

## IDE VIM TECHNOLOGY FOR MINE COOLING APPLICATION

The VIM (Vacuum Ice Maker) technology produces ice inside a vacuum chamber (The VIM's Freezer) which is kept under "triple point of water" conditions. The ice is formed due to the evaporation of portion of the water in the freezer due to the deep vacuum condition, which drops down the boiling point of water. The evaporation of the water requires heat which is taken from the remaining water in the freezer, causing a portion of it to freeze. The water vapor is than "sucked" from the freezer by the unique, high speed, vapor compressor which also compresses the water vapor to the point where it can be condensed in the VIM's condenser. The water-ice mixture is pumped from the freezer, in form of ice slurry, and delivered to the ice concentrator, where the ice is separated from most of the water forming mixture of about 75% ice and 25% water by mass. The ice is than scraped from the top of the ice concentrator and delivered to the mine shaft.

### VIM Evolution

The first Vacuum Ice Makers, which where installed for mine cooling, called Eco-VIM (Ecological VIM) due to the fact that they where using cooling tower for the supply of cooling water to the VIM condenser. The Eco-VIM units were equipped with a horizontal two stage compressors system and were capable of using cooling water at temperature of up to 22°C. This cooling water temperature could easily achieve at the climatic condition of South Africa.

Due to global warming IDE developed a new design for the VIM which receives the required cooling water from a conventional water chiller and by that increases the VIM's availability and actually gives the units the ability to produce ice at any ambient condition. In the new VIM design IDE had also implemented modification and improvements as result form the 15 years experience of operating the unit at Mponeng gold mine.

The main design improvements were the implementation of a vertical design unit - equipped with one stage compressor, the use of greased bearings and dry vacuum pumps. These modifications improves the units operation and maintenance and, as already mentioned, secure the unit availability through any ambient condition.

The VIM unit is designed to produce 3000 kWR, which allow the production of 40 ton/hr of transportable slush ice considering feed water supply at 4.5°C.

### VIM Power Consumption

The nominal power consumption of VIM850 unit, with a nominal refrigeration capacity of 3000 kW, is 379 kW – That gives unit COP of 7.91.

As noted, the VIM850 unit is supported by a water chiller for supplying cooling water to the VIM's condenser. The nominal cooling capacity required by the water chiller is typically 3400 kW. When assuming chiller COP of 6.1 (including cooling tower and pump), considering the climatic conditions of Johannesburg) – the power consumption of the chiller system is about 557 kW.

These numbers sum-up to 936 kW for the whole system – and COP of 3.21.

