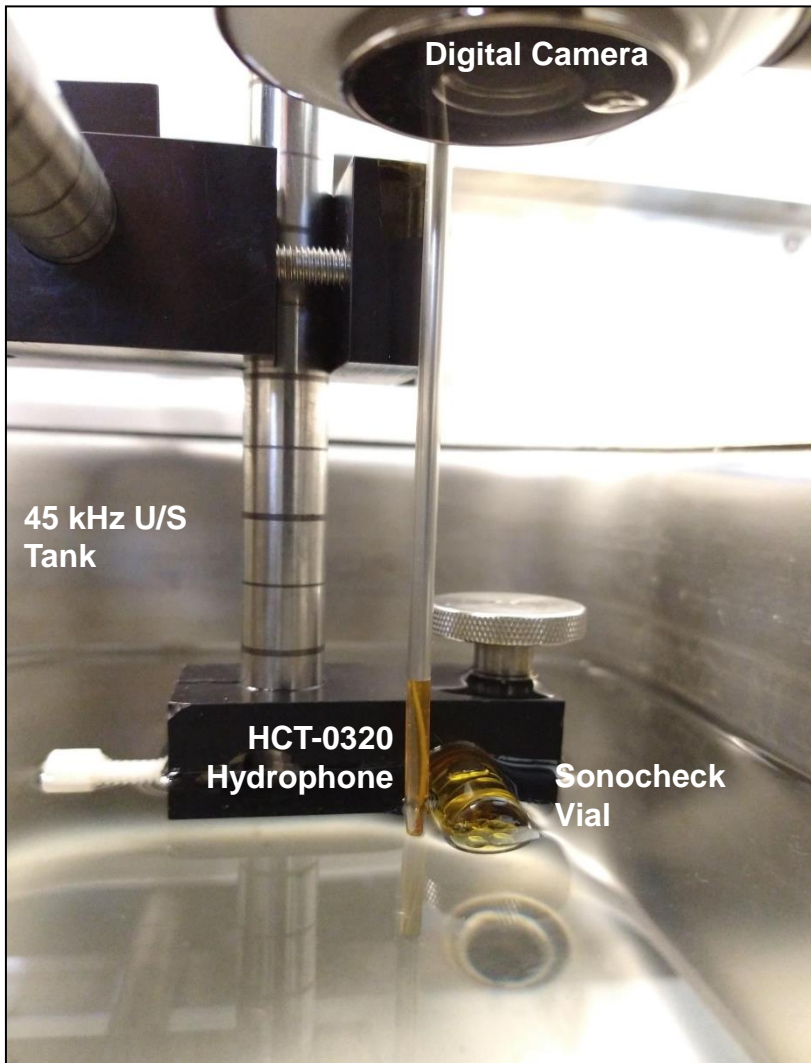




Comparison Study: ***Hydrophones and Sonocheck Vials***

February 24, 2021

Comparison Study: Hydrophones & Sonocheck Vials

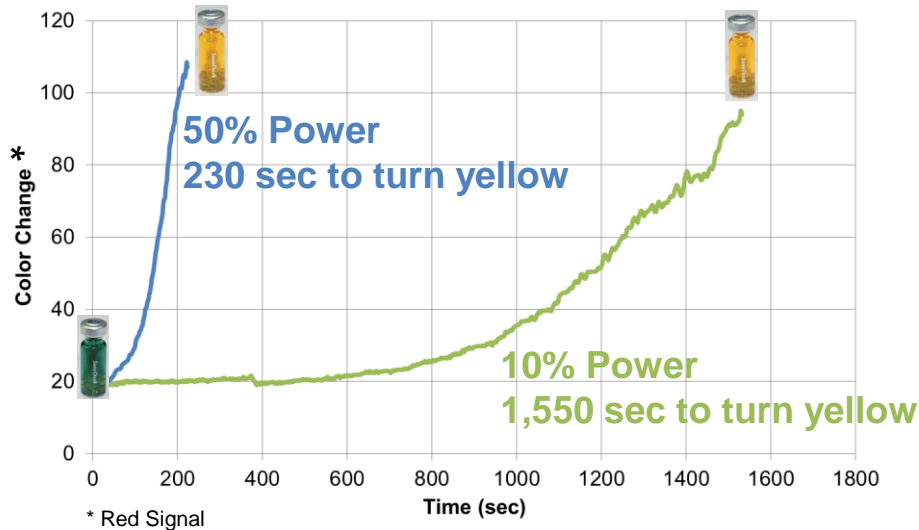


Test Conditions:

- Tank Frequency: 45 kHz
- Generator Power: 10% and 50%
- Medium: tap water
- Temperature: 25 deg C
- Dissolved O₂: 9.1 mg/L
- Position: center, 13 cm from bottom surface, fully submerged
- Measurement Parameters:
 - R, G, B signals (0-255 scale)
 - Total Pressure (kPa)

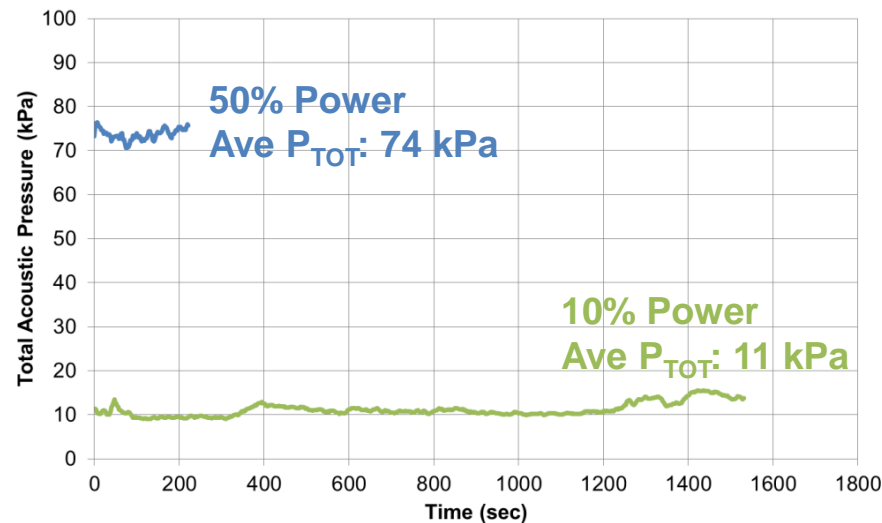
Time Study: 10% & 50% Generator Power Levels

Sonocheck Vial



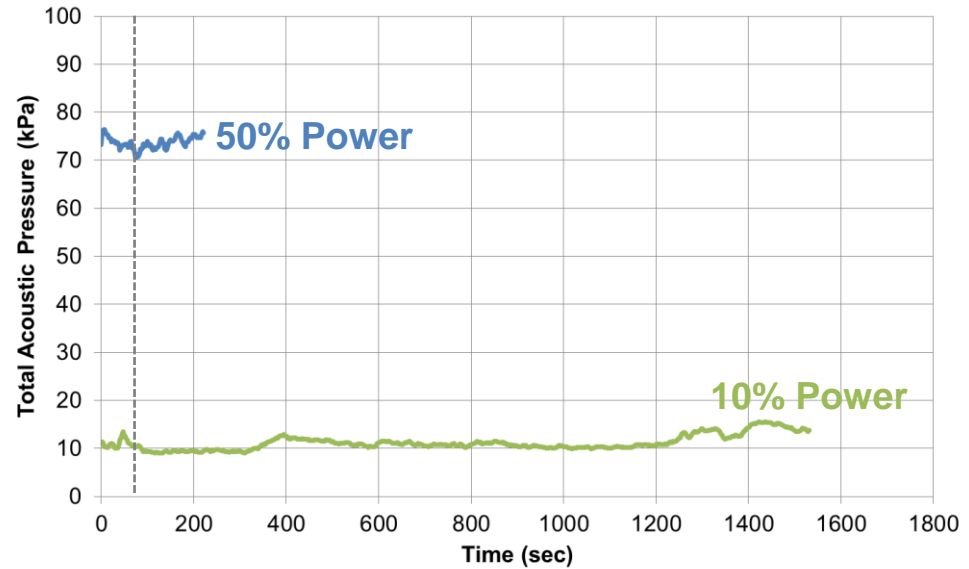
- 'Color Change' determined by RGB signals (0-255)
- At 50% power, color changed over 230 sec
- At 10% power, color changed over 1550 sec
 - Over 20 min longer than at 50% power!
- Hydrophone measurements provide real-time acoustic pressure data to catch process excursions immediately

Onda Hydrophone

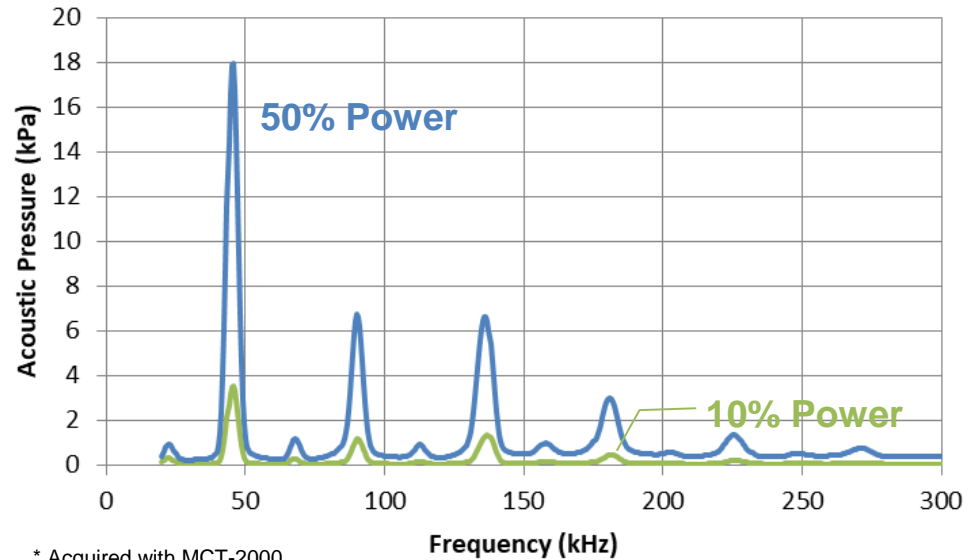


Acoustic Characterization at 10% & 50% Power

Total Pressure



Acoustic Spectrum*



* Acquired with MCT-2000

Synchronized Video Indicating When Vials Turn Yellow ([YouTube video](#))

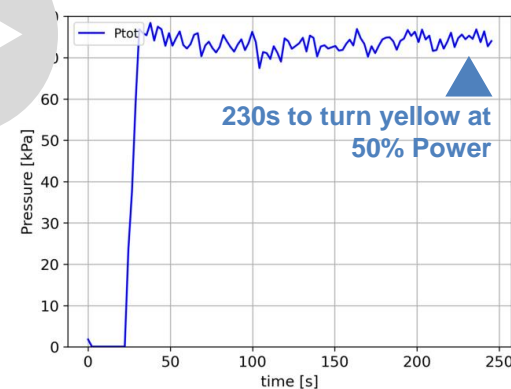
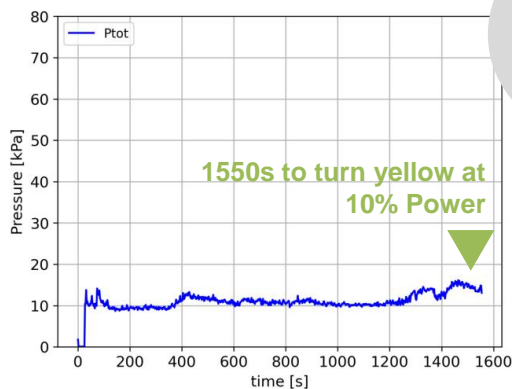
10% Power

50% Power

Sonocheck Vial



Onda Hydrophone



ONDA

Onda Corporation. www.ondasonics.com

Observations

- Color change in vials occur as a result of a sonochemical reaction
- Process parameters that affect this reaction include sonication time, generator power, frequency, temperature, gas concentration, loading, position, etc.
- These parameters are often uncontrolled and may lead to inconsistent color change results
- Sonocheck vials offer some qualitative benefit indicating the presence of acoustic energy for occasional spot checks; it is more convenient than the classic Aluminum foil test.
- Hydrophone measurements are quantitative and provide a means to continuously or routinely monitor the acoustic stability of cleaning tanks

Summary of Comparison



MCT-2000



MCT-1200

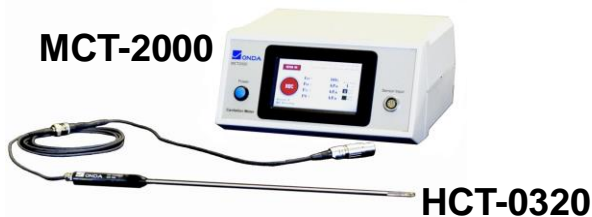
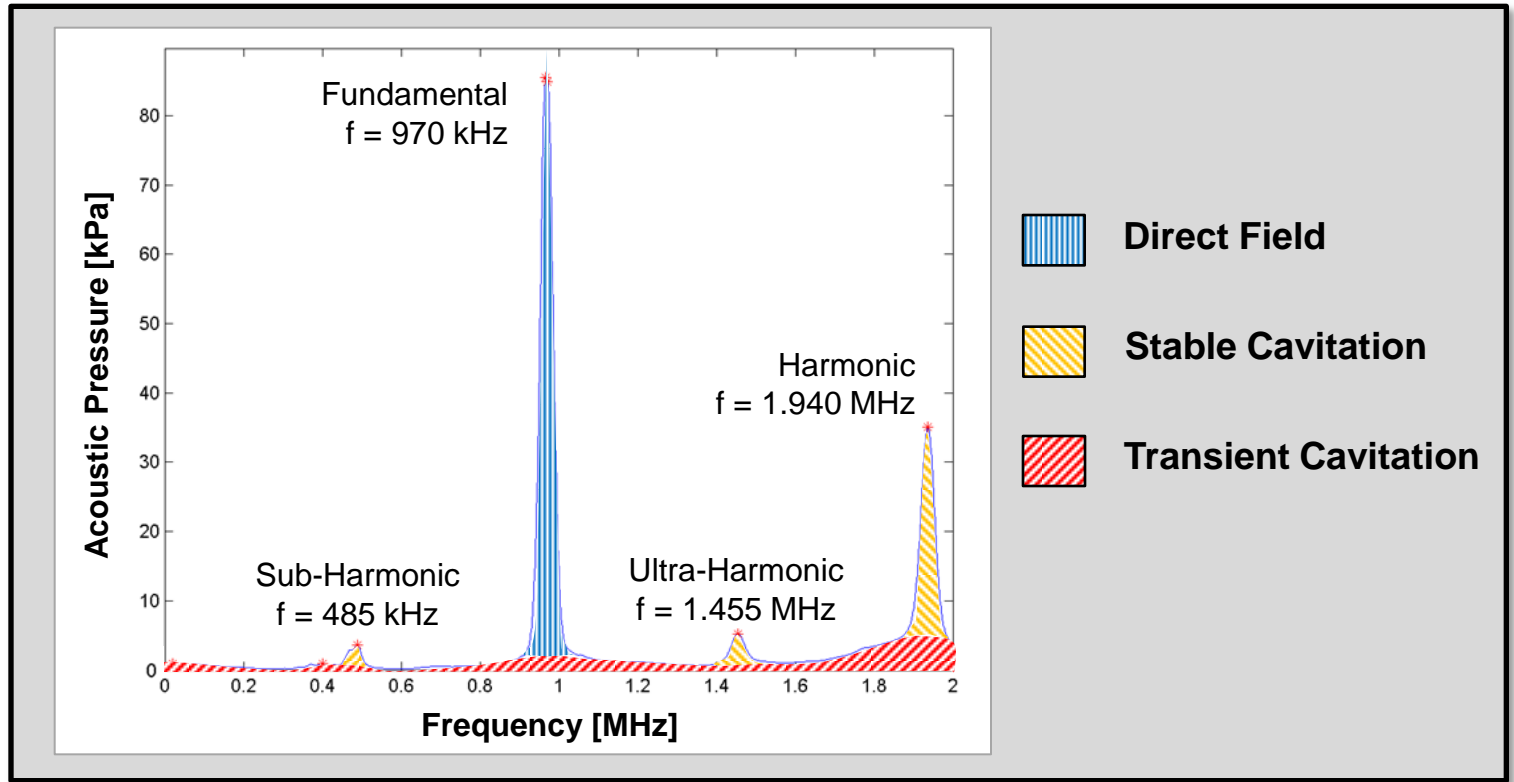


Sonocheck Vials

APPLICATION	R&D, Absolute Reference	Process Monitoring	Spot Check
PARAMETERS	Cavitation Pressure & Frequency (P ₀ , P _s , P _t , F ₀)	Total Pressure & Frequency (P _{tot} , F ₀)	Color Indication (yellow, green)
METHOD	Hydrophone Conforms with IEC/TS 63001:2019	Hydrophone	Sonochemical
CALIBRATION	External-calibration to achieve traceability and matching	Self-calibration to achieve matching	--
TEST CONDITIONS	Real-time measurements in actual cleaning conditions	Real-time measurements in actual cleaning conditions	Color change varies with cleaning conditions: (freq, time, temp, gas, load, position, etc.)
AUTOMATION	Data saved to local memory; Report generation	Real-time data transfer for continuous monitoring	--
VALUE	Higher Performance	Lower Cost	Lowest Cost

BACKUP

Anatomy of Acoustic Spectrum



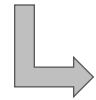
Different pressure components contribute to cleaning and damage

Method to Measure Cavitation

Reference: IEC/TS 63001:2019

Measurement of cavitation noise in ultrasonic baths and ultrasonic reactors

Acquire data with Hydrophone



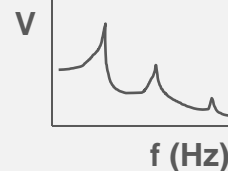
Voltage vs Time



Fourier Transform



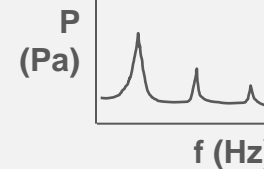
Voltage vs Frequency



Apply Hydrophone Calibration



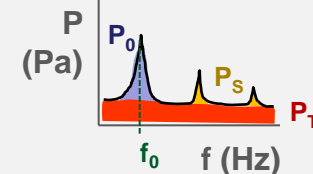
Pressure vs Frequency



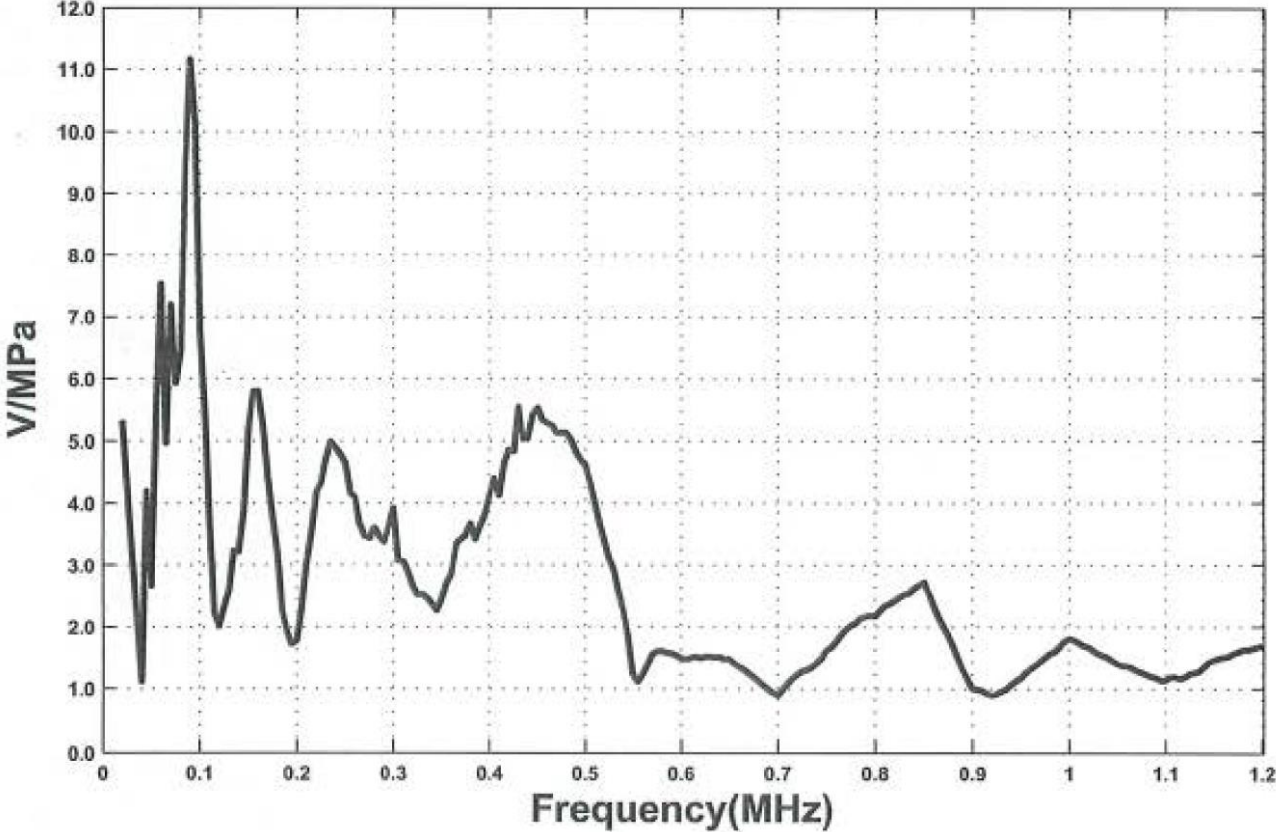
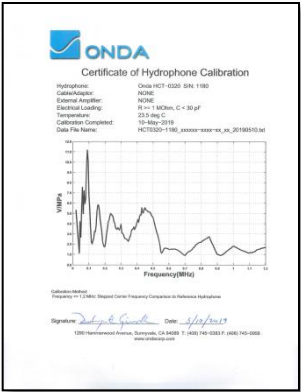
Apply MCT-2000 Algorithms



Calculation of P_0 , P_S , P_T , f_0



HCT Hydrophone Calibration



Voltage does not represent pressure



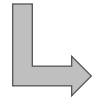
MCT-2000 Cavitation Meter



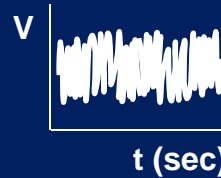
MCT-2000 Measures:

- V vs. t
- P vs. f
- P_0 , P_S , P_T , f_0

Acquire data with Hydrophone



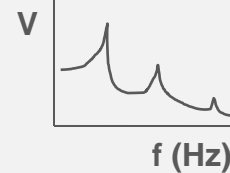
Voltage vs Time



Fourier Transform



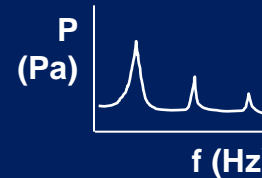
Voltage vs Frequency



Apply Hydrophone Calibration



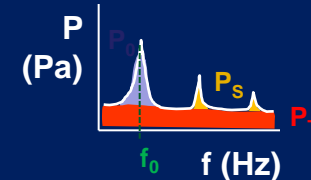
Pressure vs Frequency



Apply MCT-2000 Algorithms



Calculation of P_0 , P_S , P_T , f_0



MCT-1200 Pressure Meter

Acquire data with Hydrophone



Voltage vs Time



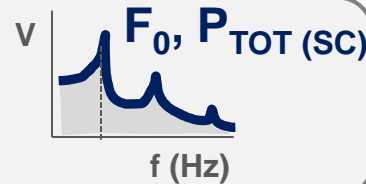
MCT-1200 Measures:

- F_0 , P_{TOT} (Self-Calibrated)

Fourier Transform



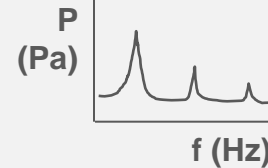
Voltage vs Frequency



Apply Hydrophone Calibration



Pressure vs Frequency



Apply MCT-2000 Algorithms



Calculation of P_0 , P_S , P_T , f_0

