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Investigation of Salt Precipitation Behavior During the Cooling Process of Fully Saturated Brine

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Abstract

It is a known fact that salt precipitation can occur in all kinds of brine flow paths and cause massive problems, for instance during the debrining phase of gas storage cavities. The accumulations on the pipe wall can lead to increased pressure losses or in some cases; the scaling can even completely plug the pipe. The established procedure is to interrupt the brine flow to flush the string with fresh water for dissolving the accumulations.

The reason for the precipitation is the reduction of the saturation concentration of the brine due to the changes in temperature and pressure conditions during the production. An example were these conditions can become particularly critical is during the debrining of gas storage caverns - when cold gas is injected and warm brine is being lifted. Also the Joule-Thomson-effect can cause local cooling zones for instance at the end of the annulus around the debrining string.

In order to conduct further investigation on this particular issue on a laboratory scale, an experimental setup was developed. The key element of the flow loop is a double pipe flow unit with an outer pipe made of acrylic glass to allow observation of the scaling process. The inner pipe is connected to a separate water loop and can thereby be cooled actively. The aim was to investigate the influence of cooling- and flow rate, on the nucleation and the scaling process.

This paper will present the results of the first flow tests performed with the flow loop under varied conditions. A general overview of the critical parameters and mechanisms which are responsible for the scaling growth in pipe flow will be provided. Particular emphasis will be placed on the effect of the flow rate and different cooling rates on the crystal growth. In addition, the amount of fresh water required to remove the salt precipitation has been investigated and will be presented too.

After the first series of tests it was observed that the flow rate affects the size of the salt grains. Bottlenecks in the string are also critical since they favor selected scaling growth.

Key words: Caverns for Gas Storage, saturated brine, scaling, debrining, slow flow