We consider the time dependence of the air content in a system with dispersed bubbles in aqueous solution of surfactant. Under conditions of turbulent mixing, bubble collisions lead to aggregation according to the orthokinetic scheme of Smoluchowski. The collision efficiency is taken into account – it can be a function of time, together with its dependence upon the sizes of the involved objects. The bubbles, and the clusters thereof, are subject to the action of the turbulent hydrodynamic acceleration and the buoyancy. The balance of fluxes includes faster removal of larger bubbles and aggregates. We formulate a model set of kinetic equations which are solved numerically to find the time evolution of all kinds of different objects in the system.

Results from Ross-Miles’ method: A column of air/ water dispersion is generated by a falling jet during several minutes operation of the pump (this represents one run). The graph shows the volume of entrained air at consecutive runs.

The theoretical calculation for the time dependence of the total air content in the dispersion is in agreement with experimental measurements (sample data are presented in the Figure). In a real system, bubble aggregation is caused by micron size deaerator particles consisting of long chain fatty alcohol wax. These particles attach to bubbles and may induce rupture of the intervening film between two bubbles. Gradual exhaustion of the particle activity is observed, mainly due to separation of the chemical components when the wax material gets in contact with the A/W interfaces. This leads to reduced efficiency of the bubble collisions to create larger aggregates, and as a consequence, the fraction of dispersed air increases.