Foam Model equations



For *So* ≥ *fmoil*

*Fo* = 0 (i.e., no foam)

For *So* ≤ *floil*

*Fo* = 1 (i.e., no effect of oil on foam)

For *fmoil* ≥ *So* ≥ *floil*



If we leave out effect of surfactant concentration (i.e., assume surfactant is present wherever water is present), then

*Fs* = 1

If we treat the effect of surfactant concentration on foam, then

For *Cs* ≥ *fmsurf*

*Fs* = 1

for *Cs* ≤ *fmsurf*



*Cs* is the concentration of surfactant in the aqueous phase. It doesn't matter which units one uses (kg/m3, mole fraction, mass fraction); the concentration is small enough that all these units are proportional. The important thing is that the initial concentration would usually be zero and there is some injected concentration. The most realistic version of this model would have *epsurf* < 1, so that most of the effect of surfactant comes at low concentrations. The break in the function at *fmsurf* makes the derivatives are discontinuous there. As long as *fmsurf* is greater than or equal to the injected concentration, then concentrations never exceed this value and the function never reaches the point where its derivatives change.

For modeling the effect of surfactant concentration, it's important that the surfactant is soluble only in the water phase, not gas or oil. Also, it would be good eventually to introduce surfactant adsorption, using a Langmuir isotherm. This sharpens up the surfactant front and guarantees (I think) a shock front in surfactant concentration. In the absence of adsorption, with surfactant soluble only in water one always gets an indifferent wave where surfactant concentration jumps from injected to initial concentration, I believe. That's OK for now.

*g* is gas viscosity

*go* is gas viscosity in the absence of foam, i.e. a constant.

parameters: *fmmob*, *fmoil*, *floil*, *epoil*, *epdry*, *fmdry*, *fmsurf*, *epsurf*

Written this way, where foam changes gas viscosity, all the relative permeability functions are unaffected by foam. They are of "Corey" form.



with parameters *Swr*, *nw*, *Sor*, *no*, *Sgr*, *ng*