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SUMMARY AND CONCLUSION

Carbon Capture and Storage (CCS) has assumed growing importance since it provides a bridging technology which allows a balance between increasing demands for energy and the requirements to reduce emission. The basic idea behind CCS is to capture CO_2 from large industrial sources before it is released into the atmosphere, and then carefully transporting and storing it in matured oil and gas reservoirs or in other deep geological formations like saline aquifers where it would remain for thousands of years or longer.

CO_2 is normally transported from the source of capture to the storage location using conventional pipeline technology under supercritical flow conditions. Depending on pressure and temperature, CO_2 can exist as solid, liquid, gas or supercritical fluid. The term dense phase is used to represent CO_2 in the supercritical or liquid state. For transporting CO_2 through pipelines the dense phase is preferred due to the fact that its density is close to that of liquid water, but its viscosity is approximately equivalent to that of gaseous CO_2.

CO_2 alone is not reactive, and it is inert to commonly used industrial materials but once in contact with brine, carbonic acid (H_2CO_3) is formed, and the corrosion rate will be significant for carbon steel. The formation of this acid reduces the pH of the brine, indicating that the brine becomes corrosive to well materials, rocks and pipelines Moreover, contamination of CO_2 can have potentially terrible consequences as it can cause major changes in the property behavior of the gas in the pipeline. The CO_2 captured from various sources may contain many impurities depending on the process and capture technology.

Therefore, to select appropriate materials for CO_2 sequestration network, the corrosion behavior of materials under the flow conditions at atmospheric pressure should be investigated. The current work has been carried out to understand **the impact of NaCl concentration in CO_2 environment and impact of solvent impurities on the corrosion behavior of carbon steels (three grades) and stainless steels (304 and 316) under simulated flow condition at atmospheric pressure by measuring mass loss using Rotating Cage (RC).** The major findings of the study are summarized below.

The reproducibility of the results obtained from rotating cage was confirmed by the data's obtained for global level **Inter laboratory study to Establish Precision statements for ASTM G 202, Standard Test Method Using Atmospheric Pressure Rotating Cage by ASTM Committee G-I on corrosion of metals, subcommittee G 01.05 on Laboratory Corrosion Tests.** Hence, Rotating cage is a simple, compact methodology to simulate pipeline flow conditions in the laboratory which ensures the reproducibility of the results.

The effect of NaCl concentration and the effect of period of rotation simulating the flow condition on the selected carbon steels has been studied under four different concentrations: 1,5,15 and 30 % and at four different periods of rotation (24, 48, 72 and 96h).The corrosion rate was found to be maximum at 5% concentration of NaCl solutions for all the chosen carbon steels.

The corrosion rate was found to decrease with the increase in time due to the protective layer ($FeCO_3$) formed on the surface. In NaCl solution under CO_2 environment, Carbon steel I was found to be least corroded while the carbon steels 5LX 42 and 5LX 60 were found to be more corroded.

Similar studies were carried out with 304 and 316 stainless steels. Compared to carbon steels corrosion of stainless steels was found to be negligible.

The corrosion behavior of metals under these experimental conditions found to follow the order

Carbon steel 5LX60> Carbon steel 5LX42> carbon steel I>304 SS>316 SS

The impact of NaCl with MEA was studied following the same experimental conditions on the selected carbon steels and stainless steels. The corrosion rate obtained was found to be negligible both on carbon steels and stainless steels.

Impact of NaCl with MEG in presence of oxygen under CO_2 environment was carried out on the same type of selected carbon steels and stainless steels. The corrosion rate was found to increase due to the presence of oxygen. But with the increase in period of rotation the corrosion rate was found to decrease following a non linear trend due to the protective layer (Ferrous carbonate and iron oxide) formation.

The surface morphology of the samples exposed to different test media were analyzed by optical microscopy. The chemical analysis and imaging on the metal samples are performed using SEM/EDS. The SEM images of the samples show that the corrosion reaction is focused mainly on the irregular surfaces on the metal. The products of corrosion were mainly carbonates under CO_2 environment and oxides in presence of oxygen.

The results of this study have revealed that further work is required to be done in order to fully evaluate the corrosion behavior of carbon and stainless steels in presence of other impurities. A collection of data helps us to develop a searchable database which will serve as a ready –reckoner in the quick evaluation of corrosion characteristics of different metals.