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Sonoluminescence

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See Unified Absolute Relativity Theory at:

http://www.wbabin.net/saraiva/saraiva105.pdf

http://www.wbabin.net/saraiva/saraiva223.pdf

The bubbles are created by sound transversal waves, not longitudinal ones.

Energy in the bubble:

$$E = \frac{PR_{MAX}}{c} \;;\quad \text{For } \; P = 1 \text{ watt} \quad \Leftrightarrow \quad E = 3.5\times 10^{-8}\, J$$

P – Sound power; R_{MAX} -- Maximum radius of the bubble;
c – Sound speed in the water = 1430 m/s

$$R_{MAX} = 50\mu m\,;\;\; R_{MIN} = 0.5\mu m\,;\;\; R_0 = 5\mu m$$

Maximum temperature:

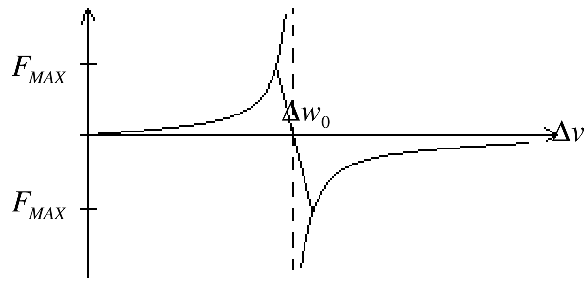
$$T_{MAX} = \frac{E}{A_{MIN}} \;;\qquad A_{MIN} = 4\pi R_{MIN}{}^2$$

The temperature is an energy surface density. $T_{MAX} = 1.1\times 10^4\, K$

Force at the bubble surface:

$$F = N \frac{f_0{}^4 \Delta v^2}{(\Delta w_0 + \Delta v)^3 (\Delta w_0 - \Delta v)}$$

F



N – Constant; f_0 -- Sound frequency;

$\Delta w_0 = c - w_0$; w_0 -- Sound speed for f_0; c – Sound speed for $f_0 = 0$

$\Delta v = c - v$; v^2 -- Gravitational potential of the medium

$f_0 = 3\times 10^4 Hz$; $x_0 = 4.77\times 10^{-2} m$

Number of particles in the bubble:

$n = 1.43\times 10^{10}$; $E = nk_B T$

E – Energy in the bubble; k_B -- Boltzman constant; T – Temperature

$\Delta w_0 = 7.15\times 10^2$; $\Delta v_0 = \Delta w_0 / 2$

Maximum force:

$$F_{MAX} = 0.2N$$

Maximum pressure:

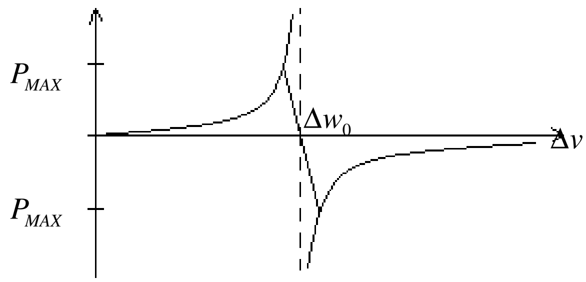
$$P_{MAX} V_{MIN} = E \;; \qquad V_{MIN} = \frac{4}{3}\pi R_{MIN}{}^3$$

$$P_{MAX} = 7.14\times 10^{10} N/m^3 = 7.14\times 10^5 Atm$$

Pressure:

$$P = M\frac{f_0{}^4 \Delta v}{(\Delta w_0 + \Delta v)^3 (\Delta w_0 - \Delta v)}$$

P



Variation of the gravitational potential:

$$\Delta v = \Delta v_0 \left(1 - \frac{V^2}{c^2}\right) \;; \qquad V^2 = V_0^{\,2} \sin\left(\frac{4\pi^2}{x_0^{\,2}}\left(c^2 t^2 - x^2\right)\right)$$

$$V_0^{\,2} = c^2 \;; \qquad \Delta w_0 = S f_0^{\,2}$$

Minimum radius:

$$R_{MIN} = \sqrt{\frac{n k_B}{4\pi}}$$

Maximum temperature

$$T_{MAX} = \frac{100E}{A_0} \;; \qquad A_0 = 4\pi R_0^{\,2}$$

For higher temperature we need smaller bubbles.
For higher temperatures we need higher sound power and higher frequency.