Evaluation of Hydrogen migration and geochemical reactivity into underground

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The use of hydrogen as an alternative for energy storage has emerged rather recently though it was originally more identified as a secondary energy carrier and storage medium. By way of electrolysis it becomes one of the major actors in the possible conversion of excess wind or solar energy with the favorable arguments of being environment-friendliness and having high storage densities [1]. The concept of "Power to Gas" comes from the conversion of electricity into gas via electrolysis process. Hydrogen and Oxygen produced under various forms can be reused for several purposes and applications. Research project related to investigate the feasibility of storing hydrogen in porous geological formations are under development like the H2STORE project in Germany [2], the European project HyUnder which proposes to evaluate thoroughly from a technical, economic and societal standpoint if hydrogen underground storage can become a potentially attractive solution [3]. In Austria, the Undergound SUN.STORAGE project, led by the Rohöl-Aufsuchungs Aktiengesellschaft (RAG), conduct research and analysis of the impact of hydrogen on underground gas (methane) storage systems [4]. In Pentagonia, Argentina, Hychico S.A. is conducting operations to convert electricity produced from the Diadema wind farm into hydrogen to be injected into a depleted oil field converted into a methane gas storage reservoir [5]. In this paper we assess the transport properties of hydrogen gas injected into a sandstone formation like. Using a core sample of the rock, laboratory experiment is conducted to evaluate the permeability relative to hydrogen gas phase flow into a water saturated sample of sandstone rock representative of the Alsace Triassic formation. Geochemical reactivity of dissolved hydrogen with clay minerals of the rock is also investigated using autoclave experiments, meaning that crushed powder of rock is remained in contact with hydrogen and water for several weeks to evaluate the possible change of the chemical composition of the water in contact with Hydrogen and rock mineralogy. These measurements should serve at providing reservoir storage criteria for estimation with numerical modeling tools of storage capacity of underground sedimentary formation for large scale storage of hydrogen.

REFERENCES

1. Crotogino, F., Donadei, S., Bünger, U., Landinger, H., Large-scale hydrogen underground storage for securing future energy supplies, Detlef Stotlen, Thomas Grube (Eds.): 18th World Hydrogen Energy Conference 2010 – WHEC 2010, Proceedings, May 16-21 2010, Essen. ISBN: 978-3-89336-654-5.
2. Ganzer L. V. Reitenbach, D. Pudlo, M. Panfilov, D. Albrecht, ,R. Gaupp, The H2STORE Project - Experimental and Numerical Simulation Approach to Investigate Processes in Underground Hydrogen Reservoir Storage Society of Petroleum Engineers, EAGE Annual Conference & Exhibition incorporating SPE Europec, 10-13 June, London, UK Publication, 2013.
3. Correas, L., "Storing renewable energy: is hydrogen a viable solution?", Paper presented at the EUSEW HyUnder Workshop, 26th of June 2013, Brussels, available at http://www.hyunder.eu/publications/59-hyunder-eusew-workshop.html.
4. SUN.STORAGE, 2014, http://www.underground-sun-storage.at/en/project/project-description.html
5. Hychico, 2014, http://www.hychico.com.ar/