



## Saturated hydraulic conductivity of self-sealing lining materials for desalination evaporation ponds

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### ABSTRACT

Evaporation ponds are used in the disposal of saline waste produced by desalination plants. An increase in concentration of saline wastewater by evaporation reduces the resistance of clay-based lining material commonly used in evaporation ponds and increases the risk of groundwater pollution. Self-sealing lining materials can add resistance to the lining system against advective flow through their capacity of reacting with the saline waste, unlike other liners. The objectives of this research were to quantify the effect of electrical conductivity (EC) of solution, duration of ponding of solution, bulk density of lining material and porous media, and wet-dry cycles on the saturated hydraulic conductivity ( $K_s$ ) of porous media through laboratory experiments. The Alamogordo variant very fine sandy loam (Tularosa soil) and #1 dry-silica sand/SIL-CO-SIL 125-silica (synthetic soil) were the two soils used in this study. Sodium silicate, calcium hydroxide and magnesium hydroxide, were the lining materials used in this study because of their expected ability to form transport-limiting solids. The lining materials were packed as either a homogenized mixture of 5–10 g of lining material and 60 g of soil or as layering the lining material between 50 and 10 g of soil. A stock solution of 0.25 M of calcium chloride, magnesium chloride, sodium carbonate and sodium sulfate was diluted using DI water to prepare different solutions of EC 30, 20, 10, 5 and 2 dS/m. The  $K_s$  was determined by the constant head method in each soil column for different EC-solutions. Mostly, the layer of lining material produced lower  $K_s$  of porous media than the homogenized mixture. The  $K_s$  decreased with increasing EC, duration of ponding (1–14 d), and bulk density in columns packed with calcium hydroxide. X-ray diffraction results showed that calcium hydroxide reacted with the saline solution to form precipitates such as calcite and gypsum. The inverse relationship between  $K_s$ , bulk density and amount of lining material showed that in order to achieve the EPA-recommended  $K_s$ , the porous media including the layer of lining material must be compacted to higher bulk density using greater amounts of lining material. This study demonstrated that calcium hydroxide could be used as a lining material with self-sealing capacity for desalination evaporation ponds.

**Keywords:** Saturated hydraulic conductivity; Bulk density; Lining material; Electrical conductivity; X-ray diffraction; Evaporation pond

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