Study of casings retrieved from the final abandonment of the Ketzin pilot site

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The Ketzin pilot site outside Potsdam, Germany has since 2004 been used to scientifically investigate the underground storage of CO₂ [1-3]. The site had previously been used as a seasonal storage for natural gas by utilizing a reservoir at a depth of 280 meters. However, a deeper sandstone layer suitable for storing CO₂ at a depth of 630-650 meters was identified and the site was transformed into a pilot site dedicated for research on all aspects of large scale CO₂ storage. A total of five wells were drilled for the operation in the period of 2007 and 2012; three deep observation wells (Ktzi 200, Ktzi 202, Ktzi 203), one injection/observation well (Ktzi 201) and one shallow observation well (P300). In total, 67 kilo-tones of CO₂ were injected into the saline aquifer reservoir between 2008 and 2013.

Preparation for decommissioning and abandonment of the site started in 2013 [4] and with the abandonment of observation well Ktzi 202 the first well was abandoned in the autumn of 2015 [5]. The other four wells Ktzi 200, Ktzi 201, Ktzi 203 and P300 were then abandoned in the autumn of 2017. The objective of this particular work was to study casing samples obtained from the abandonment of the wells Ktzi 200 and Ktzi 201. Different casings were collected, ranging from wider 9 5/8 casing to narrow 2 7/8 injection tubing. The collection depth of the casing samples ranged from shallow (20 meters) down to the depth of 560 meters. The samples were characterized by visual inspection of the samples to assess the severity of corrosion and erosion. The thickness of the rust layer propagating into the steel matrix was measured and the surface roughness measured.

The parameters taken into consideration on the discussion of the results are the variety of the downhole conditions, such as temperature, pressure, and what chemical environment the casings have been subjected to during the operational phase. The casing samples from the observation well Ktzi 200 did not exhibit high level of erosion or corrosion on its surface given the condition they were subjected to. A mild effect on the depth was observed on the 5 ½ casing with more corrosion observed for samples retrieved from the deeper section of the well. A similar observation was done on the 5 ½ casing from the samples obtained from well Ktzi 201 with slightly more corroded surface for the deeper sections. For the 3 ½ injection tubing more severe signs of pit-corrosion were observed in several sections located near / at the joints of the 3 ½ injection tubing. A possible explanation is the larger outer diameter of these sections, which meant a higher probability of mechanical knocks to the casing during the well completion phase. These mechanical knocks would thus generate a potential
attack point on the casing surface for pit-corrosion. The 3 ½” pipes were also the only ones standing in a fluid over all the year. This was a completion fluid consisting of water plus corrosion inhibitor. Whereas the other casing pipes cemented which should reduce the impact of the any corrosive condition down hole.

Figure Photograph taken of 3 ½ injection tubing from well Ktzi 201 showing example of corrosion.