

Organic Cosolvent Effect on the Estimation of the Solubility of Oil Residues in Soil

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Abstract: The solubility in water and the partition coefficients, K , in soils samples of residues of petroleum of different ages were determined using an organic cosolvent (methanol), and the solvophobic theory was applied for the interpretation of results. The behavior of the residuals turned out to be dependent of the cosolvent fraction. The values of K 's vary among 900 (Lkg^{-1}) and 2,900 (Lkg^{-1}) showing a general and marked increase for residues of increasing age. The determined parameters are useful for the modeling of environmental impact in polluted soils.

Introduction

In the field of Environmental Chemistry is of interest to know the behavior of the pollutants in water since the transport and most of the degradation processes take place in water phase. The studied system is complex; therefore the solubility of each component should necessarily be affected by the presence of the other ones. The composition of each crude oil is unique and the oil in the environment is under very variable conditions, therefore a strong historical component exists in its current composition. This makes the testing in field samples to be of fundamental interest [1-3] since it is impossible to reproduce similar conditions in the laboratory. The oil residuals are hydrophobic but their solubility can be increased by means of the use of an organic cosolvent, as the alcohols.

This study intent to investigate on one hand, if the variations observed in the solubility and K (distribution coefficient) of the oil residuals, in the presence of different cosolvent fractions can be interpreted by the solvophobic theory and if, based on it, the solubility in water and the K 's in complex mixtures can be estimated.

Experimental

Samples of polluted soils, were product of oil spills in different times at six locations in the surroundings of Comodoro Rivadavia city. For the measurement of the solubility in water experiences were carried out by means of the use of water and mixtures of water and organic cosolvent (methanol).

The following relationships were used for the interpretation of the measured data [1,4]: $\log S^m = \log S^w + \sigma f_c$ (1), where S^m is the solute solubility in the water- cosolvent mixture, S^w is the solubility in water, σ is 'the potential as cosolvent' and f_c is the volume fraction of the cosolvent. According to the solvophobic theory: $\ln (K^m/K^w) = - a \alpha \sigma f_c$ (2), where K^m is the partition coefficient in water (Lkg^{-1}); K^w is the partition coefficient in the mixture of solvents (Lkg^{-1}); a is the empirical constant accounting for water-cosolvent interactions, α is the empirical constant accounting for solvent-sorbent interactions; and σ is the cosolvency power of a given solvent and solute accounting for solvent-solute interactions.

Results and Discussion

For the oldest polluted samples the solubility in water calculated according to (1) are higher in all the cases to that experimentally measured. The differences increase with decreasing σ , indicating that probably the progressive loss of the potentiality of the cosolvent to solubilize has effect on the observed differences. The values of K 's vary among 900 (Lkg^{-1}) and 2,900 (Lkg^{-1}) showing a general and marked increase when increasing age.

This information was related with the possibility of transport and it would contribute to the estimate of the mobility of oil residuals and the possibility of oil degradation.

References and Notes

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