Venting - Getting back the CO_2 from the reservoir

A subsurface reservoir has been filled up with CO_2. Can the CO_2 be recovered? And why should it be recovered? In the unlikely scenario of leakage it might be necessary to remove the CO_2 from the reservoir in a controlled way, reduce the reservoir pressure and prevent unwanted migration. Another possible scenario is that in the future CO_2 should be used as raw material in chemical engineering, e.g. for generating methane (CH_4) from hydrogen gas (H_2).

At Ketzin, Germany 67000 t of CO_2 have been injected into a saline aquifer between 2008 and 2013. During almost two years after injection stop the CO_2 migrated in the reservoir and the pressure decreased. It was attempted to recover a part of the CO_2 using the remaining reservoir pressure. The experimental equipment of the venting field test is shown in Figure 1.

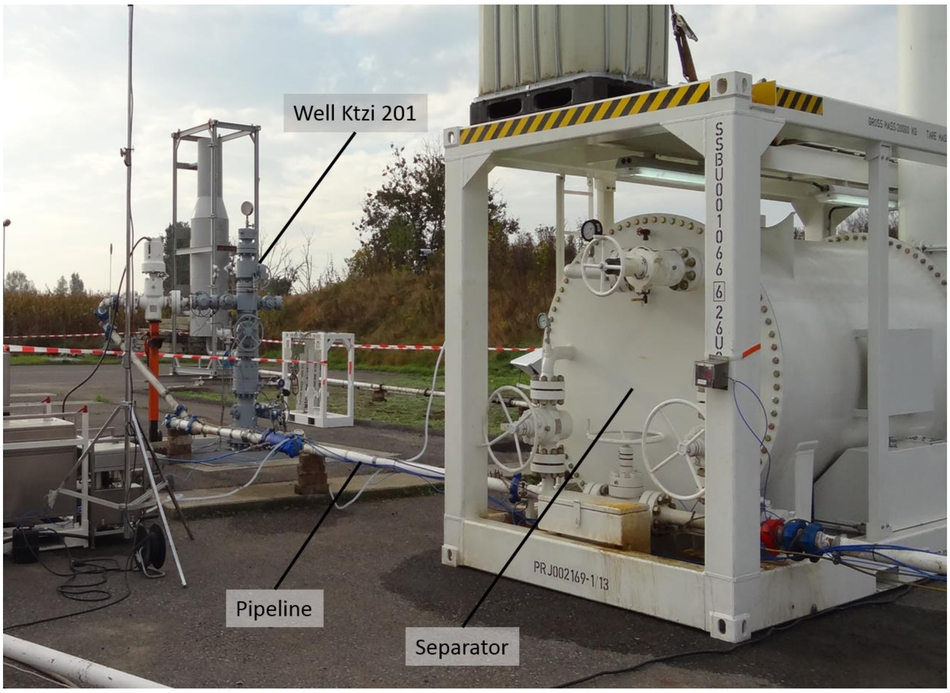


Figure 1: Experimental setup of the venting experiment. The CO_2 is extracted by the grey well, and transported through the white pipelines. The white tank in the container frame separates the brine and CO_2.

There are CO_2 and brine present in the reservoir, where the CO_2 is similar to a gas and in the upper part of the reservoir and the brine is similar to water in the lower part of the reservoir. Both components can interact with each other in different ways (Figure 2).

Scenario a: When the well is opened CO_2 starts flowing out of the well. The brine remains in the reservoir and accumulates in the well. If the accumulation reaches the upper end of the reservoir, two further scenarios (b, c) can happen.

Scenario b: The brine fills up the extraction well from below. The weight of the brine column reduces the outflow of CO2 until only tiny bubbles migrate upward.

Scenario c: If the velocity of the CO_2 is high enough, drops of the brine are transported upwards and leave the well. The accumulation of brine remains small and the flux remains high.

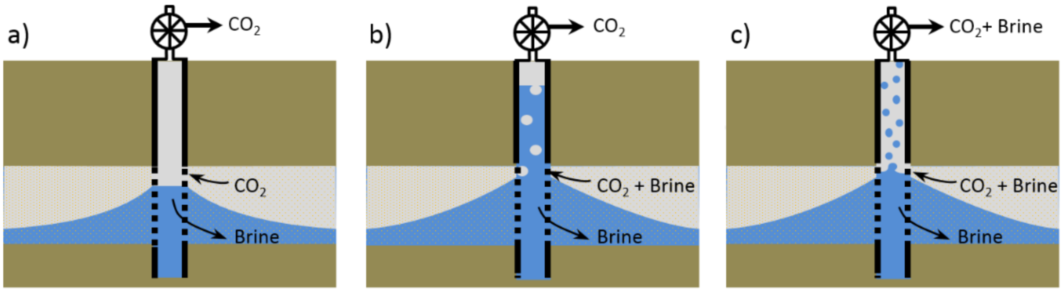
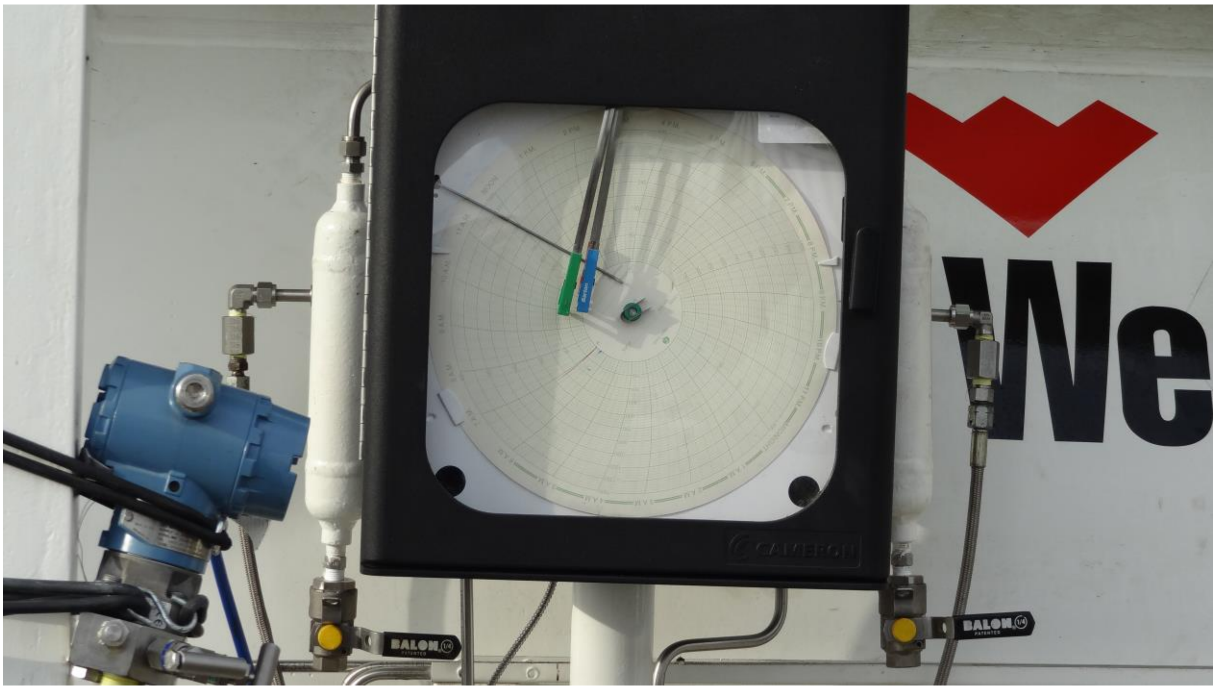


Figure 2: Schematic view of different scenarios during the venting experiment. The black element in the center is the extraction well, the grey area represents the CO_2, the blue area the brine in the reservoir.

At the Ketzin experiment the scenario a) was limited to a very short period at the beginning, and scenario c) was prevailing. In total 240 t of CO_2 and 63 t of brine were produced. The ratio of CO_2 and brine remained almost constant during the experiment, although the production rates varied between 800 and 1600 kg per hour. The brine had to be disposed.

The experiment shows that it is possible to retrieve CO_2 by back production from the reservoir, but simultaneously a relevant amount of brine is produced. This brine requires a proper disposal.

The experiment was monitored scientifically with respect to pressure, flow rate, distributed temperature and geoelectric signatures. These data are evaluated within the Mirecol Project for a better understanding of the processes and to make a prognosis for application of venting in a larger context.



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