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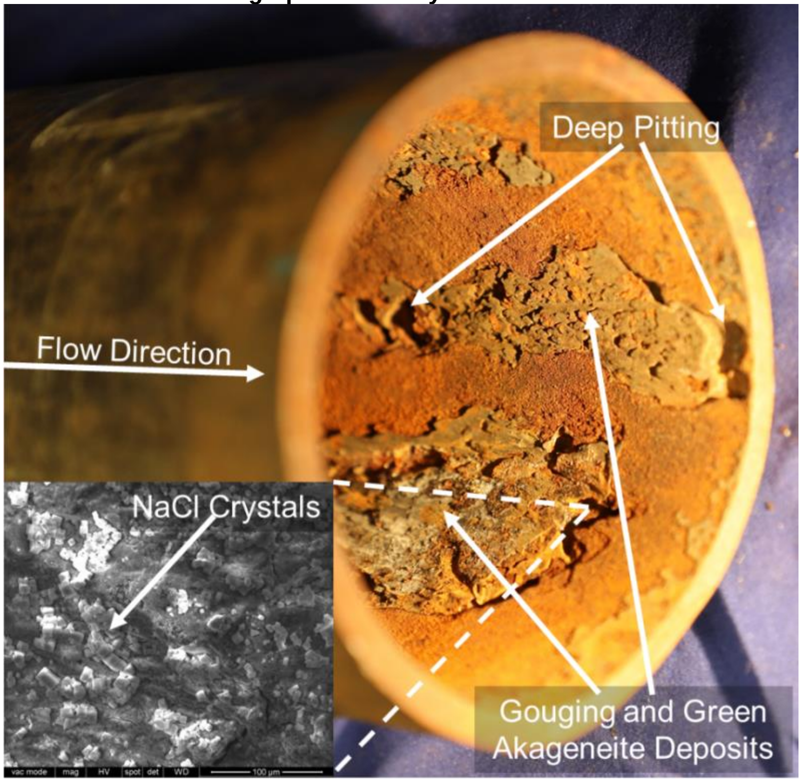
"Providing Fast Failure Analysis and Customized Testing Services to Solve the Most Demanding and Complex Material Problems!"

Chloride Erosion-Corrosion of Oilfield Piping

Background: A client contacted KnightHawk Materials Lab to have a failure analysis performed on some oilfield pipping that failed due to through thickness pitting corrosion after less than one year in service. An NDT inspection found severe wall thinning throughout the well's pipping and identified the corrosion damage mechanism as CO_2 corrosion.

Figure 1: Macrophotograph of Pitting, Gouging, and Green Corrosion Deposits with Inset Showing SEM Micrograph of Salt Crystals in the Pits



Summary: The failure of the pipes was caused by salt water/chloride induced erosion corrosion. X-ray diffraction testing revealed Akageneite, which is a chloride-containing iron oxide often formed when steel is exposed to salt water. SEM/EDS of the corrosion pits revealed significant deposits of crystallized NaCl (Figure 1). Process data revealed that the well was producing water to oil at a ratio of approximately 9:1, resulting in an abundance of salt water in the system. The chloride pitting (Figure 1) caused by the salt water then increased the turbulence of the flow, which allowed the oil/water/sand slurry to remove the Akageneite and to expose fresh steel, which then continued to corrode, leading to the very fast erosion corrosion of the material.

Take Away: Though field inspections and first impressions have value, it is important to conduct full laboratory testing, especially in complex environments with multiple possible causes for failure. In this case, though the damage did macroscopically appear to be consistent with CO_2 corrosion, the process data indicated that there was very little CO_2 present. Thus, the real cause of the failure was only determined through laboratory analysis.

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