

INACTIVATION OF VIRUSES IN WATER BY PLASMA TREATMENT

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Abstract. Alternative methods for the inactivation of viruses in water have recently attracted enormous attention. The methods should enable rapid inactivation at room temperature and should be free from chemicals. The application of gaseous plasma fulfills these regulations but may be impractical because plasma sustained at atmospheric pressure is limited to the volume of the large electric field. A useful method for sustaining plasma at low pressure despite the water being at atmospheric pressure is the application of hydrodynamic cavitation. The saturated water vapor pressure at room temperature is established in a stable super-cavitation bubble of volume several cm³, and the electrodes are immersed into the bubble and powered with a suitable voltage supply to sustain the non-equilibrium gaseous plasma in a glow discharge mode. Plasma sustained in water vapor at the pressure of a few 10 mbar is a rich source of OH radicals, which are dissolved in the liquid. The high speed of liquid water passing the cavitation nozzle enables optimal mixing, so a few passages of water through the device enable the inactivation of viruses for 5 decades by an irreversible interaction of OH radicals with the organic matter. The water pH does not change significantly, and the concentration of hydrogen peroxide remains below 1 mg/L, so the effect of H₂O₂ on virus inactivation is marginal. The preferred discharge power is between 10 and 100 W, so the energy consumption is minimal.

References

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