Comparative study of the effectiveness of organic petro-or biosourced surfactants in inhibiting carbon steel corrosion in a standardized reconstituted geothermal water

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6. Production and Re-injection: Chemical solution; scale/corrosion inhibitor injection

COMPARATIVE STUDY OF THE EFFECTIVENESS OF ORGANIC PETRO- OR BIOSOURCED SURFACTANTS IN INHIBITING CARBON STEEL CORROSION IN A STANDARDIZED RECONSTITUTED GEOTHERMAL WATER

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Key Words

Standardized Reconstituted geothermal water, carbon steel, corrosion, scaling, petrosourced inhibitor, biosourced inhibitor, hydrogen sulfide, iron sulfide, electrochemical techniques

ABSTRACT

Since 1989, petrosourced inhibitors has been gradually used to prevent corrosion-scale in geothermal installations exploiting the Paris Basin Dogger aquifer. This anti-corrosion-deposition treatment, using a well bottom treatment tube, was preceded by studies on the corrosion phenomenology and kinetics or accompanied by studies carried out to refine the choice of effective inhibitors.

Various petrosourced molecules and/or formulations (i.e alkyl-amines or diamines, fatty amines and quaternary ammonium salts) adapted to the water geochemistry of the Dogger aquifer, were or have been used with some satisfaction for almost three decades.

Once injected in an actual or standardized reconstituted geothermal water (SRGW), those formulations are known to be anticorrosive and anti-scale at the recommended doses and bactericide at large doses. According to their physical and chemical properties, they significantly reduce the corrosion rate of the carbon steel and delay the crystallization of mackinawite from amorphous iron sulfide (FeS) scale.

Although some problems, encountered when using these products, have been resolved, their use is far from being risk-free. Other difficulties must be overcome, such as (i) under-deposit corrosion, which, in most cases, takes the form of pitting and (ii) persistence of the no biodegradable formulated molecules.

At present, the orientation towards sustainable development and respect for the environment, whether by voluntary approaches or by obligation to European directives, gradually gives rise to a replacement of petrosourced and ethoxylated products by alternative, environmentally friendly products. Thus, innovative biosourced inhibitors are also tested, under the same procedures, in order to progressively replace partly or fully the

persistent petrosourced inhibitors. However, these biodegradable inhibitors are efficient at slightly higher doses.

Testing the efficacy and understanding the behaviors of those corrosion inhibitors in the SRGW is important to optimize their utilization. Therefore, electrochemical techniques were used, with carbon steel XC38 stationary working electrodes immersed from the start in a SRGW, treated or no with some quantity of each inhibitor. Stationary and transitory electrochemical methods were implemented to measure corrosion rate and assess the inhibitive action of the formulas tested as a function of immersion time and surfactants compound concentration.

By combining and comparing results gathered using various electrochemical and analytical techniques and including the case without inhibitor, the mechanisms governing the action of inhibitors and their effectiveness were determined.