A PRELIMINARY MODEL FOR HORIZONTAL WELL LEACHING

by

A. Saberian, P.E. , PH.D.

ABSTRACT

Leaching of a horizontal borehole in a salt formation by water injection at one end, and production of the resulting brine at the other end, will encompass different flow mechanisms. Initially, at the borehole stage, the flow is a tubular flow dominated by momentum forces. As leaching continues and the borehole evolves into a gallery, gravity gradually takes over and vertical salinity gradients are formed along the gallery. In the last stage of leaching, gravity totally controls the fluid flow under a single vertical salinty gradient, just as in any other mature cavity. Numerical modelling of such systems is complicated mainly because a mesh system suitable for momentum flow is not adequate for gravity flow and vice versa. This can be resolved by developing a model that provides the means for the transformation of the mesh system as the flow transition occurs.

The subject of this paper is the modelling efforts for the initial stage of leaching. Using a polar coordinate along the horizontal hole, the length is divided into so many tubular sections. Each of these sections is a cluster of pie-shaped computational cells. Symmetry is assumed, so computations are performed only for half of the cells in a cluster. In the early borehole stage, fluid velocity greatly influences the dissolution rate. As the hole enlarges, fluid velocity diminishes and the orientation of the salt surface becomes the influential factor for determination of the local dissolution rate. At this phase, each cell in a cluster is represented by a radius and an arc. At the end of each computational time increment, new radii are calculated and the local cumulative dissolved salt is used to evaluate a new brine salinty for each cluster.

Simulation runs are made to illustrate the performance of this preliminary model regarding gallery shapes, and cross sections.