Mintek's Expertise in Magnesium Production and the MTMP Process

Mintek's Thermal Magnesium Process (MTMP) relies on silico-thermic smelting of calcined dolomite in a DC open-arc furnace. Magnesium extraction takes place at atmospheric pressure and at 1600-1750°C. The volatilized magnesium is captured in a surface condenser and is kept molten for prompt and periodic tapping of the crude magnesium metal, which is then refined and cast into ingots. As such, the process can be operated on a continuous or semi-continuous basis.

In comparison, the Pidgeon process is carried out in retorts and at 1100-1200°C, where the pressure is kept near vacuum. It is a batch and labour intensive process where the cycle time ranges from 12-24 hours. An advancement of the Pidgeon process was realised in the 1960s when the Magnetherm process was developed by Pechiney in France. In this process, magnesium extraction is carried out in an AC submerged arc furnace operated at about 0.05 atm. and 1600-1650°C. The magnesium vapour is condensed in a surface condenser, largely to a solid phase. When the condenser is full, the operation is stopped to remove the condenser and to replace it with an empty one. The process is, therefore, semi-batch with a cycle time of 10-12 hours.

Development work on Mintek's Thermal Magnesium Process began in the early 1980s at Mintek and was carried out at 50-100 kW scale. This initial work proved two concepts; the first relates to atmospheric extraction of magnesium and its subsequent condensation, the second relates to the applicability of DC arc furnace technology for magnesium production. As a result, a US patent was granted in 1987 (US patent 4,699,653). Pilot-plant testing of the MTMP process was carried out at Mintek in the period 1999-2004. The work consisted of the design and manufacture of a 100 kg Mg(v)/h pilot plant, commissioning, and pilot-plant trials. The trials comprised ten different and extensive campaigns which led to the demonstration of the process at the 750-850 kW scale (80-100 kg Mg(v)/h). Another outcome of the testwork was the design and operation of the novel Mintek condenser (US patent 7,641,711 B2). The condenser aims at capturing the volatilized magnesium in a molten state, which is continuously agitated in order to maintain any solids arriving at the condenser suspended in the magnesium bath for prompt tapping. The features of the MTMP process make it possible to carry out magnesium production on a more continuous basis.

Throughout the pilot testwork, extensive experience was also developed in magnesium cleaning and refining using various salt fluxes. This work proved that the crude magnesium produced in the MTMP process could easily be refined to meet the standards for ASTM B92 Grade 9980A specifications. In addition, a great deal of knowledge was gained on the calcining of various dolomite ores, and the subsequent characterization and assessment of the calcined product for suitability for magnesium production in the MTMP process.

Mintek also has extensive capabilities in the area of techno-economic evaluation of various processes, particularly with regard to magnesium production, where detailed pre-feasibility studies of the MTMP process can provide capital and operating cost estimates within 10-15% accuracy.

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