Microbubble Ozonation: Next Generation Oxidation

Stream

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Introduction

Microbubbles have emerged as an exciting new technology with potential for application in aeration and ozonation processes in water treatment. Microbubbles are bubbles with a diameter of <100µm compared to 2-6mm for conventional bubbles produced through traditional fine pore diffusion. It is well documented that the oxidation of organic matter is achieved through both direct and indirect reactions with ozone. The use of microbubbles has been shown to significantly increase the efficiency of the ozonation process due to the larger surface area to volume ratio and decreased rising velocity leading to higher rates of gas transfer and faster degradation of target compounds. In this work, humic acid and the pesticide mecoprop have been treated using microbubble and conventional bubble ozonation at a range of ozone gas flow rates.

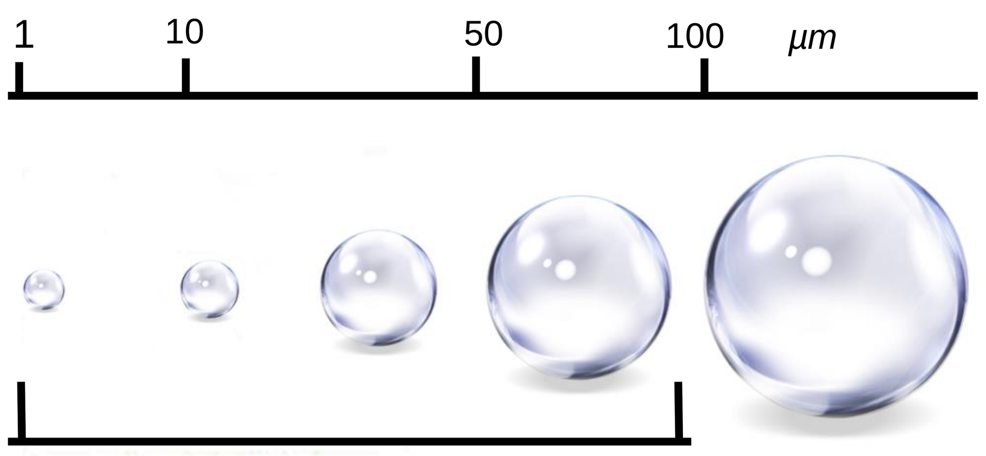


Figure 1: Microbubble Size

Materials & Methodology

The ozonation experiments were carried out in a 100L batch bubble column reactor filled with deionised water. Ozone was produced from air by corona discharge at a rate of up to 2g hr^{-1}. Microbubbles were produced from a regenerative turbine microbubble generator. Conventional bubbles were generated with fine pore diffusers with diameters between 2-6mm (Figure 2). 10mg L^{-1} humic acid and 10µg L^{-1} mecoprop and metaldehyde were treated for one hour. The degradation of humic acid was measured using UV-254 and the degradation of mecoprop was measured using liquid chromatography mass spectrometry.

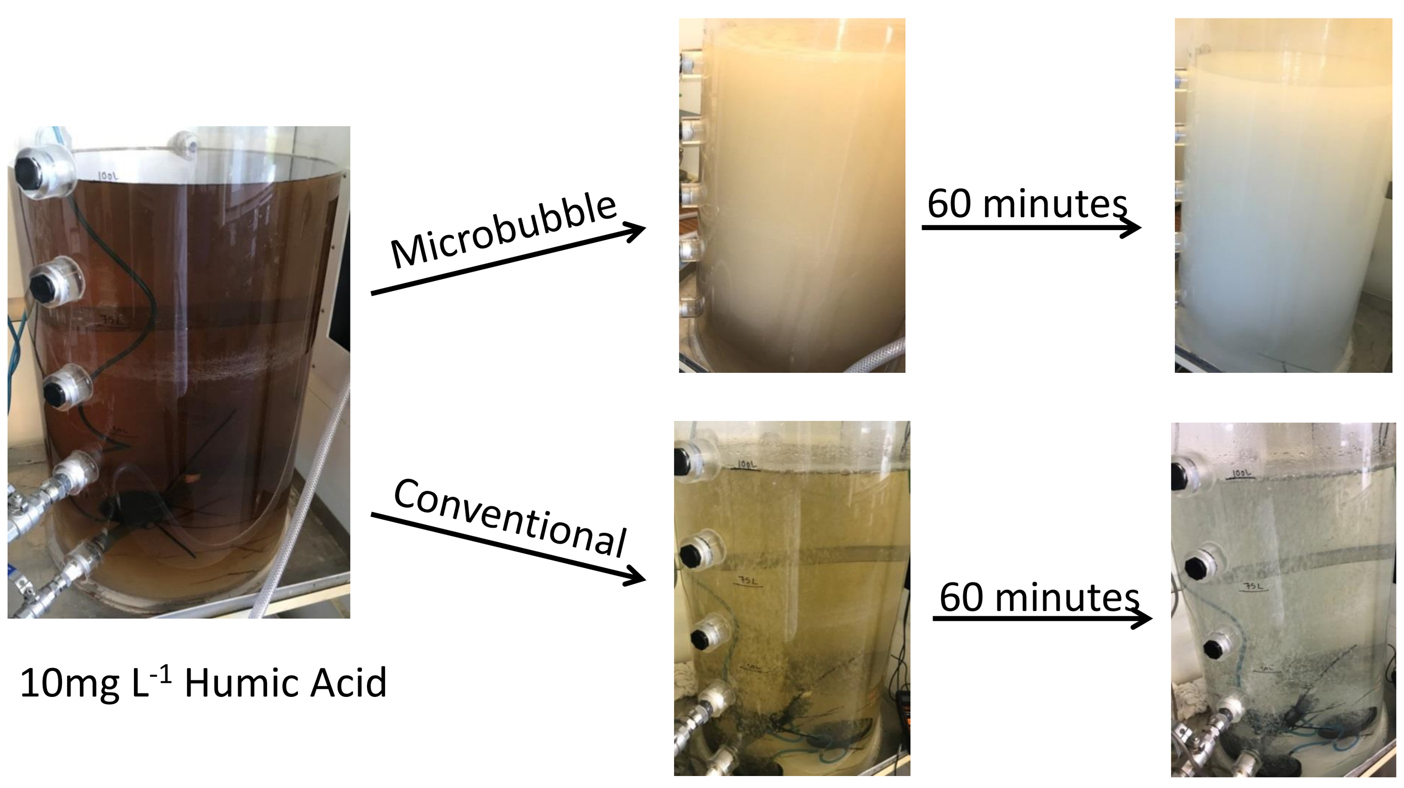


Figure 2: Experimental Setup

Results - Degradation of Target Compounds

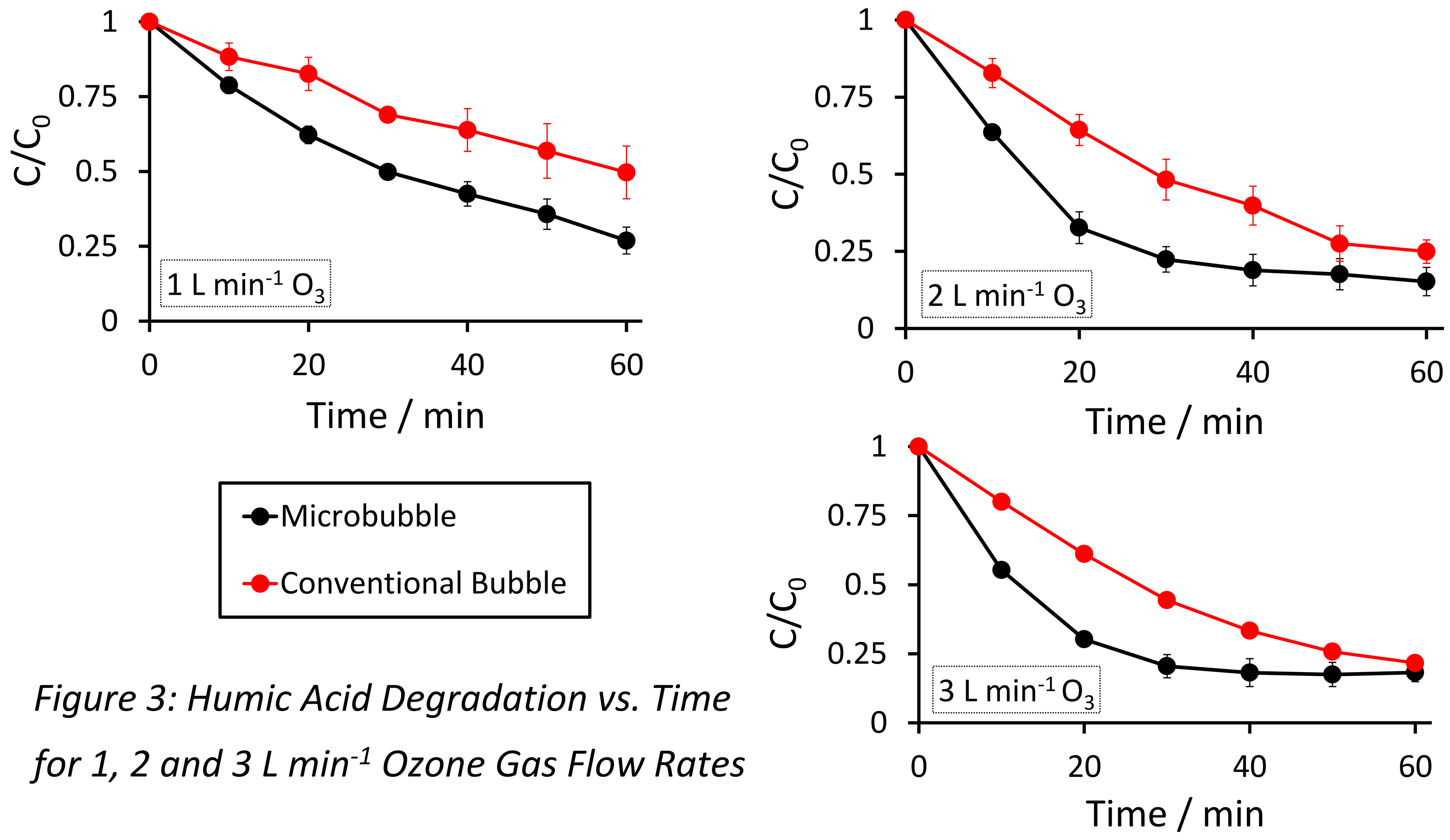


Figure 3: Humic Acid Degradation vs. Time for 1, 2 and 3 L min^{-1} Ozone Gas Flow Rates

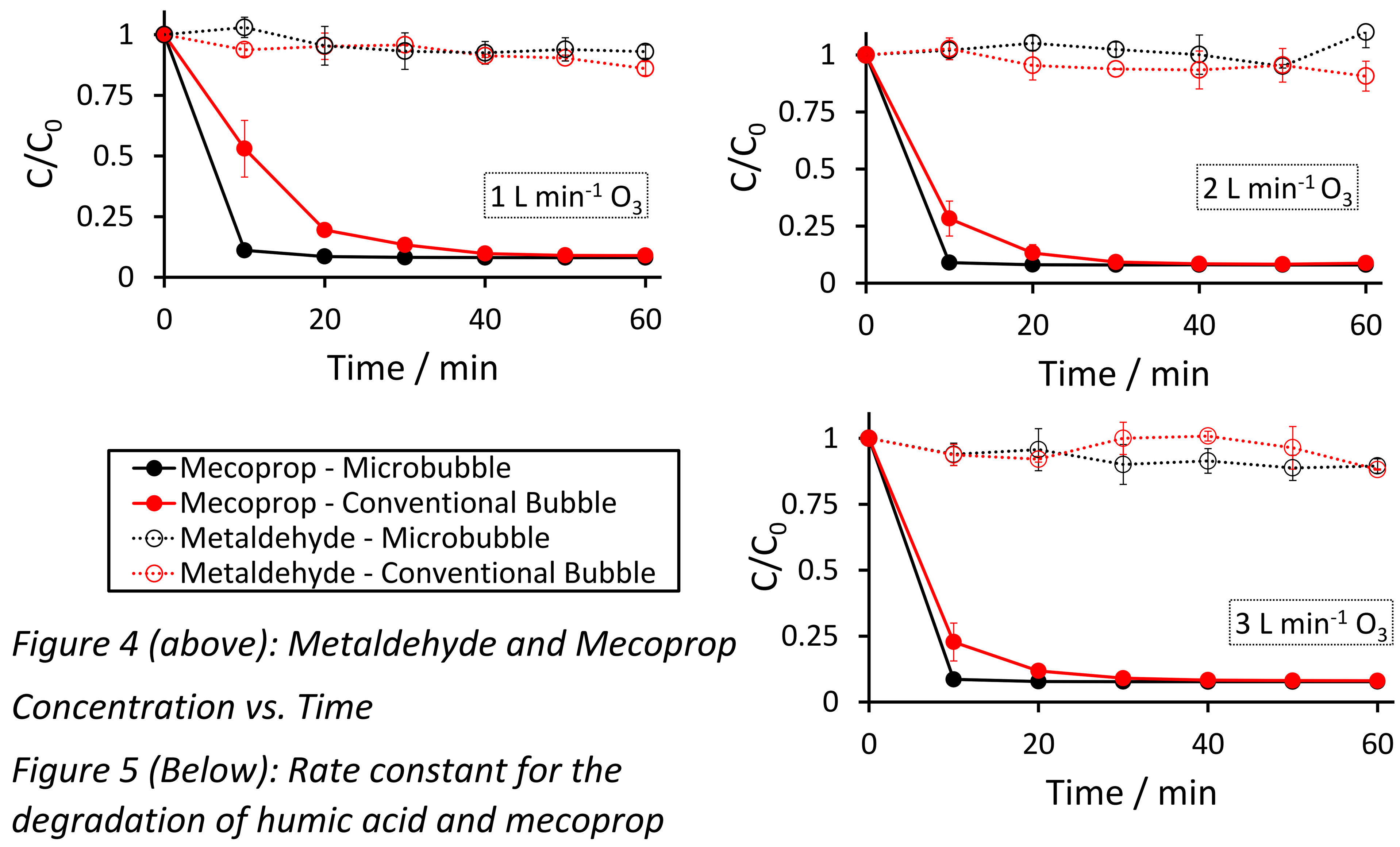
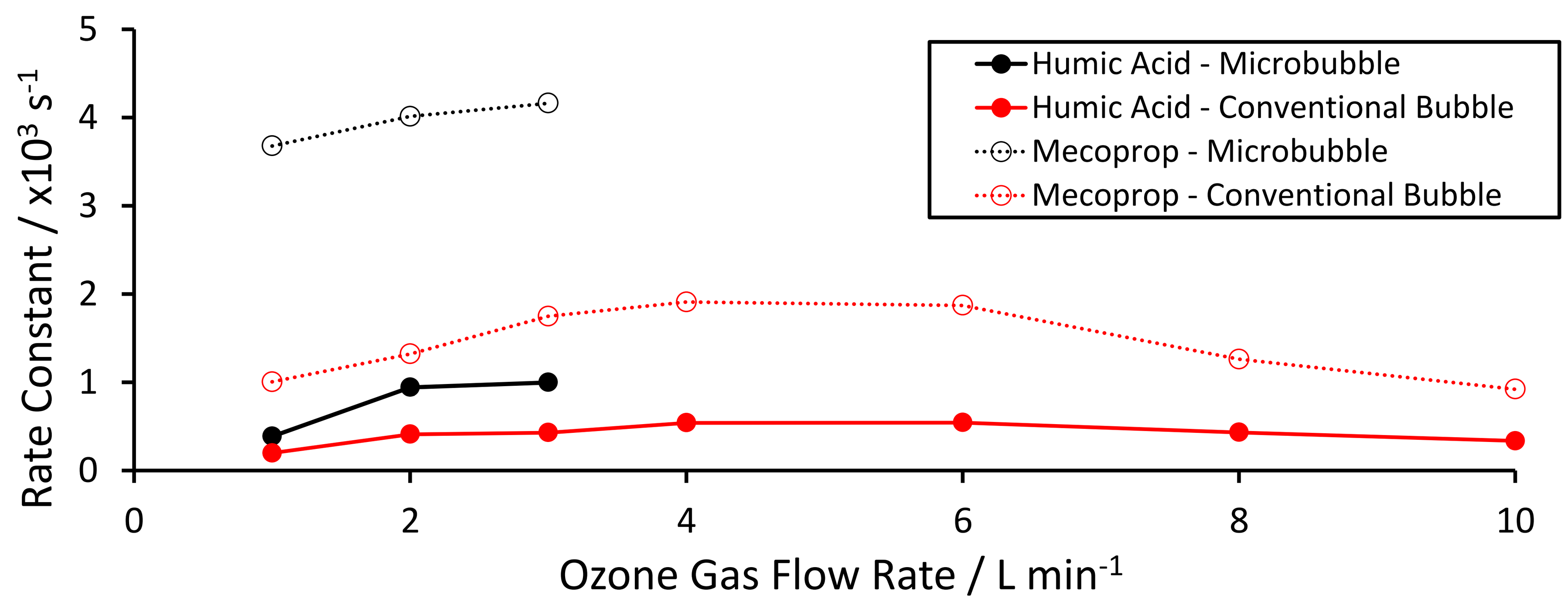


Figure 4 (above): Metaldehyde and Mecoprop Concentration vs. Time

Figure 5 (Below): Rate constant for the degradation of humic acid and mecoprop



Conclusion

It has been found that:

- Ozonation using microbubbles degrades humic acid 1.9-2.3 times faster than conventional bubbles (Figure 3).
- Ozonation using microbubbles degrades mecoprop 2.3-3.6 times faster than conventional bubbles (Figure 4).
- Ozonation using microbubbles does not degrade metaldehyde significantly more than conventional bubbbles (Figure 4).

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