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Simulation of Potash Production by Selective Leaching of a Flooded Mine

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Abstract
When a working potash mine is flooded and de-watering is not possible, solution mining becomes the only alternative for further mineral extraction. Since a mine provides extensive surface area, selective leaching is a viable and economical mining technique. A flooded mine is not a closed system. Therefore, brine has to be lifted out of the mine. This requires separate injection and production wells. To maximize the retention time for the circulation brine, injection wells are placed at the extremities of the mine. Production wells, all equipped with submersible pumps are positioned farthest away from the injection wells, preferably at the deep end of the mine. A large, lake-like brine pond is used as the source of injection brine. It also receives the produced brine and serves as the KCl harvesting pond.

For numerical simulation of selective leaching in such a mine, a spoke and hub arrangement is assumed. The injection wells are at the end of spokes and the production wells are lumped together at the hub. The length of each spoke is the actual distance from that particular injection well to the location of the production wells. Each spoke is a cylinder, sub-divided in many segments. These segments are the computational cells. Each cell is assumed to be wrapped in a thermal envelope. During a calculation time increment, the heat exchanges between the formation, the thermal envelope and the cell brine are evaluated. Simultaneously, the mass transfer between the cell walls and the cell brine is calculated. The simulation results for multiple years of operation in one mine compared favorably with the measured field data.