



Technical White Paper

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Why the Sonic Solutions Ultrasonic Products do not harm life forms other than algae.
By George Hutchinson

Ultrasound is sound with a frequency greater than the upper limit of human hearing, this being approximately 20 kilohertz (20,000 hertz). Ultrasound can be generated by a transducer that converts mechanical or electrical energy into high frequency acoustical (sound) energy. The Sonic Solutions algae control transducer is designed to convert electrical energy into sound and project the sound through a body of water.

There are a broad range of applications for ultrasound. They range from healing technologies to weapons used in the military. The medical applications can range from low intensity to high intensity. The industrial industry uses ultrasound to find flaws in materials. Sonochemistry is used to enhance chemical reactions.

When you hear of harm being caused by ultrasound it is typically due to a water cavitation effect (rapidly expand and contract), that causes the cell damage. This requires a very high power output.

High intensity focused ultrasound applications include breaking up kidney stones and dental hygiene teeth cleaning process. The ultrasound imaging used on an unborn fetus utilizes 2000 watts of power. Cleaning jewelry or surgical instruments are done at the 20 – 40 Kilohertz range. Benign and malignant tumors are treated via a process known as Focused Ultrasound Surgery which generally use lower frequencies than medical diagnostic ultrasound (from 250 kHz to 2000 kHz), but significantly higher time averaged intensities. The treatment is often guided by MRI, as in Magnetic Resonance guided Focused Ultrasound.

Everything on the earth vibrates and has a resonance frequency which can be affected by sound waves. At the same time each living organism on earth has a “critical” resonance frequency which when subject to that particular sound wave can do damage to it. For example, Ella Fitzgerald can break a crystal glass by singing at its critical resonance frequency.

In sound applications, a resonant frequency is a natural frequency of vibration determined by the physical parameters of the vibrating object. Some of the implications of resonant frequencies are:

- It is easy to get an object to vibrate at its resonant frequencies, hard to get it to vibrate at other frequencies.
- Most vibrating objects have multiple resonant frequencies. For example: an out of balance car tire.

To cause a harmful vibrational effect, a combination of the resonance frequency and sufficient power must be applied. For example, one can draw an analogy to the electromagnetic waves in a microwave that match the same natural frequency of water. With humans having the majority of their body makeup as water – microwaves will harm humans due to our bodies matching the resonance frequency of water. If the frequency generated by sound or electromagnetic waves does NOT match a critical frequency in a living thing – it has little to zero effect on it. For example radio waves pass through human bodies, because we do NOT synchronize with that frequency and thus, do us no harm. Plastic in a microwave oven does NOT heat up because its natural frequency is different than water. The Sonic Solutions unit MATCHES the critical resonance frequency of an algae vacuole cell wall – thus causing the wall to break.

Common algae types are about 0.001 millimeters in size that equates to approximately 1/20th of the diameter of a human hair. The frequencies of the Sonic Solutions devices are in a bandwidth range and intensity level where there is a high probability of matching critical resonance frequencies of green algae contractile vacuoles and blue-green algae gas vesicles causing them to tear or collapse. Since life forms and organisms of a higher order do not resonate at these frequencies and intensity levels, it essentially has no affect on them. The 5 models of Sonic Solutions available address the size of the body of water by applying sufficient power of the sound wave to cover the desired area.

In over 10 years of product history in worldwide applications by various manufacturers, this technology that operates similarly to a boat fish finder has never been found to have harmed any life form other than algae, fungi, and some bacteria in close proximity to the transducer. In summary, these systems are designed to operate in a frequency bandwidth that can be harmful to algae and yet at a power output level that does not harm other life forms.