18a A Monte Carlo Ray Tracing Simulation of Polarized Light Propagation in Liquid Foams: a Preliminary Approach to Foam Characterization

J.N. Swamy, Czarena Crofcheck, and M.P. Menguc

Liquid foam is a dense random packing of bubbles in a small amount of immiscible liquid. Foams bear practical importance in several applications ranging from food industry to adsorptive bubble separation techniques like foam fractionation and froth flotation. Hence, there is a requirement to know the variables important to foam production, stabilization and physical properties in order to predict and control the properties of products made from or incorporating foams. Both foam structure and mechanical properties strongly depend on the liquid fraction and the bubble size distribution. Thus it is desirable to determine these parameters inline to have a better control of the formation process. The goal of the current study is to examine the use of a polarized light scattering based technique in characterization of liquid foams. Several studies have been conducted to investigate the multiple light scattering in foams. However, the change in the polarization of incident light has not been examined in detail. If the change in the physical characteristics of foam can be related to the changes in polarization and intensity of scattered light, a non-intrusive diagnostic system can be developed for the purpose of monitoring foam properties. The present work is intended to provide a theoretical understanding of the interaction of light with foams and to predict the expected physical phenomena following a detailed computational effort. The change in the intensity and polarization of a collimated polarized light incident on a foam layer is studied using a combined Monte Carlo/Ray tracing approach. The foam structure is modeled using the statistics obtained from PLAT, a two dimensional foam simulation program. Angular and radial profiles of scattered light polarization and intensity are predicted for a foam layer subjected to a collimated beam of polarized light. The sensitivity of the results to the liquid fraction and bubble size distribution is discussed in the light of a possible foam characterization scheme.