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Technical Conference Paper

The Increasing Importance of Hydrogen Derivatives – Evaluation of Ammonia Storage in Salt Caverns

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SMRI Fall 2023 Technical Conference
2-3 October 2023
San Antonio, Texas, USA

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Abstract

Green electricity and hydrogen are considered as key energy carriers in the transformation of the energy system. In this context, an increasing interest in so-called hydrogen derivatives can be observed. Especially ammonia (NH_3) - a compound of hydrogen and nitrogen - promises great technical and economic advantages in the maritime transport of green energy carriers and this despite additional conversion processes.

The advantages are liquefaction at much more moderate temperatures and pressures than for hydrogen, a much higher volumetric energy density and the already existing infrastructure and transportation networks worldwide. Currently, large plants for the production of green hydrogen are being planned and built in regions such as Australia, the Middle East and North Africa in order to supply densely populated industrialized countries such as Germany and Japan with green energy and fuel in the future. Almost without exception, it is planned to use ammonia as an energy carrier in case of maritime transportation over very long distances.

With this in mind, the question of storage arises both on the producer and on the receiver side. Similar to today's situation with the fossil fuels crude oil and natural gas, storage will also be required on different scales - from relatively small operational storage facilities to seasonal or strategic storage facilities.

The storage of large volumes of ammonia is state of the art worldwide. Large volumetric storage densities can be achieved by storing in cooled form at -40°C / -40°F in liquid form or under a pressure of approx. 8.6 bar / 124.7 psi. However, the high safety standard that has been achieved for some time now in surface storage requires a great deal of effort in planning, installation and maintenance. The reason for this is the high toxicity of ammonia, which is why a great deal of effort is made to prevent leakage.

However, since a large increase in storage capacity is to be expected in the near future, especially on the receiving side, if the planned delivery rates are realized, there is increasing interest, mainly with regard to public acceptance, in investigating the possibility of underground storage as well.

For this purpose, an initial evaluation of the technical feasibility of ammonia storage in salt caverns was carried out by investigating different storage concepts, comparing their pros and cons and identifying technical obstacles and further research needs to allow for a statement on the basic feasibility.

Key words: Salt Caverns, Cavern Storage, Ammonia, NH_3 Storage, Hydrogen Derivatives