Hydrogen Storage in Geological Formations – The TWINN2SET project

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ABSTRACT

Hydrogen is one of the preferred options for the energy transition. It can be native or produced using different technologies, in which case it must then be stored, in particular in underground geological formations. Whatever the case, the question of the circulation of hydrogen, a very light and reactive gas, in the subsoil arises.

Hydrogen storage in geological porous media is the most suitable alternative in which hydrogen is stored in deep geological formations in a similar manner to natural gas or CO2. The literature of hydrogen storage in subsurface porous media is relatively sparse compared to hydrocarbon or CO2 storage in the subsurface. Storage of hydrogen in geological formations has been considered in connection with large-scale use of hydrogen, as well as for storage and regeneration of electric power from intermittent renewable sources such as wind energy. Candidates are salt domes, aquifers and rock cavities. The present research activity tries to highlight the conditions for storing hydrogen in such formations by investigating the potential for storage of hydrogen in various porous subsurface media.

The use of the geological structure for underground gas storage depends on underground geological conditions and limitations on the Earth's surface. The identification and selection of appropriate sites is a key element in the designing and construction of underground gas storage. Geological criteria that should be taken into account include: general geology of the area, rock types, structural and tectonic factors, seismic hazards, hydrogeological and geothermal problems, physical and chemical properties of the stored gas affecting its behavior in underground space, and geotechnical factors [1].

In that respect, the Institute of Geoenergy (FORTH/IG), has put forward a comprehensive work plan that will pave the way to the successful research project execution [2]. The three-year research work plan focuses on the stability of geological hydrogen storage, the practical set-up of operation and the potential competition or synergies of other uses of the underground space for gas storage (i.e natural gas and CO2). The final objective is to develop of an integrated geochemical/mineralogical, bio-geochemical and thermodynamic numerical simulation model that will be able to assess the performance of potential hydrogen storage geological sites for operators planning hydrogen storage facilities. The main outcomes of this tool will be the following:

- Identification of suitable geological sites for hydrogen storage and data acquisition requirements
- Assess cap rock integrity and seismic risk
- Reservoir description and characterization
- Assess subsurface distribution of injected fluids and log-term hydrogen-rock interactions
- Assess and mitigate subsurface risks of hydrogen operations

REFERENCES

[1] Radosław Tarkowski, Barbara Uliasz-Misiak, Piotr Tarkowski, Storage of hydrogen, natural gas, and carbon dioxide – Geological and legal conditions, International Journal of Hydrogen Energy, 46/38, 20010-20022 (2021).

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