

# Environmental Application of Ultrasonic Irradiation



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## Abstract

The ultrasound waves (20kHz to several hundred kHz) generated from the conversion of electric pulses by using a transducer can cause dramatic chemical and physical effects. Cavitating bubbles formed under ultrasonic irradiation produce high temperature and pressure conditions (up to 5,000K and 1,000 atm) inside the bubbles and as a consequence reactive oxygen species and many other reactive radicals are produced. The ultrasonic irradiation technique for cleaning polluted water has several merits over the other typical advanced oxidation technologies (AOTs) because this technique does not require chemical additives or catalysts and is independent of the color of the polluted water.

**Keywords:** Ultrasonic Irradiation; Cleanup of Polluted Water; Soil Remediation

## Examples of Environmental Application

Ultrasonic irradiation is a powerful way to degrade a variety of pollutants and toxic chemicals [1-3]. Demonstrated examples for ultrasonic removal in aqueous media include fuel oxygenates [4], a variety of chlorinated compounds [5], series of phenols [6,7], arsenic species [8], polycyclic aromatic compounds [9], textile dyes [10,11], and surfactants [12]. The sonochemical effect can be economically enhanced by combining other means with ultrasound. Such hybrid methods have been reported by using ultrasound with H<sub>2</sub>O<sub>2</sub> or O<sub>3</sub> [12], solid particles or catalyst [13], or Fenton reagent [14]. Because the irradiation of ultrasound is simple and has low impact on fish and aquatic plants, ultrasound has been widely studied for control of cyanobacteria as well as algal control [15,16]. The disintegration of bacterial cells is effectively achieved by using high power ultrasonic irradiation with low frequencies, and its effect is enhanced by combining it with UV irradiation [17]. Ultrasonic irradiation can reduce the quantity of chemicals required for water treatment facilities [18]. Despite the fact that membrane technologies are widely accepted for the separation of solids from liquid, fouling is one of the serious problems with this technology [19]. Ultrasonic irradiation has been demonstrated to be effective for membrane cleaning by producing reactive oxygen species [20] with the advantage of possible ultrasonic defouling even with an actively operating membrane. Soil remediation is another field where ultrasonic irradiation can be applied to the environmental cleanup. Ultrasonic irradiation enhances the flushing of soils which are contaminated by hydrocarbons [21]. Effective removal

of heavy metals from contaminated soil is possible by applying ultrasound to the soil in aqueous media [22].

## Conclusion

The environmental application of ultrasound has been drawing attention for many decades. This area covers the broad ranges of polluted water decontamination, soil remediation, membrane defouling, and decontamination of soils. Application of ultrasound in aqueous media produces both chemical and physical (mechanical) effects which are useful in purification and separation for solving environmental problems with simple and compact means. It is easy to combine ultrasonic technique with the other conventional treatment methods to reduce operational costs.

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