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Advancing the Arizona State University Knowledge Enterprise

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Method to Quantify Nanobubble Reactivity in Water

Background

Nanobubbles are an emerging water treatment technology that can find application in bodies of water, groundwater, treatment plants, pipelines, medical facilities, industrial cooling towers, and many others. Their generation can be achieved through several methods including, ejector, venturi, cavitation, and mixing. With sizes ranging from 20 nm to 500 nm, nanobubble concentration can vary between 106 and 109 per milliliter. These large quantities in water can thus alter the bulk water and/or contaminant chemistries.

Of particular interest to researchers are the formation and reactivity of reactive oxygen species (ROS) from nanobubbles. This is especially relevant to agriculture and horticulture industries, as ROS affect plant nutrient uptake, disease, and root health.

Current methodology to quantify nanobubbles in water involve counting the number of nanobubbles using laser or light-scattering technologies, but which are often only suitable in high-purity water due to interference from other particles in water. Furthermore, these techniques fail to measure the reactivity of nanobubbles and only quantify their presence.

Invention Description

Researchers at Arizona State University have developed a technique that overcomes current challenges associated with quantifying nanobubble number concentrations alone. This is accomplished through a spectrophotometric (colorimetric) method based on the understanding that nanobubbles only produce ROS as nanobubbles “pop” in water. By coupling a way to intentionally pop the nanobubbles (e.g. by sonification) with a colored dye that reacts with the ROS, nanobubble reactivity and concentration can be determined. The process expects to deliver time-efficient, economical, field-deployable test kits and easy-to-use operation.

Potential Applications

- Industrial water treatment
- Agriculture
- Algae control
- Oil and gas processing
- Drinking water

Benefits and Advantages

- Colorimetric method directly correlates with nanobubble reactivity and presence
- Quick, easy-to-use, and economical
- Less susceptible than competing techniques to particle interference

Laboratory Homepage of Professor Paul Westerhoff