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Effect of a magnetic field on water crystallization in tunnel drainage pipes in karst areas

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ABSTRACT

In order to study the inhibitory effect and mechanism of magnetic fields on the crystallization of tunnel drainage pipes in karst areas, a 20-d experiment was performed in magnetic fields of six different intensities in the laboratory, with polyvinyl chloride (PVC) coiled pipes simulating drainage pipes in a magnetic field environment and a solution of calcium chloride and sodium bicarbonate simulating groundwater in Karst areas. The Leshan-Hanyuan Express Way project is the background of the experiment. The crystallization rules in this experiment are determined by the experimental crystal quality and X-ray diffraction patterns. A calcite crystal simulation model was built to calculate the changes in the magnetic field. It was found that the magnetic field reduced the quantity of crystals. As the magnetic flux density increases, the number of crystals decreases to the critical magnetic flux density of 0.1 T, and then remains constant as the magnetic flux density increases further. In some cases, the magnetic field can change the form of calcium carbonate ($CaCO_3$) from a stable crystal to an unstable one. When the magnetic flux density is increased beyond the critical value of 0.5 T, the crystal form hardly changes. Temperature has no significant effect on the number of crystals formed in the drain under a magnetic field. The test results have important guiding significance for the development of technology for preventing and controlling crystal blockage of tunnel drainage pipes.

Keywords: Magnetic field; Tunnel in karst area; Crystallization in drainage pipe; Magnetic flux density; Temperature

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