An investigation on shock and rarefaction waves in a hyperbolic model of incompressible fluids is presented. To this aim, the so-called extended quasi thermal incompressible (EQTI) model recently proposed is used (Gouin & Ruggeri, Internat. J. Non-Linear Mech. 47, 688, 2012). In particular, it will be analysed the case in which the constitutive equation is a variant of the well-known Boussinesq approximation in which the specific volume depends not only on the temperature but also on the pressure, leading to a hyperbolic system of differential equations [2]. The limit case of ideal incompressibility, namely when the thermal expansion coefficient and the compressibility factor vanish, is also considered.

It will be shown that the propagation of shock waves in an EQTI fluid is characterized by small jump in specific volume and temperature, even when the jump in pressure is relevant, and rarefaction waves originating from a general Riemann problem are characterized by a very steep profile. The knowledge of the loci of the states that can be connected to a given state by a shock wave or a rarefaction wave allows also to completely solve the Riemann problem. The theoretical results are confirmed by means of numerical calculations.

References: