Online monitoring of conductivity for optimization of lab-scale hydrodynamic cavitation system

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A novel lab-scale device for hydrodynamic cavitation (0.8-1.5 L) with the online monitoring of conductivity has been set up, as shown in Fig. 1. The decomposition of CHCl3 in aqueous solutions was investigated, while the variations in conductivity of solutions dependent on orifice tube and orifice plate were online recorded and analysed, as shown in Fig. 2. Due to decomposition of CHCl3 and the releases of H+, Cl− and ClO−, the conductivity of CHCl3 solution increases linearly with the irradiation time. Therefore, the increasing rates can be compared among different conditions, in order to optimize the hydrodynamic cavitation system. Based on Fig. 2, the orifice tube at pump inlet plays more important role than the orifice plate at pump outlet in this system. An optimal orifice tube obviously exists for each orifice plate. Under the optimal condition, the energy efficiencies for chlorocarbons degradations by hydrodynamic irradiation have been significantly improved, as compared with our former lab-scale device (2.4 L). However, the energy efficiency by hydrodynamic irradiation is still obviously lower than that by 850 kHz ultrasonic irradiation. The energy efficiencies for the degradations of CHCl3 and CCl4 by 850 kHz ultrasonic irradiation in 60 min are 9.2-fold and 6.5-fold higher than those by hydrodynamic irradiation, respectively.

![Fig. 1: Lab-scale device for hydrodynamic cavitation.](image)

![Fig. 2: Variations in conductivity of solutions dependent on orifice tube and plate. Irradiation conditions: Speck GY-028-2 pump, 0.8 L of 1.0 mM CHCl3 solutions, 20 °C. Range of pressure for upstream: 125-70 psi, range of flow: 180-1710 L/h, irradiation time: 15 min. Greisinger GMH 3430 digital conductivity and temperature meter.](image)

Keywords: hydrodynamic cavitation, online monitoring of conductivity, lab-scale, chlorocarbons degradation, energy efficiency.