

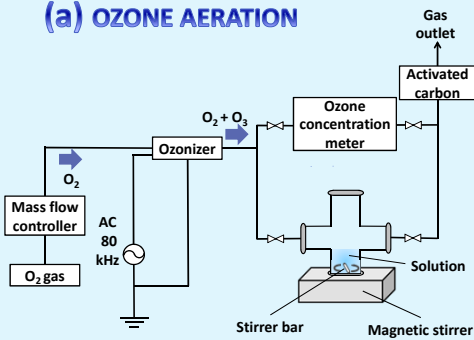
High-Efficiency Transport of Active Species Through Gas-Liquid Interface with Liquid-Phase Stirring

Summary

Liquid-phase stirring seems to be a method which results in high-efficiency decomposition of organic compounds in water using active species generated by plasmas. However, the effect of the stirring is not fully understood. Therefore, we conducted experiments in two ways. In ozone aeration system, the amount of the dissolved ozone concentration in pure water and the diminution of methylene blue concentration were compared with and without liquid-phase stirring with a magnetic stirrer. The experimental results showed that the dissolution velocity of ozone was increased by the liquid-phase stirring. In acetic acid decomposition using plasma generated between a needle electrode and water surface, on the other hand, the decomposition efficiency was decreased with the liquid-phase stirring.

Experimental Setup

(a) OZONE AERATION



Experimental condition

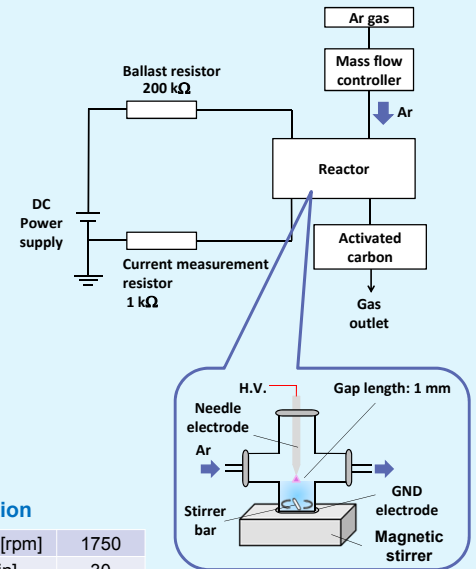
➤ Dissolution of ozone in pure water (Physical absorption)

Rotation frequency [rpm]	1750
Treating time [min]	5
Ozone concentration [g/m ³]	36
Gas flow rate [sccm]	50

➤ Decomposition of methylene blue

Rotation frequency [rpm]	85	293	1125	1750
Treating time [min]	30	15	9	9
Initial concentration [mg/L]	8.5	20	40.6	
Ozone concentration [g/m ³]	35.5			
Gas flow rate [sccm]	50			

(b) ACETIC ACID DECOMPOSITION



Experimental condition

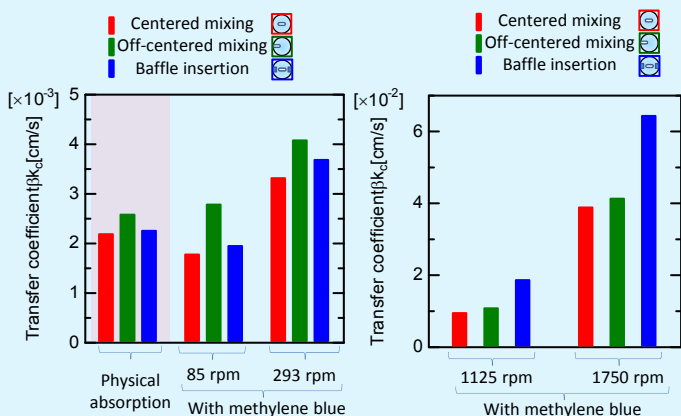
Rotation frequency [rpm]	1750
Treating time [min]	30
Initial concentration [mg _{TOC} /L]	10
Discharge current [mA]	10

STIRRING METHODS

- Centered mixing**
:Set a stirrer bar on center of bottom in a reactor
- Off-centered mixing**
:Shift a stirrer bar from center of bottom in a reactor
- Baffle insertion**
:Insert baffle into a reactor and stir with a stirrer bar

Results and Discussions

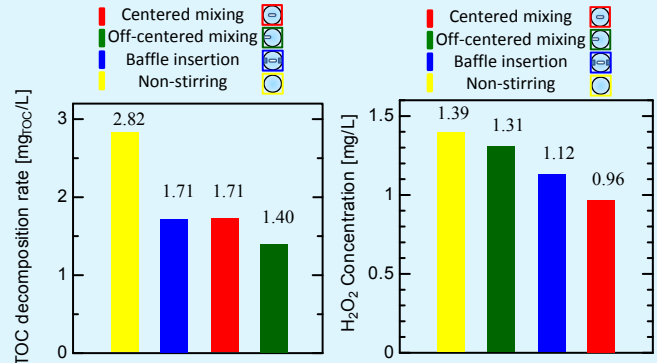
(a) OZONE AERATION



- ◆ In the case of **small** transfer coefficient
Transfer coefficient of ozone with methylene blue decomposition had a similar tendency to physical absorption.
- ◆ In the case of **large** transfer coefficient
The higher the effect of mixing was, the higher the transfer coefficient became.

- ✓ Liquid-phase stirring increased the dissolution velocity of ozone.
- ✓ The stirring method which was effective for promotion of mass transfer differs from the method with high transfer coefficient.

(b) ACETIC ACID DECOMPOSITION



- ✓ Liquid phase stirring decreased TOC degradation rate.
- ✓ In case of non-stirring, H₂O₂ concentration was higher than those in other methods.

- ✓ Liquid-phase stirring by a magnetic stirrer impeded dissolution of OH radical. The reason is that the direction of water flow induced by the magnetic stirrer is the reverse of the flow by discharge.