It is well-known that conventional (one-pressure) two-fluid model equation system is mathematically ill-posed as an initial-value problem, since Lyczkowski et al. [1] pointed out that it has complex eigenvalues. Numerical solution resulted from the ill-posed equation system may instantaneously be amplified at least in the limit of short wavelength, and then it has no physical meaning. To improve this defect, numerical simulations with low accuracy of bubbly flows have been conducted by adopting a rough grid resolution, which leads to a large artificial viscosity, so far. Our group has proposed a three-pressure two-fluid model equation system [2], where a surface-averaged pressure of a liquid on the interface is more rigorously incorporated than previous works so as to treat the violent collapse of cavitation bubbles on the basis of the method of Prosperetti et al. [3] and has demonstrated that it is mathematically well-posed for various void fractions throughout the range of gas- and liquid- steady uniform flow velocities (at least in the conditions which we could investigate) [4]. Also, we have revealed that there exist two types of wave propagation modes, i.e. slow mode and fast mode, in the bubbly liquid and the fast mode stems from the compressibility of liquid phase by use of the three-pressure two-fluid model equation system. In this study, we investigate effects of the liquid compressibility on mathematical well-posedness of the two-fluid model equation system. As a result, we clarify that the assumption of an incompressible liquid brings some ill-posed regions, though the equation system is unconditionally well-posed at the equal phase velocities. Furthermore, we present typical examples of eigenvalues obtained from the ill-posed equation system versus wave numbers.