

*2008, 2014 New Technology,
2019 Green Technology from
Ministry of Environment, Korea*

DOF (Dissolved Ozone Flotation) & DAF (Dissolved Air Flotation)

Technologies in Water and Wastewater Treatment

MICHIGAN TECHNOLOGY

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□DOF (Dissolved Ozone Flotation) System

$$\text{DOF} = \text{DAF} + \text{Ozone}$$



Excellent Separation

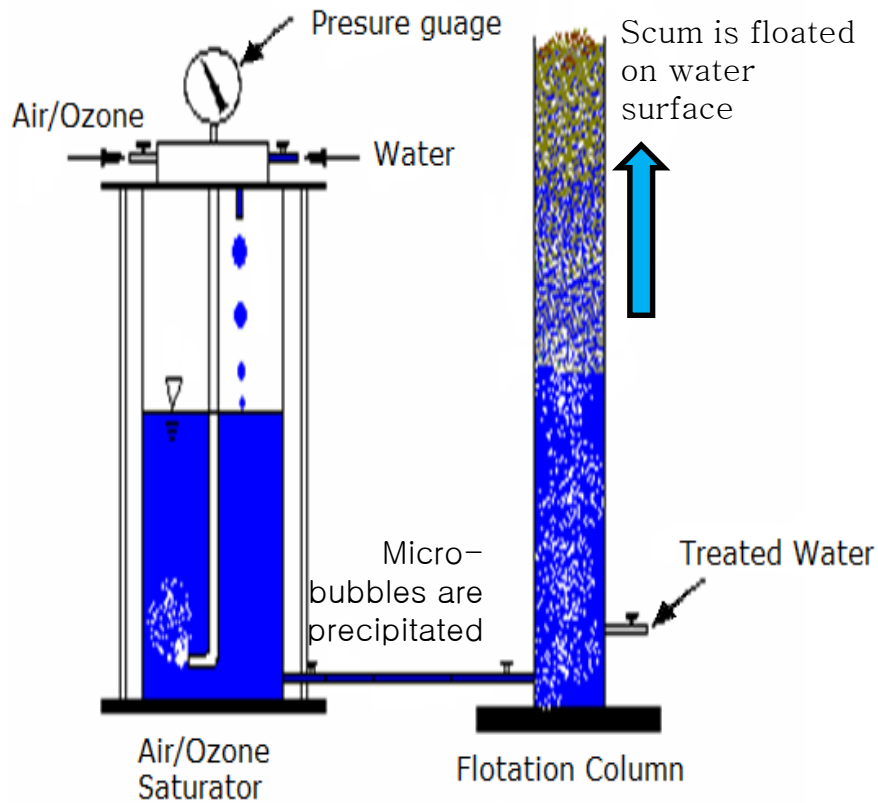
Suspended solids, Turbidity
Oils, Surfactants
Total phosphorous
Algae, etc.

Strong Oxidation

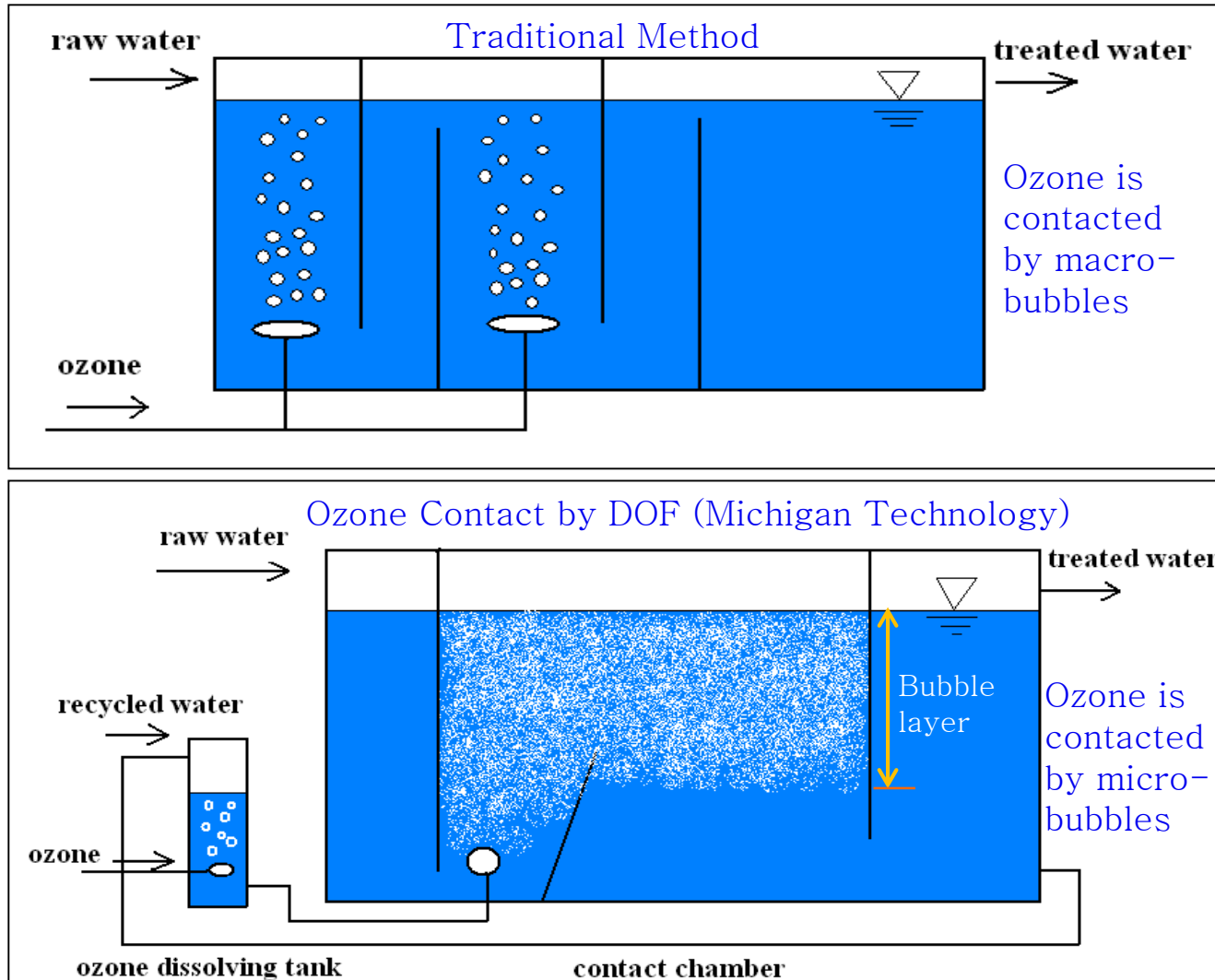
Disinfection of Virus, Bacteria
Removal of Color, Odor, Taste
Removal of BOD, COD,
Hazardous Materials

DOF can do all these in **one unit!**

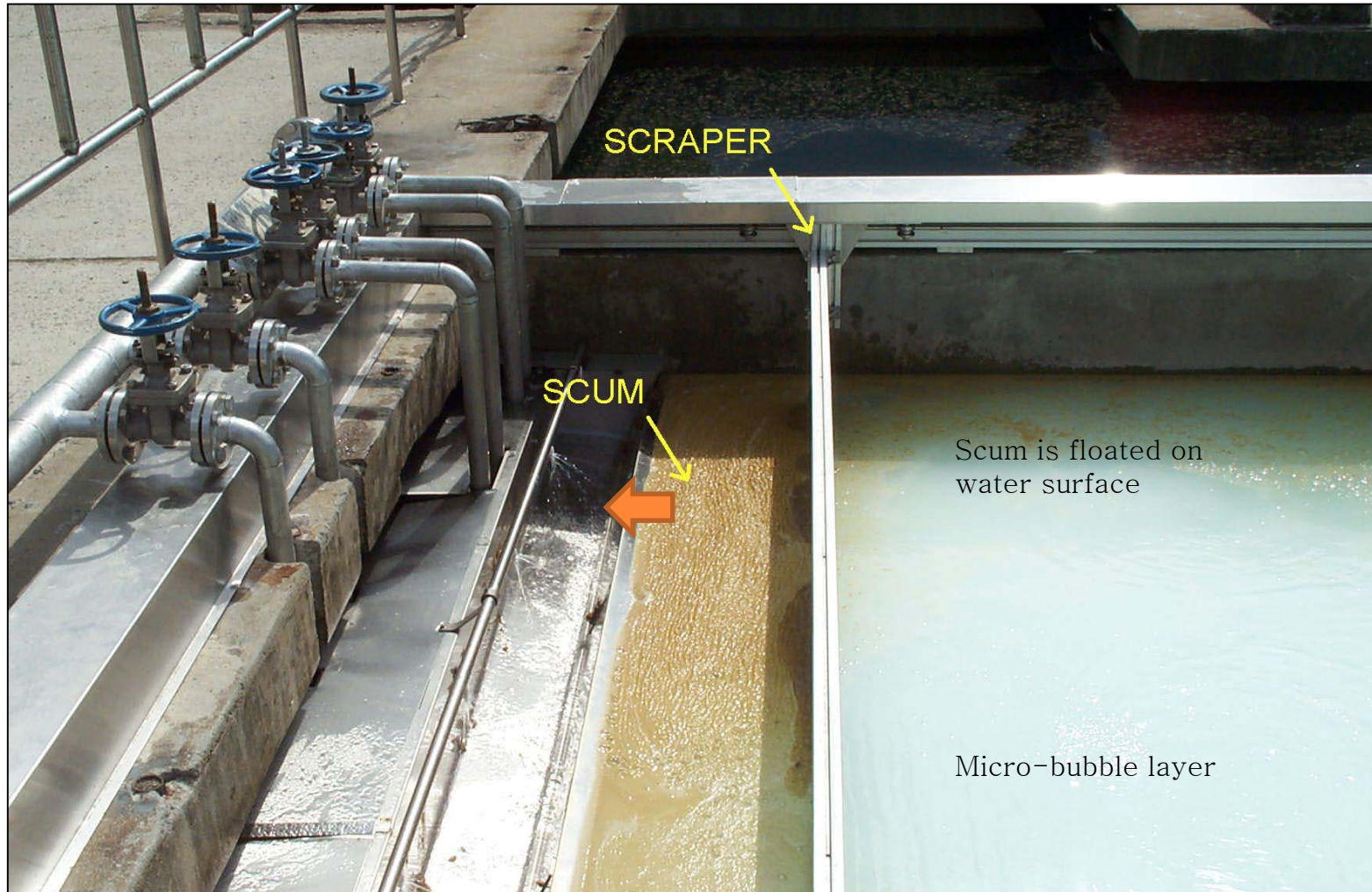
DAF/DOF (Dissolved Air/Ozone Flotation) System



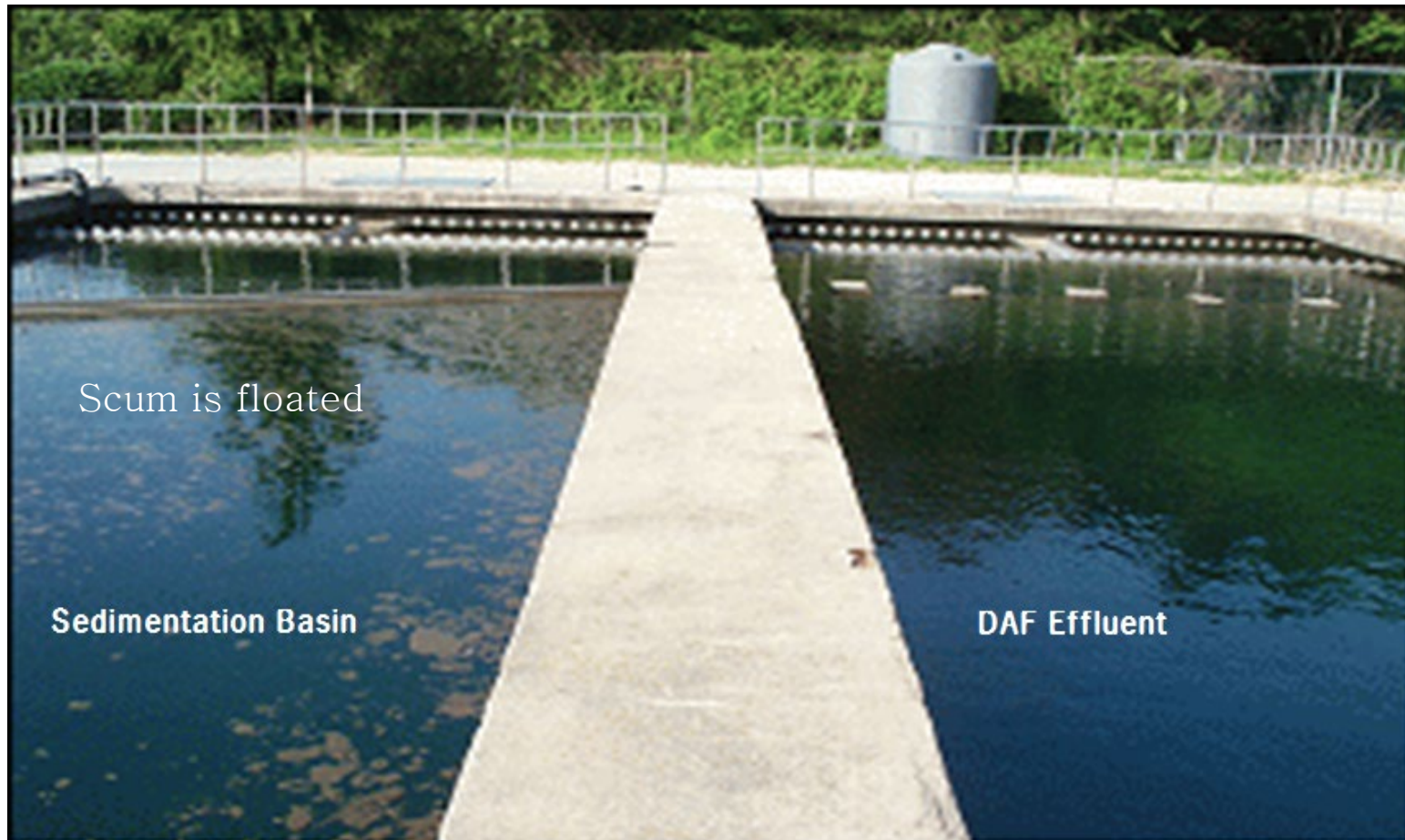
Ozone Contact Method Comparison



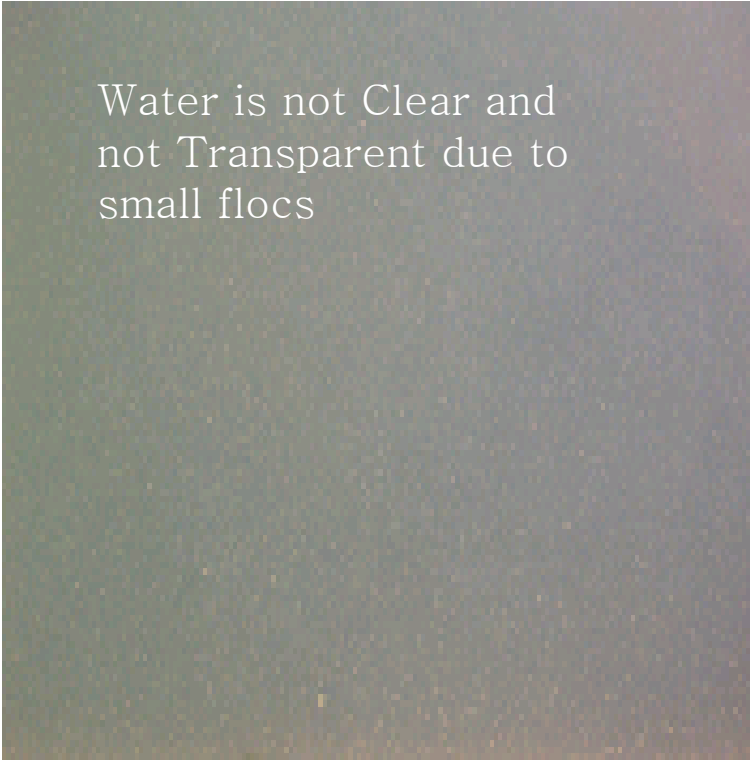
DAF Field Application (B Water Plant)



Conventional and DAF Treatments (B Water Treatment Plant)

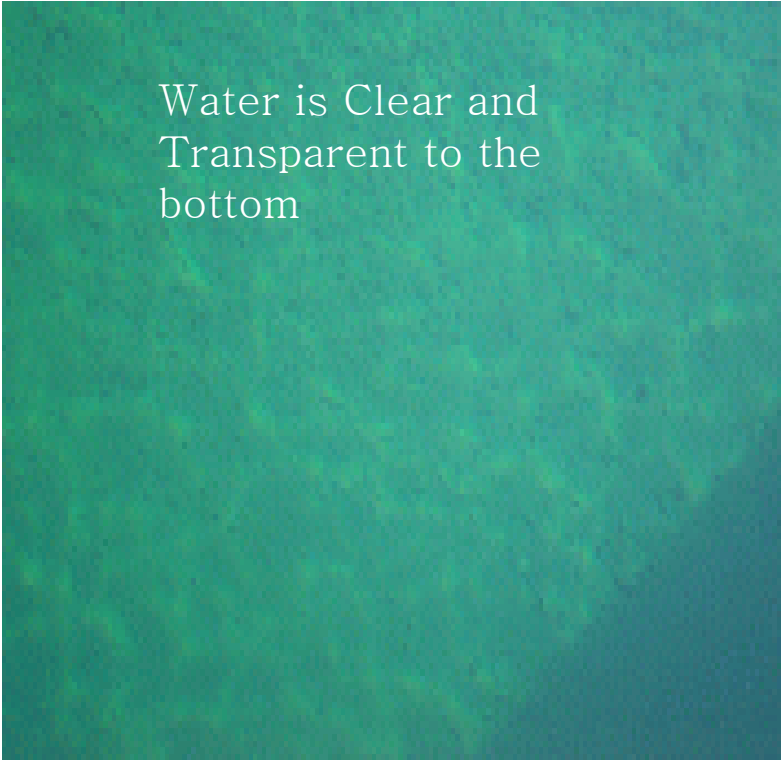


Water Quality Difference: Sedimentation vs DAF (B Water Treatment Plant)



Water is not Clear and
not Transparent due to
small flocs

Sedimentation Basin

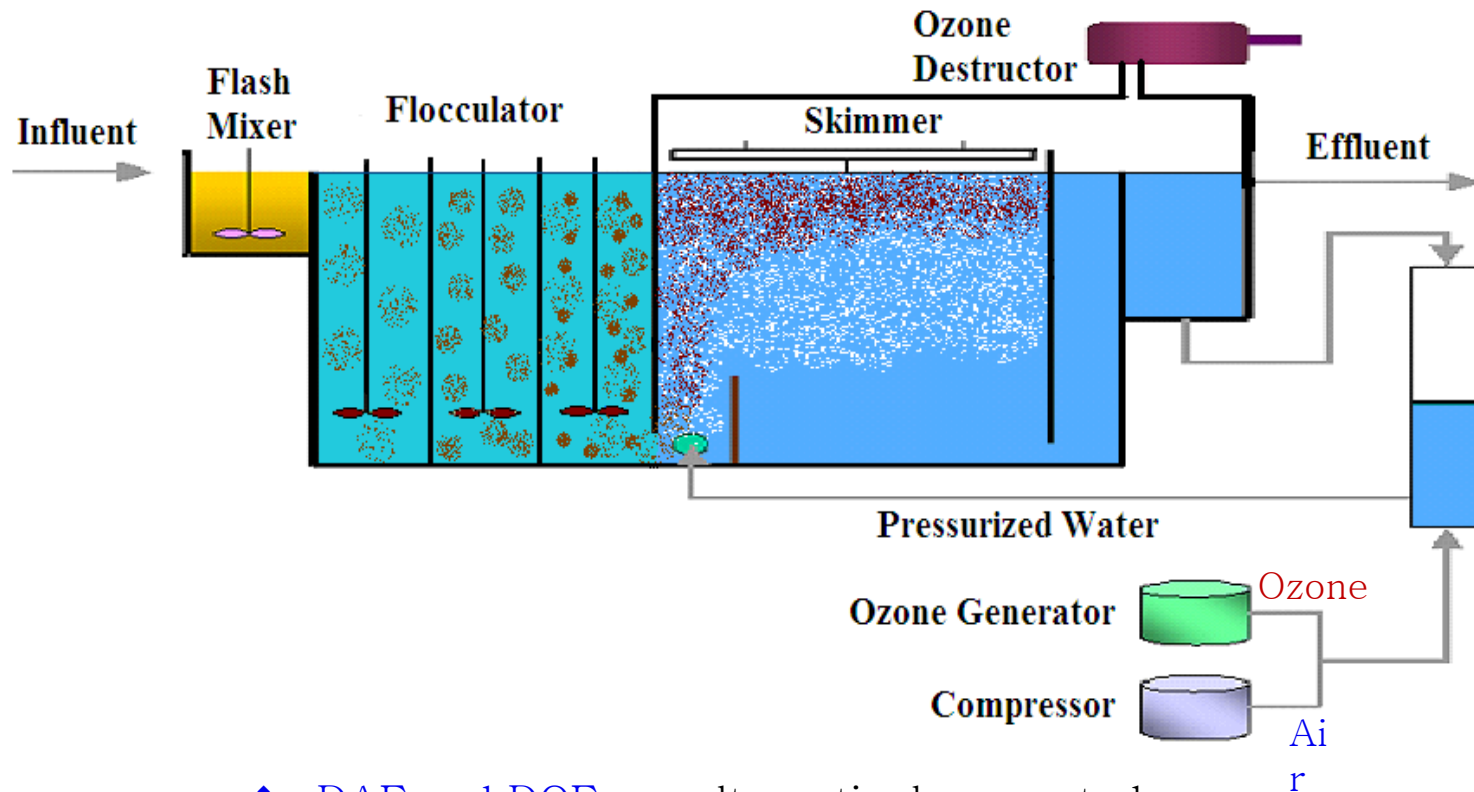


Water is Clear and
Transparent to the
bottom

DAF Effluent Basin

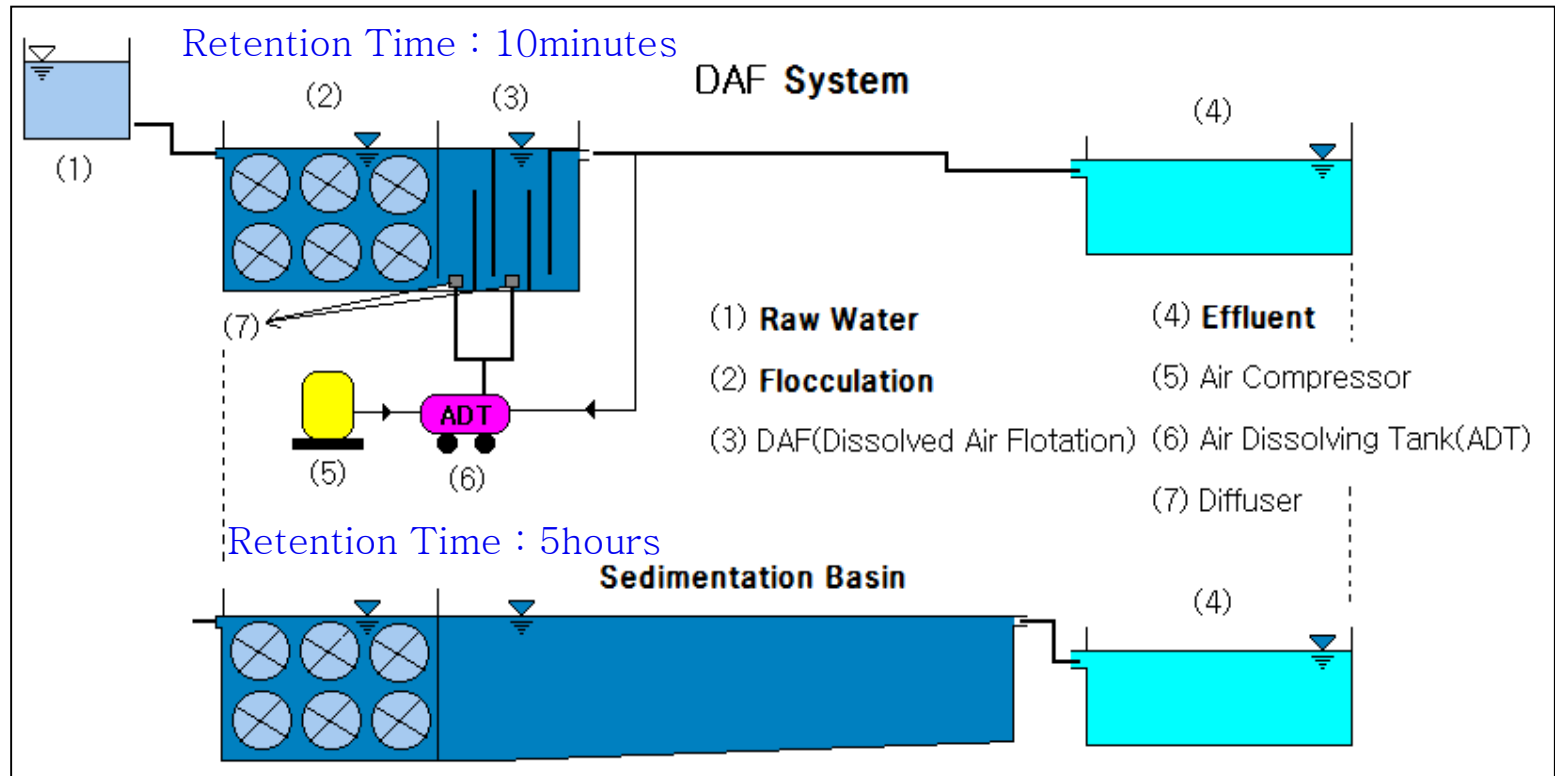


Diagram of DOF



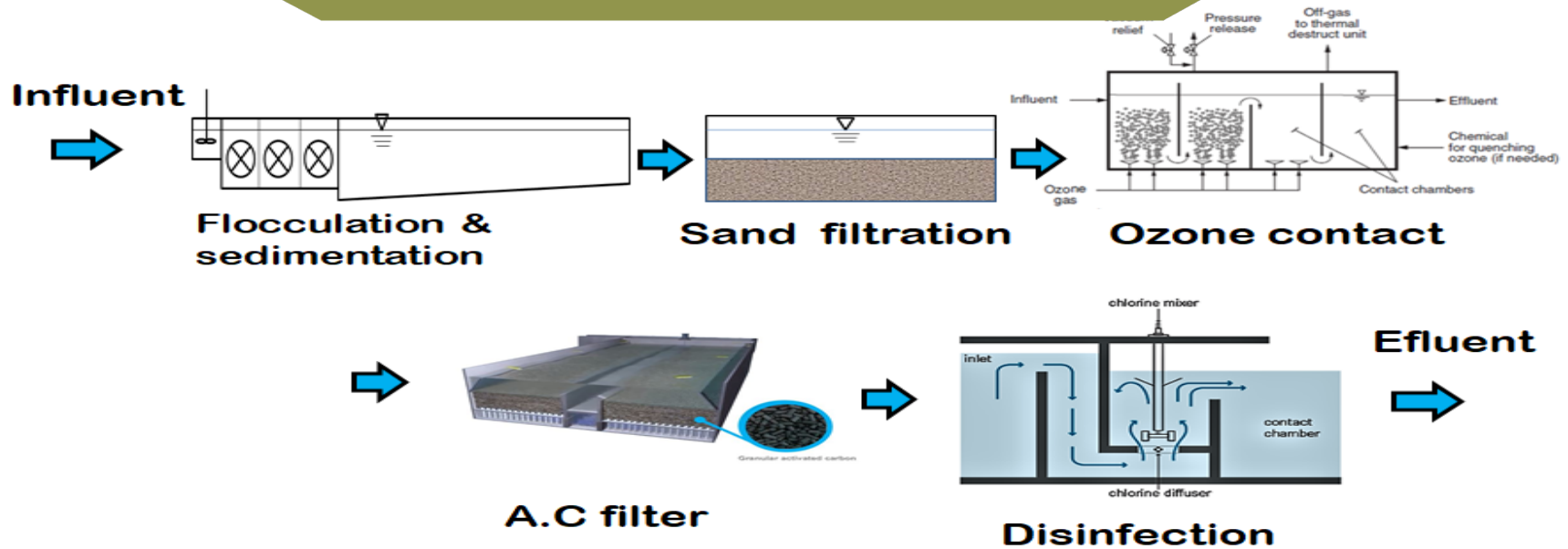
- ❖ DAF and DOF are alternatively operated depending on influent quality

Advantages of DAF/DOF

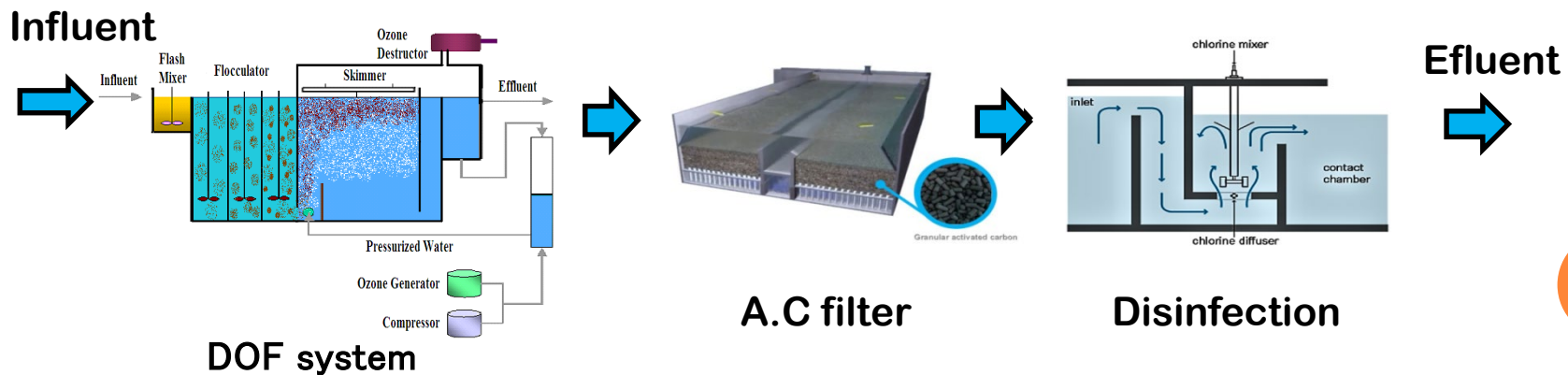


1. Higher treated water quality
2. Much smaller construction cost
3. Much smaller footprint

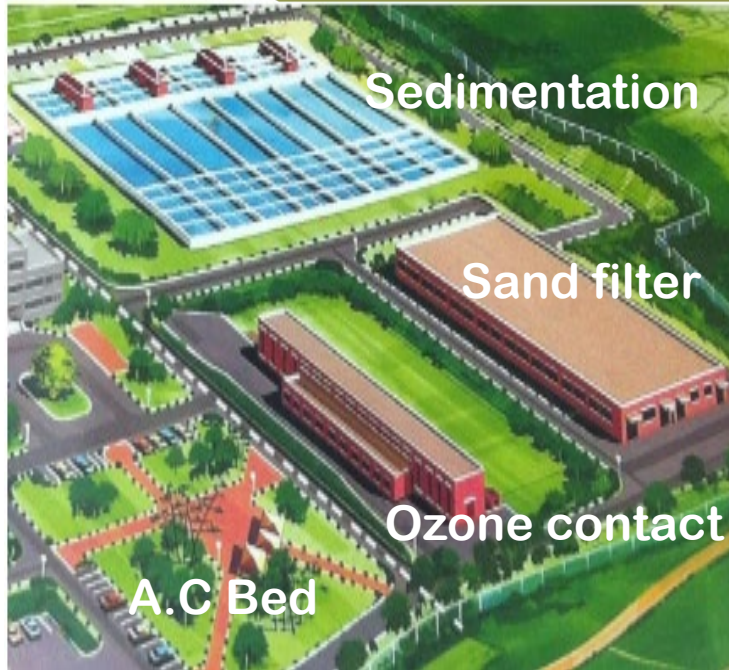
Conventional Drinking Water Treatment



Michigan Drinking Water Treatment



Conventional Drinking Water Treatment



Can be
replaced by
DOF



DOF
system

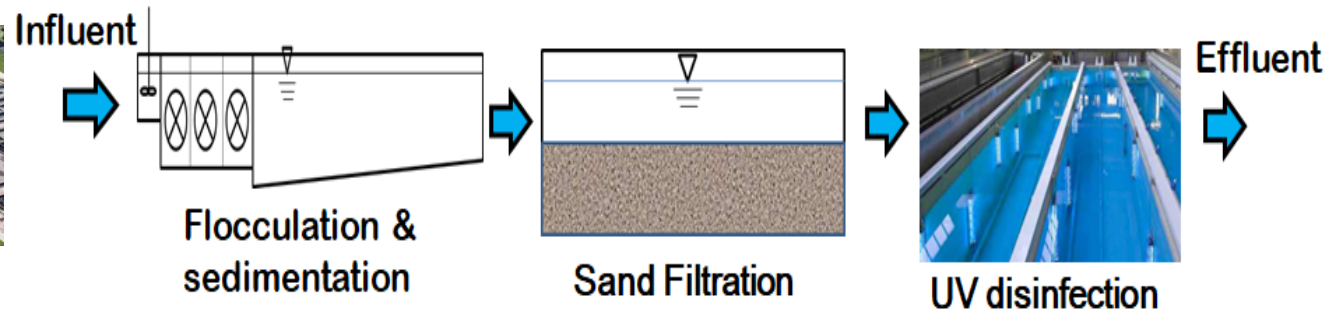


Renovation of Domestic Wastewater Treatment by DOF for Water Reuse

Conventional Water Reuse Process



Biological Wastewater Treatment

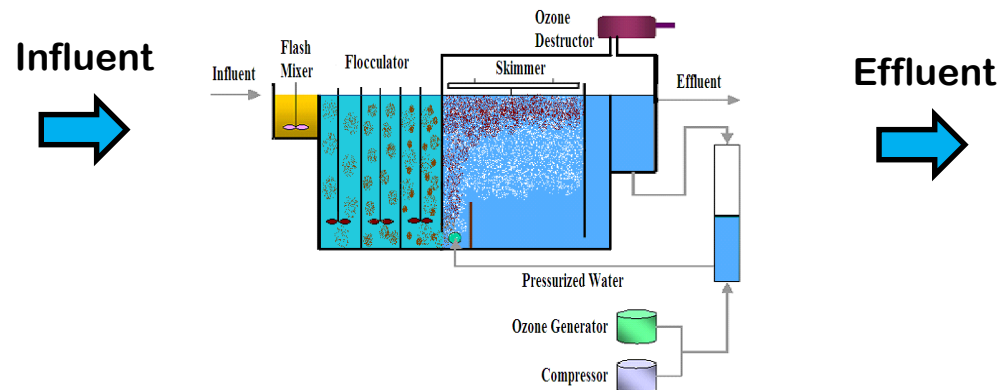


DOF can replace many processes

Renovation by DOF system



Biological Wastewater Treatment



Treated Water Quality by DOF (Domestic Wastewater)

items	Ozone Dose: 1.98 mg/L		
	Influent	Effluent	Removal (%)
SS (mg/ℓ)	6.9	3.0	57.2
UV-254 (ABS)	0.145	0.044	69.9
BOD (mg/ℓ)	9.5	1.4	84.9
COD _{Mn} (mg/ℓ)	10.7	6.5	39.6
Color (CU)	24.7	4.3	82.4
T-N (mg/ℓ)	8.497	7.230	14.9
T-P (mg/ℓ)	0.39	0.04	89.7
Coliform Bac.(MPN/ml)	193	0	100
HTP Bac.(CFU/ml)	6,933	0	100

DOF treated effluent quality is a level of reuse

Drinking Performance of Treated Domestic Wastewater by DOF Plant



Domestic Wastewater can be
Treated at a Drinkable Level

MASTER PLAN

Anticipated International New City



Residential Area with Waterfront : High tech-Ubiquitous City (U-City)

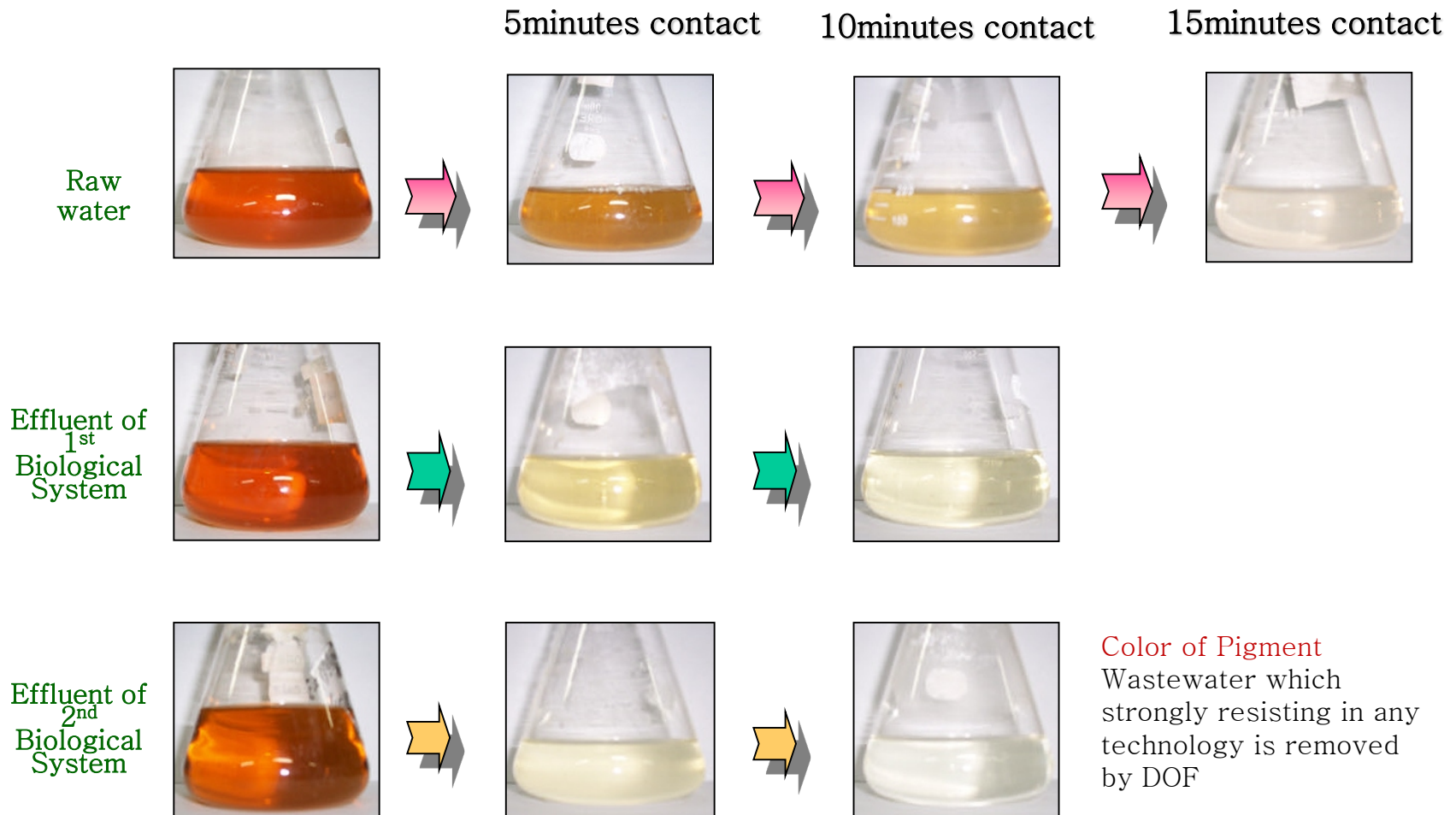
Agricultural Purpose



MASTER PLAN



Pigment Wastewater Treatment by PO_3 (Pressurized Ozone) Technology



Color of Pigment Wastewater which strongly resisting in any technology is removed by DOF

Expected Color Removal by DOF



Raw Water 498(CU)



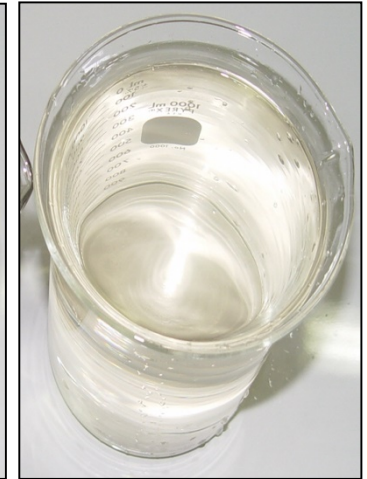
5ppm 150(CU)



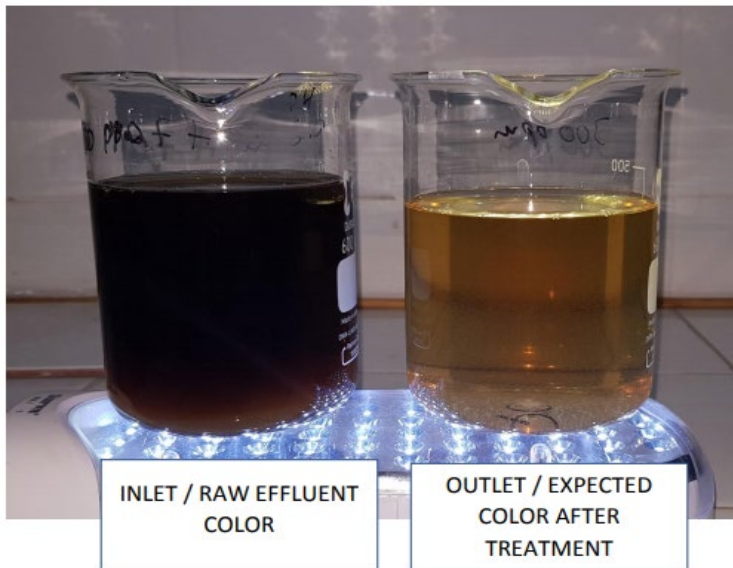
6ppm 112(CU)



8ppm 72(CU)



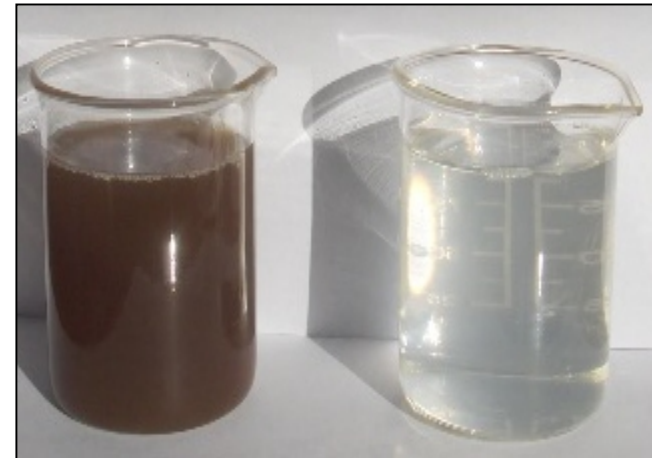
14ppm 35(CU)



Palm oil wastewater
color

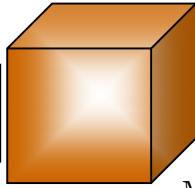
Livestock Wastewater Treatment by DOF-PO₃

item	Raw water (mg/L)	Effluent (mg/L)	Removal Rate (%)
COD _{Mn}	619.9	63.0	89.8
SS	409	22	94.7
T-P	27.04	0.35	98.7
Color	850(CU)	42(CU)	95.1
HTP	U.C	0	100.0

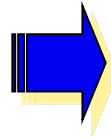
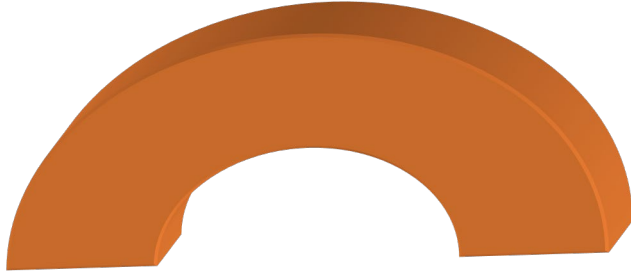


Michigan Technology

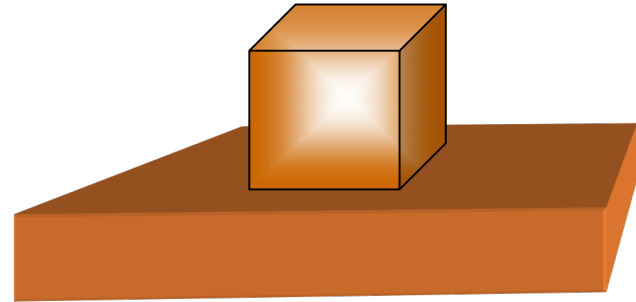
High Conc. of
Ozone(8.28 volts)



Michigan Technology **can Control**
Ozone Concentration in Water

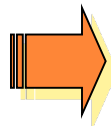
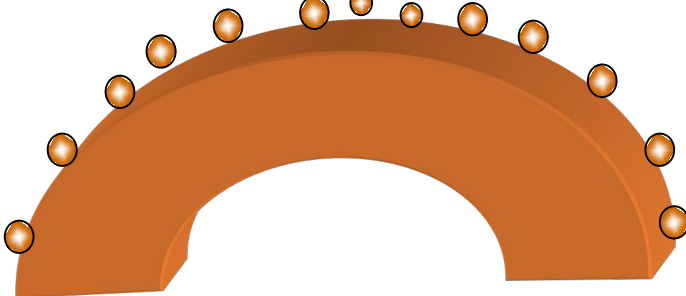
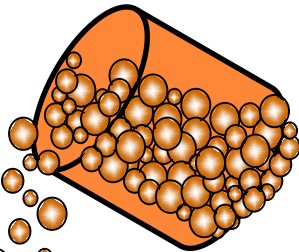


Michigan Technology :
Contact **Ozone** in **High**
Concentration



Conventional

Low Conc. of
Ozone (2.07 volts)

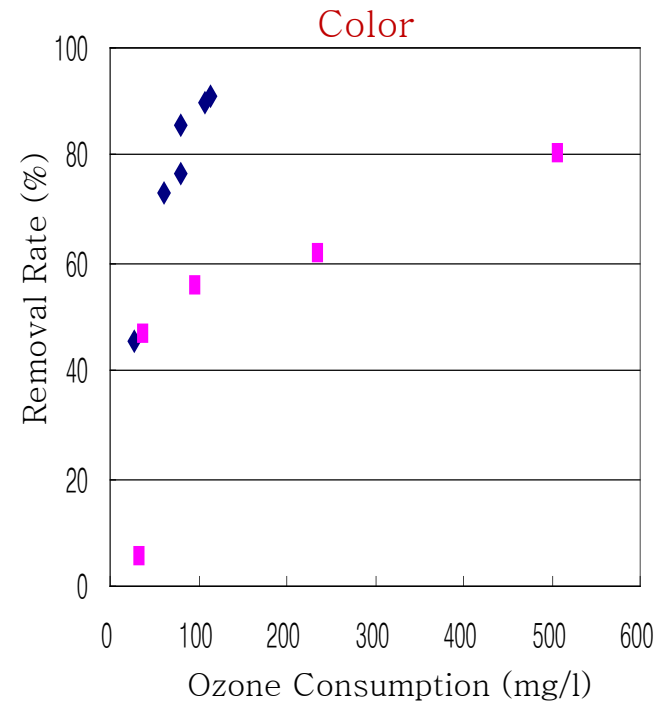
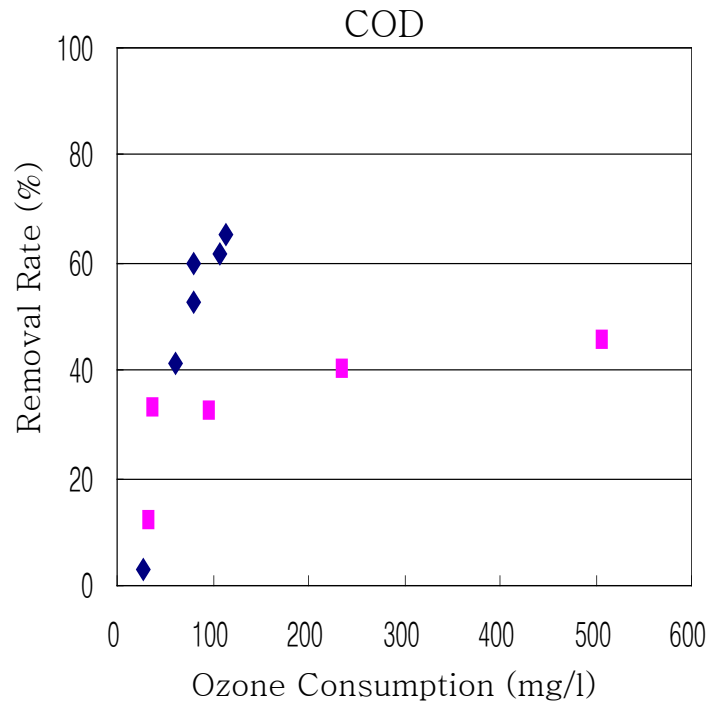


Conventional Technology:
Contact **Ozone** in **low**
Concentration



Industrial Wastewater Treatment by DOF

(Raw Wastewater : S Chemical Company Wastewater)



Blue : Michigan (COD 70% removal by 100mg/l- O_3)

Pink : Conventional (COD 50% removal by 500mg/l- O_3)

Michigan Technology can remove more with smaller chemical

DOF Small Plant (200m³/day)

Operating Cost : about 5cents/m³



Front Side



Back Side

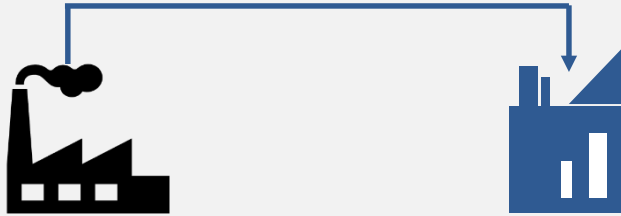
Size : 2m x 1.5m x 2.5m (May be carried inside Container Box)

Drinking water : may supply to 1000 people

Mobile System of the DOF Small Plant (200m³/day)



Middle Size of the DOF Plant

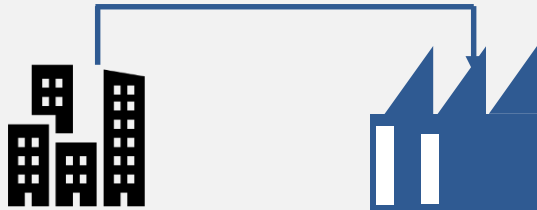


- Wastewater treatment and water reuse solution for midsize city, apartment complexes
- Fit for wastewater treatment for individual factories
- Higher capacity in compact standardized plant
- Treatment capacity of 100~2000ton / day



The Large Scale Plant

- Large scale drinking water and wastewater treatment



- Solution for Large scale drinking water treatment plant to supply an entire city
- Solution for wastewater treatment for big cities
- Wastewater treatment solution for entire industrial complex
- Water circulation system solution for lake



DOF-PO₃ system (Pig Wastewater Treatment)



- Capacity: 120ton/day (20hr/day)
- Size: 4.0M X 3.5M
- Ozone generation : Using Oxygen generator
- Site : Chung Nam
- COD Influent 484.9-Effluent 86.0 (RR: 82.5%), SS Influent 392.5 – Effluent39.4 (RR 90%)

Records of applications (References)

DOF/DAF Systems

Advanced wastewater treatment plant at Sabong in Jinju (DAF)



Advantages of Michigan Technology (DOF/DAF)

Higher Water Quality

Lower Construction Cost

Smaller Footprint

Smaller Operating Cost (About 5cents/m³)

No Clogging like in Filtration

No Concentrate production like in RO