Aerated flow is a complex hydraulic phenomenon that exists widely in the field of environmental hydraulics. It is generally characterised by large deformation and violent fragmentation of the free surface. Compared to Euler methods (volume of fluid (VOF) method or rigid-lid hypothesis method), the existing single-phase Smooth Particle Hydrodynamics (SPH) method has performed well for solving particle motion. A lack of research on interphase interaction and air concentration, however, has affected the application of SPH model. In our study, an improved multiphase SPH model is presented to simulate aeration flows. A drag force was included in the momentum equation to ensure accuracy of the air particle slip velocity. Furthermore, a calculation method for air concentration is developed to analyse the air entrainment characteristics. Two studies were used to simulate the hydraulic and air entrainment characteristics. And, compared with the experimental results, the simulation results agree with the experimental results well.