CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S0516

Project Title
The Correlation Between Conductivity and Corrosion Potential of Solutions in Simulation of an Oil Field Environment

Abstract

Objectives/Goals
To determine the correlation between conductivity and corrosion rates in various solutions in simulation of a typical oil field environment.

Methods/Materials
Part I: Carbon-steel corrosion coupons (3#x.5#) were weighed and placed in the following solutions: sodium chloride solution, produced water (from an oil field), hydrochloric acid (pH 4), and carbon dioxide solution (pH 6). The solutions were sealed and placed at either room temperature or 50ºC (120ºF) for one week. The coupons were then removed, cleaned of excess corrosive residue, and the final mass was obtained. Each solution was tested ten times at both temperatures for a total of 80 trials.
Part II: An LPR probe was placed in each of these solutions for one hour at both temperatures. A reading [in mils per year] was then obtained from the probe. A conductivity reading was taken using a conductivity probe.

Results
The coupon results show that hydrochloric acid was the most corrosive (when heated it had 68.33 mpy and 55.01 mpy at room temperature). The carbon dioxide demonstrated an average loss of 7.72 mpy when heated and 11.39 mpy at room temperature. Produced water showed an average loss of 4.44 mpy when heated and 1.16 mpy at room temperature. Sodium chloride solution was the least corrosive with 1.35 mpy when heated and .77 at room temperature. The LPR Probe demonstrated similar results with the hydrochloric acid being most corrosive (2281.11 mpy heated, 209.68 room temp.), followed by produced water (209.68/125.76), and sodium chloride (100.40/43.48). The conductivity results also mimic this progression.

Conclusions/Discussion
My hypothesis was supported by the data. Hydrochloric acid was far more corrosive then all of the other solutions. With excess hydronium ions in solution in the acid, the formation of hydrogen gas (and therefore the loss of electrons from the metal) is greatly increased. This allows for the oxidation of iron to be much more prevalent (which indicates that greater amounts of iron would be lost into solution as oxidized ions). In general, the effects of heat produced a more corrosive environment. As conductivity increased, the amount of corrosion also increased. While the conductivity meter is not perfect, it can be useful in understanding general corrosion trends of a solution. For a low budget project that needs supportive results, the conductivity meter can be used effectively.

Summary Statement
To determine the correlation between conductivity and corrosion rates in various solutions in simulation of a typical oil field environment.

Help Received
Mr. Jim Griffin provided the LPR probe; my dad helped come up with the project idea; and my mom assisted with the assembly of the board.