MORPHOLOGY CHANGES DURING PHASE INVERSION OF MICRO AND MACROMULSIONS.

EXPERIMENTAL RESULTS AND MODELING

Introduction

Catastrophe theory permits to interpret the discontinuity of natural phenomena, at least in a local sense. The forth model of this theory has been associated successfully to the phase behavior phenomenon and to the emulation type for a SOW system. The characteristic variations of the system conductivity, observed in this work, indicate that these are three cases of morphology changes as inversion takes place.

Experimental Procedures:

For the catastrophic inversion, the system: mixture of kerosene and an oil cut (EACN=8.3) / brine (5% NaCl) / polyethylene sorbitan monooleate 1% (HBL 15.4), was agitated at 2000 rpm at ambient temperature (22 ºC). The morphology change was induced by adding continuously pure 2-butanol (5ml/dl) in the emulsification cell. The volume in the emulsification cell was kept constant.

On the other hand, the transitional inversion is gotten by increasing or diminishing the system temperature at the preceding system which surfactant 5% and HBL 11.6, and an aqueous phase fraction of 0.5.

Results and discussions

A SOW system presenting up three phases in equilibrium, will have as representation of its Gibbs’ free energy, a function occurring three minima which correspond to the three possible states of minimum energy. The geometric place of such extrema is named manifold and its bifurcation represents the transition between such states.

The conductivity variation that describes the system submitted to a transitional inversion, shows that its transitory states are concurred whatever is the sense of the inversion.

In the Abnormal-Normal catastrophic inversion, the system conductivity, during the inversion process, indicates that the system stays in its initial morphology O/W during all process until the final step that marks the inversion. This path, represented from E to A on the manifold x(c,d), can be represented by the convention of perfect delay, by means that the system adopts a unique state all along of the process and the inversion process. This multiplied morphology can be explained as the coexistence of the two possible states of the system on the bifurcation (from E to D). According to the Maxwell’s convention, this behavior is kept until the disappearance of one of the two coexisting states.

On the other hand, in the catastrophic inversion from abnormal to normal region (path from A to E), the system conductivity shows the appearance of emulsions with multiplied morphology as an intermediate behavior during the inversion process. This multiplied morphology can be explained as the coexistence of the two possible states of the system on the bifurcation (from B to D). According to the Maxwell’s convention, this behavior is kept until the disappearing of one of the two coexisting states.

Conclusions

For the catastrophic inversion of an emulation, in the sense Abnormal-Normal, the modeling of the phenomenon will be best represented taking in consideration the convention of perfect delay, by means that the system adopts a unique state all along of the process and below to reach the inversion point. However, in the sense of Abnormal-Normal inversion, the Maxwell’s convention is revealed to be more appropriated to the system manifestation in its two possible states. Such states are represented for the studied systems by the presence of a complex morphology where coexist both types of possible emulsions for a system with biphasic behavior: an internal emulation, type O/W and an external emulation, type W/O.

References