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Investigation and Prediction of Corrosion and Scaling Tendency in Wastewater Pipelines and Tubings of Disposal Wells of Rag-e-Safid Crude-Oil Desalting Unit

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INTRODUCTION

Metal corrosion and Scaling in the presence of water is a common problem in most industries, including the oil and gas industry. Since the formation water is located in the underground reservoirs, in the vicinity of the petroleum due to the density difference in the underlying bed and the water droplets are saturated among the oil molecules in the petroleum layer [1]. Wastewater and effluent of the desalination units are injected into the disposal wells for environmental protection purposes. The accumulation of suspended solids and petroleum products along with the effluent in the disposal wells of the wastewater of the desalination units results in plugging the reservoir pores and decreases their permeability [2]. This issue is always one of the operational concerns, and operating companies have incurred significant costs in this regard. To solve this problem, it seems necessary to use wastewater treatment system in desalination units [3]. Rag-e-Safide desalting unit produces 3126 barrels per day (bbl/day) of wastewater from oil processing. This large volume of wastewaters, with the high amount of minerals and TDS, is injected into a disposal well through a 6-km pipeline. Injecting this wastewater into the disposal well causes a great deal of damage due to the formation of mineral deposits or scales in pipelines and processing and desalination equipment as well as downhole equipment. Therefore, eliminating these pollutants and supplying the required quality water requires the use of advanced, efficient as well as economical treatment methods. One of the indirect methods to determine the corrosion and scaling potential of desalination units is corrosion and sedimentation indices. These indicators reflect

the qualitative characteristics of water. The accuracy of corrosion and sedimentation indices based on their abilities is evaluated to determine the states of the solution in terms of calcium or calcite carbonate, and, and thereby predict wastewater capacity in the formation of different types of calcium carbonate (calcite), barium sulfate deposits (Barite) and calcium sulfate (anhydrite); therefore, if the solution is in under saturated state, precipitation does never occur; in addition, if the solution is in saturated state, precipitation may occur (i.e. it is equilibrium or on the border of change) , and if the solution is in supersaturated state, precipitation certainly occur [4]. This study aimed to determine the corrosion rate and sedimentation rate of Rag-e-Safid desalination wastewater using corrosion and scaling indices as well as corrosion rate. This article studies and predicts the corrosion and scaling indices of tubings and the wellhead equipment of disposal well of this desalination unit and has presented operational strategies to minimize corrosion and scaling.

MATERIALS AND METHODS

The physical and chemical properties of output wastewater of Rag-e-Safid desalination unit were measured by taking samples in vitro and one liter of the wastewater of desalination of Rag-e-Safid with PH=6 and electrical conductivity 113454.5 µs/cm. Measurement methods are based on standard procedures contained in references [5-6]. The data used in this study are temperature, pH, calcium concentration, bicarbonate concentration, total soluble solids (TDS) and electrical conductivity (EC), total anions and cations, and the amount of carbonate. The pH was sampled using a pH meter with daily calibration in situ. However, alkalinity, calcium hardness, and TDS were measured by the instructions in the standard method book in the laboratory [5, 6].

RESULTS AND DISCUSSION

As can be seen in Figs. 1 and 2, the amount of calcium carbonate decreases with the injection time and water mixing, so as can be seen in these figures, only calcium carbonate deposition can be in this well at injection time.

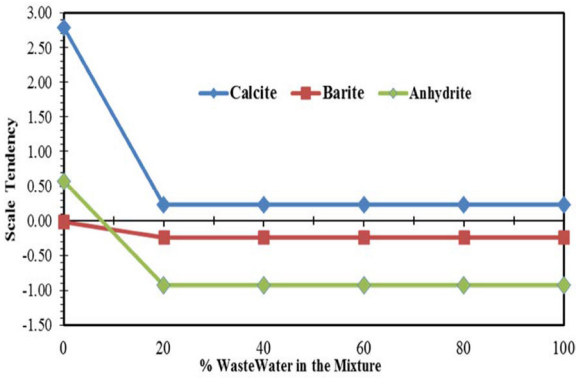

Figure 1: The scaling index calculated for different scales at wellhead condition.

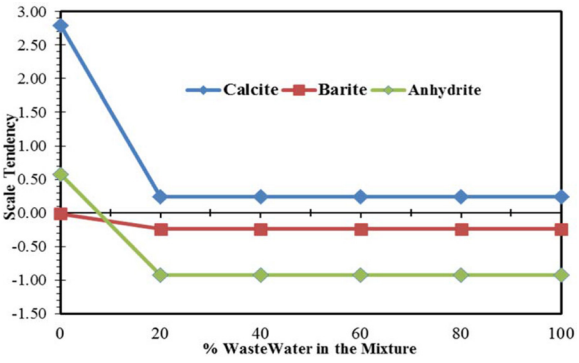

Figure 2: The scaling index calculated for different scales at bottom hole condition.

According to Fig. 3, by increasing depth and length of the tubing and also temperature and pressure from the surface to the bottom of well, the amount of corrosion rate of wastewater of this well is increased. These figures show when wastewater is injected into the disposal well, the corrosion rate of wastewater is grater mixing

water and formation water. Also, the corrosion rate of formation water is greater than mixing water at different lengths of tubing and depths.

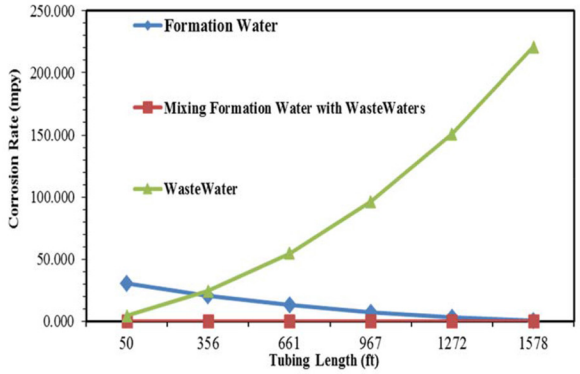

Figure 3: Corrosion rate (mpy) in the tubing of disposal well of the desalination unit.

CONCLUSIONS

In this paper, evaluation of 10 important and applicable indices of corrosion and scale that indicates high corrosion potential of this wastewater and the type of corrosion is mainly local. Under temperature and pressure conditions from the wellhead to the bottom hole, the rate of corrosion and scale of desalination wastewater is higher than the formation water in aquifer zone of reservoir and mixing of formation water with desalination wastewater. Increasing the composition of the percentage of water associated with oil (produced water) and freshwater to separate salt from oil decreases the rate of scale. The amount of scale tendency of barium sulfate in the wellhead is constant, thus the potential for the formation of this deposit exists only in the wellhead in this well. At the bottom hole conditions, only calcium carbonate deposition has the potential to precipitate. As a result, the scaling or supersaturation index for barium sulfate and calcium sulfate scales is lower than zero (SI <0) by increasing the mixing percentage of the two injectable waters for desalination and the water produced with the oil. As a result, these scales cannot be formed in the studied well at high rates of mixing of two waters (desalination wastewater and formation water).

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