CO_2 Storage in Deep Salt Water Reservoirs

One way to combat climate change is to prevent the release of CO_2 to the atmosphere by storing it in geological reservoirs. This information sheet provides an overview of the storage potential in deep salt-water reservoirs.

Why store CO_2 in deep salt-water reservoirs?

Deep salt-water reservoirs have the potential to provide very large storage capacity worldwide at relatively little cost. There are a number of places where deep salt-water reservoirs have been used as buffer stores for natural gas, giving confidence that CO_2 could be stored safely for thousands of years in carefully selected reservoirs.

Storage in deep salt-water reservoirs

Sedimentary rocks such as sandstone and limestone have many small spaces or pores that can be filled with water, trapped by an overlying layer of non-porous rock. Many of these reservoirs contain salt water. If CO_2 is injected into these reservoirs some will dissolve in the saline water and become widely dispersed in the reservoir. CO_2 can also react with the minerals within the reservoir and remain fixed for eternity. The most suitable reservoirs are those at depths greater than 800m, as the CO_2 will behave more like a liquid than a gas, enabling much more to be stored.

How much capacity is available?

The IEA Greenhouse Gas R&D Programme has estimated the global potential for storage of CO_2 in deep saline reservoirs as between 400 and 10 000 Gtonne† CO_2. This estimate was made in the early 1990s. More recent studies suggest that the storage capacity in geological reservoirs in Northwest Europe alone could be as high as 800 Gtonne CO_2. Research activities are underway in Europe and Australia to map and assess the storage capacity of offshore salt-water reservoirs while similar research in Canada and the USA is looking at onshore salt-water reservoirs. However, further investigation is needed to assess the worldwide potential.

What is the status of CO_2 injection into deep salt-water reservoirs?

Since 1994, acid gases (containing both CO_2 and H_2S) from natural gas processing plants have been injected into onshore salt-water reservoirs in Alberta, Canada. This is a cost-effective way of avoiding emission of sulphur-containing gases to atmosphere. The salt-water reservoirs used for sequestering these gases lie between 1 400 and 2 900m below the surface.

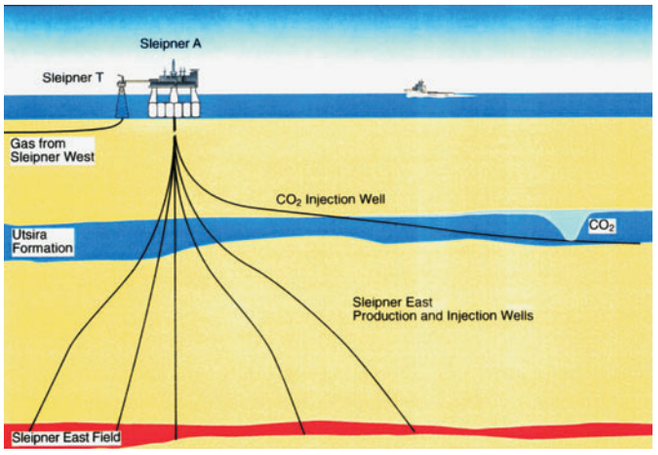
In the North Sea one commercial project is underway which is injecting CO_2 into an offshore deep salt-water reservoir. This project, at the Sleipner West gas field, has been operating since 1996. Currently over 2 million tonnes of CO_2 have been injected underground.

The natural gas from the Sleipner West field has a CO_2 content of 9%, which has to be reduced to 2.5% for commercial sale. The CO_2 is stripped out using conventional technology. It is then injected into a saline reservoir, known as the Utsira Formation, about 800 metres below the seabed.

† 1 Gtonne is 10^9 tonne

Treating CO_2 in this way, which almost entirely eliminates emissions to the atmosphere, marks a milestone in industrial history. This has never been done before on such a large scale. Nor has CO_2 been compressed and injected underground on an offshore platform before.

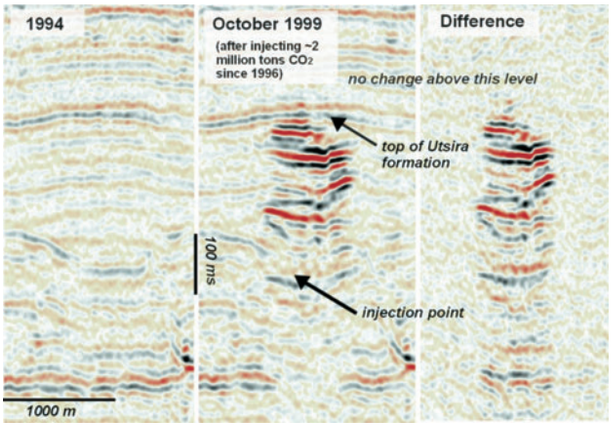
Sleipner West natural gas field where separated CO_2 is being injected into a deep salt-water reservoir (Courtesy of Statoil)



CO_2 injection into the Utsira deep salt-water reservoir Courtesy of Statoil)

An international project known as the Saline Aquifer CO_2 Storage project (or SACS for short) was established in 1998 to monitor the injection of CO_2 into the Utsira Formation. Seismic monitoring, a standard oil industry technique, can be used to follow the movement of the CO_2 in the reservoir. Initial results after 2 years of injection, clearly show the presence of CO_2 in the reservoir.

The SACS project will also study the CO_2/mineral reactions within the reservoir, the regional geology of the Utsira Formation and the shale layers above the reservoir, which provide the seal. The seismic data obtained is being used to adapt industry standard reservoir models to simulate the injection of CO_2 into the reservoir. This will allow behaviour of CO_2 in the reservoir to be predicted for thousands of years.



Seismic monitoring before and after CO_2 injection. (Courtesy of Statoil and the SACS Partners)

Will the CO_2 stay there?

Storage of natural gas and similar activities demonstrate that this type of technique could be used to store CO_2 for long periods. Even if the reservoir was not fully sealed, the time required for CO_2 to diffuse to the edge would be hundreds or thousands of years – sufficient to make a useful contribution to tackling climate change.

The results from the SACS project will be used to develop a Best Practice Manual for CO_2 storage in deep saline reservoirs. This manual will aid the planning of future storage projects in saline reservoirs.

What is the status of CO_2 storage?

Today there are only a limited number of storage projects in deep salt-water reservoirs. However, this storage option is attracting considerable interest worldwide. Currently, further projects are under consideration in Canada, The Netherlands, Norway, USA and the United Kingdom both in onshore and offshore reservoirs. Storage of CO_2 in deep saline reservoirs is expected to be a growth opportunity in the near future.

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