascelles, David Tsiokos ,2014.

The Wiluna West is a complex of high-grade bedded hematite ore deposits producing 130 Mt of iron ore at 60% Fe grade per year, located in the Joyner's Find greenstone belt (JFGB) in the Yilgarn region of Western Australia. Composed of hematite mesobands interbedded with porous layers of acicular hematite this deposit has similar textural and mineralogical properties to the premium high-grade direct-shipping ore such as Mt Tom Price or Mt Whaleback in the Hamersley Province. The JFGB was exhumed by middle to late Cenozoic erosion of a cover of unmetamorphosed and poorly undeformed Paleoproterozoic sedimentary rocks preserving it unaltered for nearly 2 Ga and providing a unique example of the early Proterozoic environment. The principal high-grade hematite deposits at Wiluna West are bedded ore bodies formed by loss of BIF chert bands during diagenesis locally enriched to massive hematite adding hydrothermal specular hematite. The Wiluna West hydrothermal microplaty hematite is unique because of its particular crystallinity. The genesis of the premium ore from the Pilbara Region has led to a lot of discussions among the authors and the Wiluna West feature provides an opportunity to compare features among the same districts and test genetic models.

References: LASCELLES D., TSIOKOS D., 2014. Microplaty hematite ore in the Yilgarn Province of Western Australia: The geology and genesis of the Wiluna West iron ore deposits, Ore Geology Reviews (66), 309-333, available on: http://www.sciencedirect.com/science/article/pii/S0169136814002583

Keywords: Wiluna West deposit – Joyner's Find greenstone belt – hematite mesobands – Proterozoic environment

Marine DELESALLE

Kimberlites and Lamproites: Primary Sources of Diamond

R.H. Mitchell, 1991

Diamond formation needs high pressure and temperature corresponding to the mantle at about 150 km depth into archean craton. According to suggested hypotheses, carbon could be juvenile coming from the harzburgite zone; or non-juvenile due to the subduction of organic deposits located in eclogite zone. Advances show that primary diamonds can be found in group 1 and 2 respectively kimberlites and lamproites types. They are differentiated by their origin, associated mineralization, and location of the ore deposit.

Group 1 (less than 100 Ma) is characterized by a hypabyssal facies corresponding to a composition of olivine-rich, monticellite, serpentine, phlogopite and calcite and an absence of pyroxene and diopside. It is found in volcanoclastic breccias called kimberlite, in other words a diatreme facies. Diatremes are subsurface structures of phreatomagmatic eruption forming a pipe linked to a feeder zone termed root zone. Kimberlites are found into the deeper part of these structures into breccias and dyke feeders. Kimberlite lava has not been recognized but is an important source of diamond (Botswana) brought out to the surface by diatremes and considered as prime exploration targets. Although these facies contains a low grade about 5 to 80 CM/100t, the diamond exploitation is based on quality, size of diamond and cost of exploitation.

Group 2, called the micaceous kimberlite or lamprophyric, is older than the group 1 between 200 and 110 Ma. It is mostly located southern Africa. The facies consists of olivine set in a matrix of phlogopite, diospside, spinel, chromite, magnetite and calcite with an absence of monticellite. Other elements can be found such as titanates or zirconium. The magmatic origin shows a high silica content (intermediate rocks) which provides a high grade up to 100 to 300 CM/t to the deposit. Lamproite system do not form diatreme or associated root zone, in this case ore deposits are condensed in pyroclastic rocks. These structures are formed along margin of craton with thick crust (40 to 55 km) or lithosphere (150 to 250 km).

References: R.H. Mitchell, 1991. Kimberlites and Lamproites: Primary Sources of Diamond. Ore deposit Models, Lakehead University, Ontario.

Key words: diamond ore deposit – kimberlite – lamprophyric – diatreme.

Erika DÖHRING

Hydrothermal extraction and hydrothermal gasification process for brown coal conversion

M. MORIMOTO, H. NAKAGAWA, K. MIURA, 2007

In 2007, lignite and brown coal were expected to become one of the most important energetic resources because of their worldwide abundances.

Brown coal contain a large amount of water, and need to be dewatered in order to be transported and used with efficiency. Moreover, dried coal is prone to spontaneous combustion, which is a big problem for storage; the process used to reduce the origin of this combustion is called upgrading, and is necessary together with dewatering.

This article proposed a new coal conversion process, using both hydrothermal extraction and catalytic hydrothermal gasification of the extract, under 350°C and 20MPa conditions. The first produce the upgraded coal, and the second transform the loss of upgrading into a gas rich in CH_4 and H_2, improving the viability of the complete process. The authors' innovation was partly within the creation of a Carbon/Nickel catalyst to upgrade the gasification process.

Using an Australian brown coal (Loy Yang), the process was tested at 350°C and 18MPa. The samples were almost perfectly converted into 53% of an upgraded coal, 23% of methane, and 24% of carbon dioxide (looking at carbon basis held in the samples). Furthermore, 4.4 moles of dihydrogen were produced for 100 moles of carbon basis.

The process transferred 97% of the energy involved in the raw material to the products, which is way enough to clarify the viability and the high efficiency of the process. It was expected to be a more efficient coal conversion process than the conventional one, which used a 1000°C condition and an oxygen supply to recycle the loss of upgrading into gas. The authors needed further examination, including the durability of the Ni/C catalyst, but the authors believed that the concept was novel and would contribute to use brown coal more efficiently.

References: M. MORIMOTO, H. NAKAGAWA, K. MIURA, 2007. Hydrothermal extraction and hydrothermal gasification process for brown coal conversion. Available online at www.sciencedirect.com, Fuel 87 (2008) 546–551.

Antoine MILLOT