

Study of water treatment effects by a ball-lightning like discharge

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As for water treatment by a ball-lightning like discharge, we investigated the change of physical and chemical properties and the water treatment effect. The increase in the processing speed of the solution in the case of positive polarity was shown to be greatly influenced by ozone formation and dissolution by electrolysis around the upper electrode.

1. Background

The ball-lightning like discharge, a long living water plasmoid, first demonstrated by Egorov and Stepanov [1], has features of 1) long discharge duration of several 100 ms, 2) large spatial volume of diameter above 10 cm and 3) relatively low supply voltage of several kV. Also, it is reported by Maeyama et al. [2] that this discharge causes strong light emission originated from OH radicals over the discharge period rather than at the onset of the discharge, and that intensive water jet occurs above the water surface.

We had reported the preliminary relationship between the processing performance and the discharge condition for decomposition treatment of indigo-carmin solution [3]. As a result, the processing speed largely varies depending on the number of discharge and the polarity of the applied voltage. These facts are thought to be a result of the physical and chemical properties of the processing solution due to repeated discharges.

Therefore, in this study, we investigated the change of these properties of the solution and the water treatment effect, experimentally.

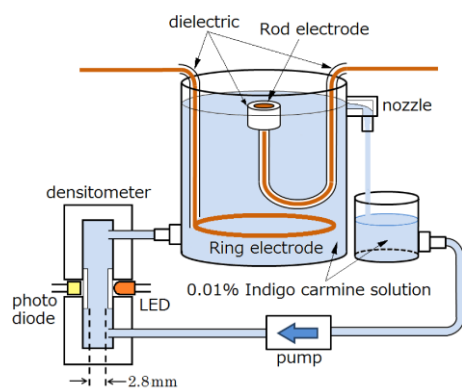


Fig. 1 Water treatment system with discharge electrodes

2. Experimental setup

Figure 1 shows the discharge device with the indigo-carmin densitometer. As diagnostics, we

used a high speed camera, a spectrometer and measurement systems of various physical and chemical properties of the solution.

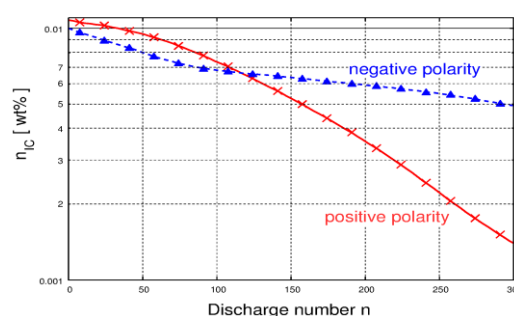


Fig.2 Changes of n_{IC} with different polarities

3. Experimental results

Figure 2 shows the change in the concentration of indigo-carmin n_{IC} by this discharge with different polarities. In the case of negative polarity, n_{IC} decreases exponentially in the early stage of treatment, but after that the rate of decrease deteriorates. As for the amount of dissolved O_2 , which generally affects the processing rate, it remains unchanged 6 mg/L in both polarity cases.

The dissolved amount of ozone O_3 greatly varied depending on the polarity of discharge. In the case of negative polarity, it increased by about 0.1 mg / L at most after even 1000 discharges, but occurred in large amounts exceeding the measurement limit value of 5 mg / L at about 250 discharge times with positive polarity. From these results, it was shown that the increase in the processing speed of the solution in the case of positive polarity was greatly influenced by ozone formation and dissolution by electrolysis around the upper ring electrode.

3. References

- [1] A.A.Egorov, et.al.:Tech.Phys.47(2002) 1584.
- [2] M. Maeyama, et.al.: JPS Conf. Proc. 1(2014) 015076.
- [3] M. Maeyama, et.al.: 21th Int. Conf. on Gas Discharges and their Applications (2016) 461.