circumstances of this development and the way in which the company has responded to them in equipping the new panel. In particular, there are very high rock stresses in the new zone, virgin rock temperatures are high, at around 54°C, and the average dip is 20° (locally 25°). The seam varies in thickness between 3.7 and 4.2 m, and it is expected to be almost ten years before the panel is worked out. In view of these conditions, a special 1,450-kW main ventilation fan has been installed and three high-power air conditioning units will cool the air during the development work and in the face entries. Double-drum shearers (2 × 400 kW) are able to mine up to a height of 4.20 m with a cut depth of 1.10 m. A 700-kN winch acting through a 34-mm chain provides the quick return movement required by the self-sharpening picks on the shearer. Face roof supports have been specially designed to last for the expected life of ten years in the underground environment. MDPA's normal box support has been reinforced up to 4 × 1,600 kN for 2.5 m of face. The open height is 4.20 m, and the hydraulic stroke is 1.10 m. In view of the long operating life, also, special attention has been given to maintenance problems. Even with the particularly difficult mining conditions, the new equipment installed on this panel should allow a daily output of 10,000 tonnes of sylvinite.

Environment and safety are major issues in the design and operation of potash mines, and the paper **Considerations on environmental engineering and mine safety at the underground potash mine of Taquari-Vassouras, Sergipe, Brazil** by R. O. da Rocha, Petrobrás Mineração S/A (Petromisa), W. T. Hennies and S. M. Eston, Mining Engineering Department, EPUSP, University of São Paulo, Brazil, gives an idea of how these problems are being addressed in Brazil. Potash is obtained from sylvinite layers encountered in the Sergipe cretaceous basin in north-eastern Brazil, where a thick sequence of evaporite layers contains halite (NaCl), sylvinite (KCl + NaCl), carnallite ($KCl.MgCl_2.6H_2O$) and tachyhydrite ($2MgCl_2.CaCl_2.12H_2O$). Sylvinite is extracted by room-and-pillar mining, to which access is provided by two vertical shafts about 450 m deep. The ore is processed at a surface plant of 1,650 t/d KCl capacity. The main problems in the areas of mine safety, hygiene and occupational health are related to creep of underlying layers of tachyhydrite, the risk of water incursions, the presence of explosive gas, and thermal discomfort. The Industrial Safety and Environment Group works in the areas of prevention, control and human training under a general programme of Loss Control Management in the mine and processing plant.

Section 3: Processing

As mined, nearly all potash minerals are mixed together with other minerals such as rock salt or halite (NaCl), magnesium chloride, calcium sulphate, or magnesium sulphate, as well as varying proportions of clay and other insoluble materials. This has to be processed in some way to enhance its potash content by rejection of unwanted insolubles and 'foreign' (non-potash) minerals. Sylvinite (KCl + NaCl) can normally be upgraded by ***flotation***, since it comprises a matrix of discrete crystals of rock salt and sylvite (KCl), which can be liberated by crushing. More complex ores in which the minerals are actually cocrystallized as double salts may have to be dissolved and subjected to ***fractional crystallization***, which is also the technique used for recovering potash and other minerals from natural brines. In some cases, it is possible to avoid the bulky equipment and procedures involved in wet upgrading methods by crushing the ore and subjecting it to ***electrostatic beneficiation***.

The commonest form in which potash is obtained is as the chloride (KCl). For many fertilizer purposes, this is quite acceptable, but for certain crops and soils it is necessary, or at least desirable, to eliminate chloride. There are very few natural occurrences of other soluble potassium salts. Chile is unique in possessing commercial deposits of caliche (a mixed potassium-sodium nitrate ore). (See pp. 37-40) And although it is possible to obtain potassium sulphate by crystallization from Great Salt Lake brine, little 'natural' potassium sulphate is available. Mostly, therefore, these forms of potash have to be produced artificially from the chloride. The oldest-established and - from the point of view of the massive equipment required, the considerable energy consumption involved and the technical problems associated with high-temperature corrosion - the most cumbersome is the Mannheim process (high-temperature attack with sulphuric acid). There is also a variety of newer processes based on techniques such as crystallization, precipitation and decomposition of double salts, and solvent extraction.

In response to the growing demand for bulk-blended fertilizers, more potash is being produced as granules. The technique used is compaction-granulation, since in the absence of other fertilizer ingredients potash cannot be granulated by conventional fertilizer granulation techniques. (A separate feature on compaction-granulation appears on pages 28-36).

S. Rohani and B. Ng, of the University of Saskatchewan, will describe a method of studying **The effect of inorganic impurities on the size distribution, habit and yield of potash crystals.** Laboratory batch experiments have been carried out to study the effect of trace amounts of inorganic compounds such as $CaSO_4.2H_2O$, $Cr(NO_3)_3$, $MgSO_4.7H_2O$ and $FeCl_3$, as well as insoluble clay particles on the size distribution, habit and yield of potassium chloride crystals. A feed brine, co-saturated in chemical-grade potassium chloride and sodium chloride at 25°C, is allowed to cool naturally to 15°C in a 750-ml jacketed, baffled crystallizer. The product crystals are sized with a particle counter and the crystal habit is studied using scanning electron micrographs. In each case a comparison is made with the product quality obtained in the absence of impurities.

Continuous monitoring of potassium levels as an aid to process control in a potash refinery by K. Ayling and G. Holyfield, of Cleveland Potash Ltd, examines the principles and problems involved in making accurate in-plant radiometric measurements of the potassium content of process streams, using the K-40 radioisotope as the indicative component. A new prototype system is described, which has been in successful operation for some two years at the Boulby Works of Cleveland Potash Ltd. This system, which determines the percentage of solids and the percentage of potassium chloride in the solids in the slurry streams, was designed in the light of extensive in-plant experiments so as to be capable of reliable, accurate performance under typical plant conditions. Following a programme of comparative checks between the radiometric results and laboratory assays carried out on equivalent representative samples, routine manual sampling of the monitored streams was discontinued. The system results are displayed in the control room and used as primary process control parameters. Examples of the correlation between radiometric and laboratory determinations are provided.

An analysis of the practical benefits arising from the continuous real time monitoring of stream composition will be given, along with an estimate of the cost savings achieved. The first prototype is in the course of being upgraded to a commercial modular system intended for application throughout the potash

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