TOXICITY STUDY OF OVER USE OF ESSENTIAL OIL

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INTRODUCTION

Toxicity is the degree to which a substance can damage an organism. Toxicity can refer to the effect on a whole organism, such as an animal, bacterium, or plant, as well as the effect on a substructure of the organism, such as a cell (cytotoxicity) or an organ such as the liver (hepatotoxicity). By extension, the word may be metaphorically used to describe toxic effects on larger and more complex groups, such as the family unit or society at large.

A central concept of toxicology is that effects are dose-dependent; even water can lead to water intoxication when taken in too high a dose, whereas for even a very toxic substance such as snake venom there is a dose below which there is no detectable toxic effect. Toxicity is species-specific, lending cross-species analysis problematic. Newer paradigms and metrics are evolving to bypass animal testing, while maintaining the concept of toxicity endpoints.

THE RESEARCH OBJECTIVES AND SCOPE OF INVESTIGATION

MEOR technology is composed of different mechanisms, consequently, the target of this study will be to investigate several aspects of MEOR in order to better our understanding of those factors that limit performance/or can enhance performance in the area of microbial enhanced oil recovery wherein referred to as the challenges in MEOR. The rationale is that, fundamental understanding of structure and function in microbial community and its linkage to biogeochemistry in reservoirs and understanding of mechanisms in MEOR environmental, microbial and physiological process is a prerequisite to developing microbial methods to enhance the quantity and quality of the HC recovery. Therefore, the scope of this project covered two main aspects namely;

(a). Microbiology in deep subsurface
(b). MEOR processes

The overall aim of this project is to come out with some answers by which microbial activity in hydrocarbon reservoir can be modified, improved or introduced to benefit oil recovery. Some of the project objectives include: Review of relevant literature available on microbial enhanced oil recovery to keep abreast with current knowledge and development Engineering of new strains of bacteria by proper adaptation to high salinity, temperature and pressure conditions to meet reservoir conditions in the North Sea oilfields Investigation of microbial fluid effect on rock properties Identification of good nutrient for the microbes for quick stimulation under reservoir conditions Investigation of oil releasing mechanisms /oil recovery process during MEOR Modelling of MEOR activities to develop predictive models that can enhance successful implementation.

RESULTS AND DISCUSSION

The effects of CO_2 dissolution on the relationship of the measured parameters; pH-conductivity at different salinities and temperature 25 oC were investigated. From the plot of the results, it is indicated that the concentration of CO_2 decreases with increased salinity i.e. from 0.055 - 0.0085 moles/L for salinity range of 0-130 g/L. This is because the amount of gas dissolved decreases because more water molecules are immobilized by the salt ions suggesting a kind of salting out effect [8, 14, 17]. This means that the equilibrium is shifted toward the left where we can assume that the species present represents the sum of both H_2CO_3 itself and dissolved CO_2 as shown in equation.□Therefore we can deduce the following simple relationship for measured dissolved CO_2 and salinity (equation 9) with a R^2 value of 0.95. [ ] 0.0003 0.056 2 CO where S is the salinity of the aqueous solution. This equation showed that salinity play a major role in the amount of carbon dioxide and the species of CO_2 available for chemical reaction when carbon dioxide is dissolved in water and can therefore be inferred to be a significant factor in controlling the amount of dissolved CO_2 present in aqueous salt solutions. Concentration of dissolved CO_2 at different salinity Measurements were taken of pH and electrical conductivity to see the variation in their relationships after injecting the sodium chloride solutions with carbon dioxide. The specie of CO_2 that will exist when dissolved in water varies in proportion based on water temperature, salinity and pressure. In this case, it evident that carbonic acid (H_2CO_3 + CO_2) concentration is greater at low salinity and decreases with increasing salinity as indicated by value of pH 3.37-3.98 measured for 0-130 g/L. It is hard to find experimental data under the same condition from the literature for comparison; however data from Barner et al. showed a final pH value of 3.35 for 1 Molar of NaCl solution at pressure of 10 MPa and temperature of 27 oC after dissolution of CO_2. In our experiment the result indicated that the final pH of 1 Molar NaCl solution at 10 MPa and 25 oC when extrapolated from the graph will be 3.6. The calculated concentration of hydrogen carbonate decreased with increasing salinity with a less pronounced change over the range of salinity measured.

The relative variation in pH and electrical conductivity measurement before and after injection of carbon dioxide to aqueous solutions at different salinity was calculated and plotted against the salinity of the medium. A polynomial relationship was observed between the relative variation of pH and salinity after dissolution of carbon dioxide that reaches maximum value at 70 g/L and started falling as the salinity increases (equation 10). The relationship indicated a kind of salting out effect after salinity 70 g/L, which tries to neutralize hydrogen carbonate.

In order to check if the pH values obtained after the dissolution of carbon dioxide in aqueous sodium chloride solution is expected, the experimental pH was compared with theoretical pH. The theoretical pH was calculated using equation 3. The plot shows that at 25 oC deviation exists between the two even though the trends were similar. The theoretical and experimental pH differ by average of 0.17 units at salinity < 70 g/L and by an average of 0.10 units at salinity > 70 g/L suggesting a closer agreement at high salinity. Even though, there is an observed deviation from experimental pH that can be due to uncertainty in activity

coefficients calculation (i.e. uncertainty in the magnitude of the ionic strength correction). The theoretical pH derived from Pitzer's activity coefficients can be used to approximate the changes in pH over the ionic strength range in this study. The electrical conductivity is relatively unchanged before and after injection of carbon dioxide. The dissolved CO_2 probably do not affect the degree of ionization significantly, or since conductivity is directly related to salinity, the ions from the dissolved salts control the conductivity, thus the negligible effect of dissolved CO_2 on the conductivity of the solution. This observation confirms the earlier findings of dissolved CO_2 and electrical conductivity relationship in aqueous sodium chloride solution reported by Fleury and Deschamps. It is evident from the plot that the concentration of dissolved carbon dioxide decreases with increasing temperature. The dissolution of CO_2 decreases with increasing temperature this suggests that less and less carbon dioxide is in aqueous solution at constant salinity when temperature was increased from 25 oC to 45 oC. Temperature is known to affect the solubility of CO_2 in brine [10, 18]. The relationship between the amount of dissolved CO_2 and temperature is given by equation 11 with a R^2 value of 0.97. The concentration of dissolved CO_2 in seawater of salinity 22 g/L was found to be around 23.07 mg/L. This amount is equivalent to about 0.00055 moles/L with measured pH of 7.80 at a temperature of 25 oC and represents the total dissolved carbon dioxide. At 1 atm the theoretical concentration of dissolved CO_2 in seawater is about 0.00882 moles/L at 25 oC. The gases dissolved in sea water are known to be in constant equilibrium with the atmosphere but their relative concentrations depend on each gas solubility, which depends also on salinity and temperature. The value is less than the value obtained when compared to extrapolated aqueous solution of 22 g/L injected CO_2 at 10 MPa in our experiment (0.05 moles/L) probably because pressure was 100 times greater and the total dissolved inorganic carbon load of seawater varies over time as dissolved CO_2 is continuously consumed by the production of carbonate and organic carbon sediments.

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