Supporting information document

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Supporting information for:

Parametric investigations of the induced shear stress by a laser generated bubble

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Supporting information 1: Tait Equation of state predictive capability

Table S1 demonstrates the predictive capability of Tait[1], stiffened gas[2] and Redlich-Kwong-Peng-Robinson[3] (RK-PR) equations of state against the IAPWS steam/water tables[4]. All results are based on isentropic compression starting from saturated liquid at 20^{o}C and pressure of 2339Pa according to IAPWS. As demonstrated in the table, Tait equation of state is superior in predicting compressed liquid states, with a minimum relative error of max. 0.06%. The RK-PR equation of state follows with a max. relative error in density predictions of ~2%. Finally, the stiffened gas equation of state has a serious relative error of up to ~46%. Note that the stiffened gas equation of state is well known to have serious deficiencies in accurately predicting heat capacity, speed of sound and liquid densities, see[5].

Table S1.Comparison between predicted density and density errors for various pressure levels between IAPWS, Tait, stiffened gas and RK-PR equations of state.

Pressure (bar)	Density IAPWS (kg/m^3)	Density Tait (kg/m^3)	Err. Tait (%)	Density Stiff gas (kg/m^3)	Err. stiff gas (%)	Density RK-PR (kg/m^3)	Err. RK-PR (%)
0.023	998.2	998.2	0.00	1391.4	39.4	1012.9	1.48%
1.000	998.2	998.2	0.00	1391.6	39.4	1012.9	1.48%
10.000	998.6	998.6	0.00	1392.7	39.5	1013.0	1.44%
100.000	1002.7	1002.6	0.00	1404.6	40.1	1013.7	1.10%
200.000	1007.1	1007.0	0.00	1417.8	40.8	1014.5	0.74%
500.000	1019.7	1019.4	0.02	1456.8	42.9	1016.7	0.29%
750.000	1029.6	1029.1	0.04	1488.8	44.6	1018.4	1.08%
1000.000	1038.9	1038.3	0.06	1520.4	46.3	1020.0	1.82%

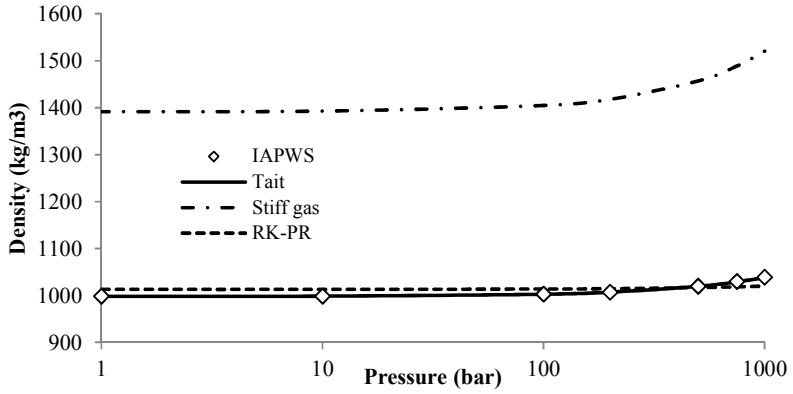

Figure S1. Tait[44], stiffened gas[48] and RK-PR equation of state[49] predictions for water in comparison to IAPWS[45].

The parameters used are:

- For Tait equation of state, the same as those described in the numerical model section
- For the stiffened gas equation of state, following Saurel et al. [2]: $p_\infty = 10^9$Pa, $c_v = 1816$ J/kg.K, $\gamma = 2.35$
- For the RK-PR equation of state: accentric factor, $\omega = 0.3443$, critical temperature T_c =647.1K, critical pressure $p_c = 22.064$MPa, critical compressibility factor $Z_c = 0.229446$. These values are provided by NIST Refprop[6].

Supporting information 2: Mass conservation error

The following graph (Figure S2) shows the gas mass over time, throughout the simulation, to demonstrate the conservation of bubble gas. The deviation is defined as:

$$err(\%) = \frac{m(t) - m_{t=0}}{m_{t=0}} \cdot 100\%$$

As can be seen, the maximum deviation is less than 0.15%, which is considered adequate.

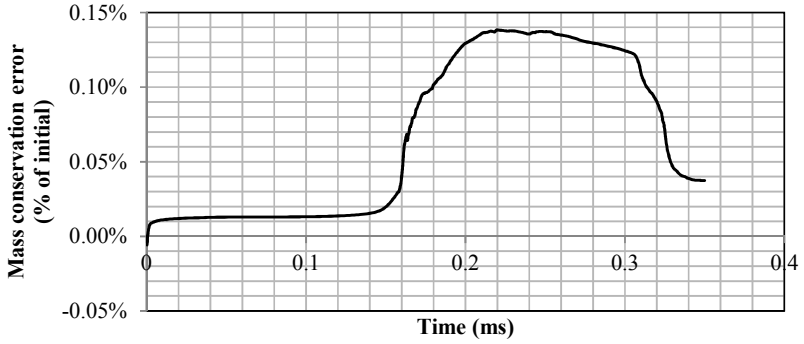

Figure S2. Gas mass conservation error in respect to time. Maximum error is less than 0.15%.

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