Sonorod design resume

1. Holed sonorod or sonotube will give higher oscillating amplitude, but it will be more expensive for production… It is necessary to have thick and very thick walls of sonotubes in order to avoid increased mechanical and thermal dissipation in sonotrode. Wall thickness should be: 0.2 OD < ID < 0.5 OD. Compromising design solution is to use ready-made hollow tubes with proper diameters.

2. Thin walls sonotubes are producing remarkable noise, significant heat and parasite impedance-frequency effects. Also thermal frequency drift (or shift) of impedance characteristics towards lover frequencies is relatively high (or very high) in cases of thin walls sonotubes, compared to reasonable and small frequency shift of thick walls tubes. Thermal frequency shift also depends on selected sonotrode metal alloy. Duplex steel has very good thermal stability and low thermal frequency shift (between room temperature and 100°C), and it could be until 200 or 250 Hz. Titanium sonotrodes and thin walls sonotubes could have large frequency shift (until 600 or 800 Hz); -what is inconvenient for automatic resonance control of ultrasonic generators.

3. Steel sonorods are generally producing lower amplitudes compared to titanium sonorods, but operating life and resistance to cavitation and erosion is much longer/better in cases of steel sonorods… Holed sonorods are producing higher oscillating amplitudes, compared to compact/solid sonorods.

4. If we select acoustically proper steel alloy (like duplex steel 1.4462) sonorods and sonotubes made from such alloy could produce similar results as titanium sonotrodes with smaller thermal frequency shift (because of convenient acoustic impedance). In such cases we can apply basic piezoelectric converter with titanium front mass, to drive directly duplex-steel sonotube, and reflected energy (from sonotrode back to ultrasonic converter) will be very small, tolerable or negligible.

5. 20 kHz sonorods are stronger and more powerful for heavy duty cleaning of very dirty parts compared to 25/30/40 kHz sonorods… because 20 kHz oscillations have higher oscillating amplitudes…

6. Housings of sonorod and sonotube piezoelectric converters should be produced from very strong/robust/heavy/massive stainless steel similar to 316L-Ti. If housing is not robust, we will have increased heat dissipation on such converters.

7. MPI Sonorod systems could be slightly more expensive for production (compared to similar systems from competitors). MPI also has low priced versions. It is necessary to have thick and very thick walls of sonotubes in order to avoid increased mechanical and thermal dissipation in sonotrode. Wall thickness should be: 0.2 OD < ID < 0.5 OD. Compromising design solution is to use ready-made hollow tubes with proper diameters.

8. Preferable objectives are: to use the same 50x20x5mm piezoceramics rings for all sonorod and sonotube transducers: 20/25/30/40 kHz. For 20 and 25 and 30 kHz, this is possible, but it is more problematic for 35/40 kHz transducers. Housings diameters for 30 and 40 kHz transducers should be smaller compared to 20/25 kHz converters, but also piezoceramics inside should be different. It is good to have the same parts for many transducers…

9. End parts (end zones) of sonotubes should present cylindrical half-wavelength resonant elements to react like mechanical filters and stabilizers.

10. Radial press fitting or crimping (with 300 ton press) in assembling sonotubes is applicable and well replacing screwing (without using adhesives). Attention should be paid that contact surfaces before radial crimping are rough (not at all smooth), such as: Ra25/N11.