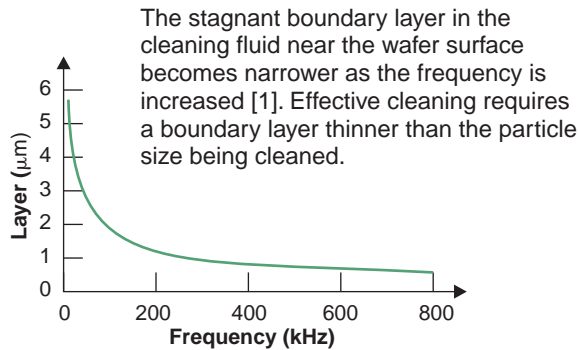
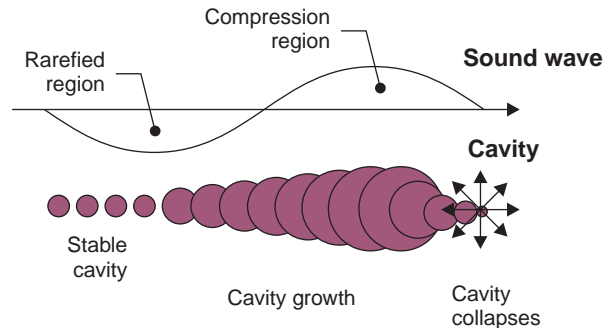


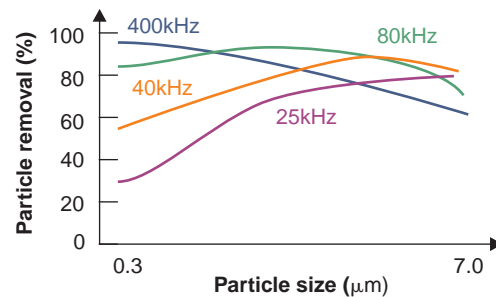
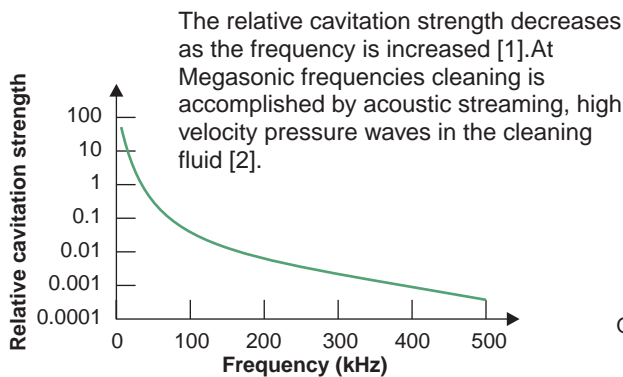
Fundamentals of Sonic cleaning

Cleaning frequencies are characterized as Ultrasonic $\leq 150\text{kHz}$, High Ultrasonic 150 - 800kHz and Megasonic $>800\text{kHz}$

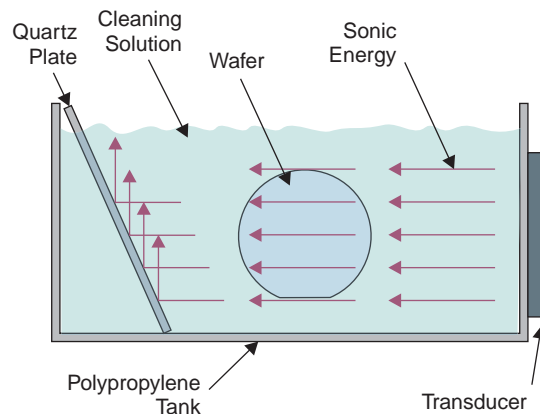
Ultrasonic sound waves moving through the cleaning fluid create cavities (cavitation) during the rarefied region of the wave, the cavities grow and then collapse during the compression region of the wave [1].



For each frequency there is a peak in particle removal efficiency at a specific particle size. The higher the frequency the smaller the particles that are efficiently removed [1].



A transducer couples the high frequency sonic energy into the cleaning fluid. The sonic energy must have a clear path from the transducer to the surface being cleaned to clean effectively (line of sight) [3]. Megasonic systems can effectively clean particles $<0.15\mu\text{m}$ in diameter without damage to the substrate [2].



References:

- [1] Harman & Lamm, "The Impact of Ultrasonic Frequency on Particle Removal," Branson Ultrasonic Corp.
- [2] "MegaCoustic™ Cleaning Technology," Branson Precision Cleaning.
- [3] Kern et.al., "Megasonic Particle Removal from Solid State Wafers," RCA Rev., 46, 81 (1985).