

A Review of Historic Developments in Potash Mining, a Scientific Approach to Correcting Assumptions used in Current Mine Designs, and Identification of New Principles for Solution Mining of Potash

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Abstract

The paper presents a review of the historic documents detailing the development of the current potash solution mining operations. The early evaluation of solution mining of potash predicted that it would provide low cost production along with low capital cost. We will show how misinterpretation of the dissolution mechanisms involved in these operations resulted in high cost, complex production facilities.

There were several test mines operated in the 60's. They tested selective mining with pond crystallization, non-selective mining, horizontal connection between wells by fracking and connected caverns. These tests had some limited success but production typically dropped off quickly. At the time they were referred to as a "Morning Glories".

The only operating mine in Saskatchewan developed out of the testing, finally settled on using water for non-selective mining of large caverns formed over predeveloped caverns in the underlying salt, then evaporating the water and crystallizing the potash. This is followed by selective mining residual potash with saturated brines cooled in brine ponds to produce potash.

The early studies did not provide workable technology (except in the complex Belle Plaine process). Recent papers and proposed solution mines have used ideas developed in these early years, without a re-examination of the basic chemistry and mass balances involved. The phase chemistry of potash is still not widely understood. Most of these new solution mining proposals will simply repeat the errors of the past.

The paper demonstrates that most of the "non-negotiable principles" from the past are not supported by good process design, based on phase chemistry. For instance the repeated recommendation of using a saturated NaCl brine for selectively dissolving potash is always wrong. (Exactly how this idea developed is a mystery). The idea that salt will plate out on the ore surface in selective mining, while possible in extreme circumstances, is easily avoided by simple process design. It is believed that KCl can be commercially leached out of the, in place, NaCl matrix. It is also believed that it is almost impossible to operate caverns at significant temperatures above rock temperature. The deep ponds used for pond crystallization are a poor choice. A few simple calculations with an understanding of the process can transform the solution mining process.

A procedure is provided using mass balance and phase diagrams to model the solution mining process, identify problems and select operating criteria. Dissolution rate information is added from various sources.

With a good design, based on proper mass balances, an understanding of the phase chemistry, and an appropriate ore resource, a full scale potash solution mine could be constructed at about 10% of

one using current technology, with production costs less than \$50 a tonne. This is about what was predicted 60 years ago.

Key words: Potash, selective mining, non-selective mining, polythermal process, phase chemistry, cavern dissolution modelling,