Abstract

The storage of natural gas in leached salt cavities remains one of the best adapted technical solutions to the establishment of strategic reserves. This study presents several analytical and numerical specific techniques in view of the dimensioning of hydrocarbon storage cavity fields and of the prediction of long term mechanical behavior, followed by its application to some actual underground storage problems. The specificity of the mechanical problem consists in the coexistence of two very contrasted types of material inside the rock mass : rock salt, a viscous fluid relatively homogeneous which behavior can be described quite precisely, and the other materials forming the cover strata which properties are rather unknown, but which behavior can be considered as elastic. Besides, long term behavior may generate a large extension of deformed zone in rock salt, resulting in the necessity of introducing the infinite conditions in order to reproduce the faraway displacement field, notably when analysing surface subsidence. In some cases, the stress field around the underground cavities may converge towards an asymptotic state which corresponds to a progressively incompressible behavior of the structure. The numerical modelisation suggested to reproduce this kind of storage cavity problems is based on a coupled boundary-finite element method. The presentation and, validation of the algorithms is made in a progressive manner by the comparison of results with analytical solutions valid for some geometrically very simple structures.