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FEM Analysis of Saline Creep Behaviour over Time

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Extended Abstract

The case study is a potash ore deposit located in the Spanish Ebro Basin; it is configured by 8 salt lithologies separated by layers of clays. Saline materials have a characteristic called Creep, which is the flow capacity once an underground excavation is opened. This flow can be fast enough to present a safety hazard for the miners and an operational issue due to the cross-section reduction of the drift or even its collapse. Different variables including temperature or pressure influence directly the creep evolution. In recent years, the mining infrastructure of this case study is reaching considerable depths, such as opening underground excavations at more than 900 meters depth. Therefore, it is crucial to control the creep evolution over time.

The ore deposit was widely studied and, consequently, there are various technical reports, as well as scientific literature [1,2], defining the geological setting, the saline lithologies and some of their geomechanical parameters. However, there is a lack of knowledge about the saline behaviour and creep evolution over time. For this reason, it is believed essential to form a database from the scientific literature. This database will represent the first step to obtaining a model to analyse its geomechanical behaviour. Different types of methodologies for modelling the ore deposit have been evaluated and, finally, FEM analysis was chosen.

It is well known that underground mining can lead to geological reactions in the mining surface field, such as subsidence [3-6]. Various mining and geological factors, including the quality and characteristics of the underground rock or the quality of the surface conditions, can influence its magnitude, shape, mode, and extent of it [7]. The surface of the study mining area is not an exception. In the late 1990s, an increase in the subsidence velocity was detected very close to an urban area, and one neighbourhood had to be evicted [8]. This event led to the need for annual subsidence monitoring campaigns for years. Therefore, this large database of subsidence values has been used as a FEM analysis verification.

This study has assessed different FEM models in order to analyse the creep behaviour produced in a particular potash ore deposit. Each model has been defined as a section of a specific area. These areas have been chosen according to the superficial subsidence values. Consequently, FEM analysis has been based on some theoretical values, but also complemented with the data of the real superficial subsidence. This data is considered particularly useful since it gives the possibility to calibrate and adjust the theoretical values in order to achieve a better realistic approach.

To conclude, FEM analysis has represented a useful tool to better approach the geomechanical characteristics of the ore deposit. This information is essential to improve the understanding of the geomechanical behaviour of the ore deposit. Therefore, improving the safety conditions, production operations, and, moreover, representing another technique to evaluate and prevent the affections of the superficial ecosystem.

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