

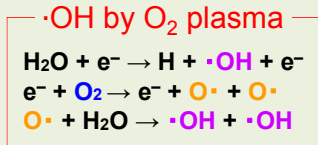
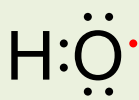
IMPROVEMENT OF EFFICIENCY IN DECOMPOSITION OF HIGH-CONCENTRATED ORGANIC COMPOUNDS BY ADVANCED OXIDATION PROCESS USING PLASMAS

Pulsed plasma inside oxygen bubbles in water

ADVANCED OXIDATION PROCESS (AOP)

Water treatment using OH radicals as oxidizing agents

OH radical (Hydroxyl radical)



Oxidation-reduction potential [V]	
2.80	OH
2.07	O ₃
1.78	H ₂ O ₂
1.36	Cl ₂

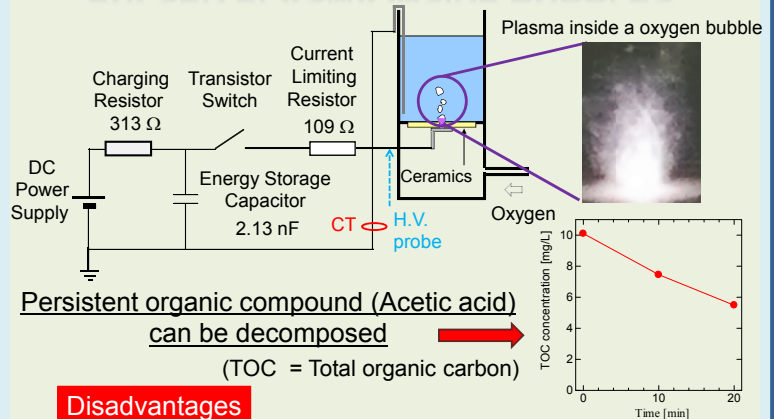
◆ The strongest oxidizing agent in active oxygen species.

✓ Capable of decomposing persistent organic compounds which cannot be degraded by ozone. (ex. Dioxine)

◆ Quite short lifetime (~ 1 ms)

✗ Necessary to be produced and reacted at the same time.

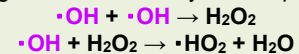
PULSED PLASMA INSIDE BUBBLES



Persistent organic compound (Acetic acid) can be decomposed (TOC = Total organic carbon)

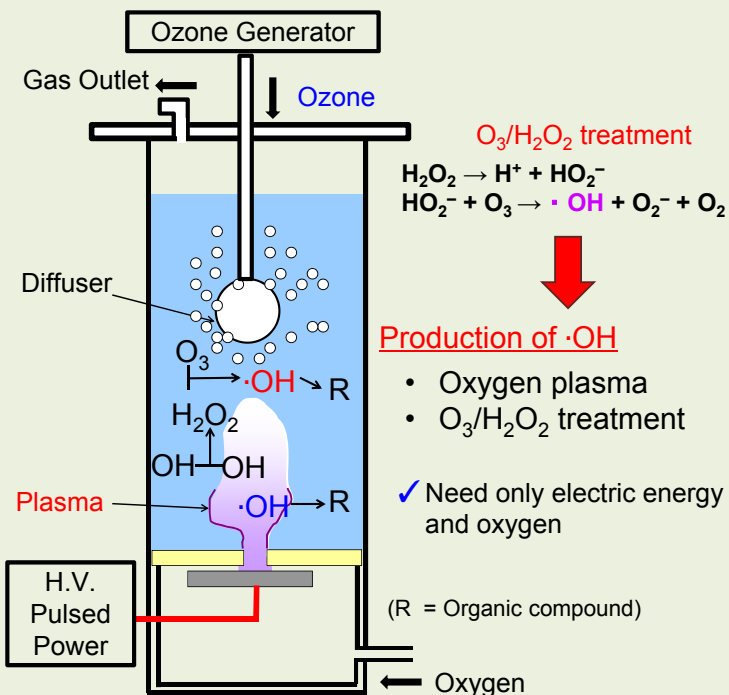
Disadvantages

Low decomposing rate and efficiency due to quenching reactions,



Advanced oxidation process using plasma and ozone

1. Experimental setup



2. Objectives

Produced water

Largest amount of wastewater from oil and gas industries
Contain oil compounds, suspended solids (SS) and organic compounds

Oil compounds and SS can be removed by physical treatment such as Flocculation and Magnetic-Separation (FMS)

After FMS treatment [1]

Clear, but still contains organic compounds Target is

the produced water after FMS treatment



[1] Hitachi, Oil & Gas Industrial Water Treatment System
<http://www.hitachi-pt.com/wts/>

3. Experimental results

Experimental condition

Target: Produced water

Quantity: 50 mL

Gas: Oxygen, 100 sccm

Ozone: 105 g/m³, 100 sccm

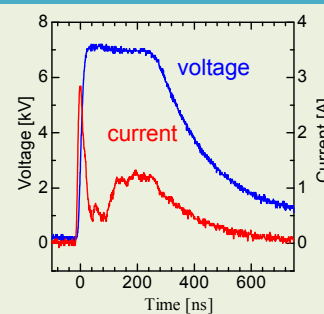
Power (plasma): 9.47 W

Power (ozonizer): 20.0 W

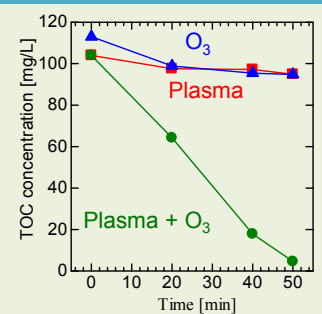
Treating time: 50 min

Initial TOC: ~113 mg/L

Voltage and current waveform



TOC concentration vs. time



	Efficiency [mg/kWh]	Rate [mg/L/min]
Plasma	44.6	0.182
Ozone	54.6	0.364
Plasma + Ozone	203	1.99

✓ TOC reduced to 4.4% in 50 minutes by treatment using plasma and ozone.

✓ The decomposing efficiency increased.

✓ The decomposing rate of treatment using plasma and ozone was higher than the sum of decomposing rate of each treatment.

We have successfully mineralized the produced water rapidly and efficiently with plasma and ozone.