Surface Water Treatment Plant Optimization To Enhance Removal Of Taste & Odor Compounds and Achieve Multi-Barrier Treatment

Applied Process Technology Inc.

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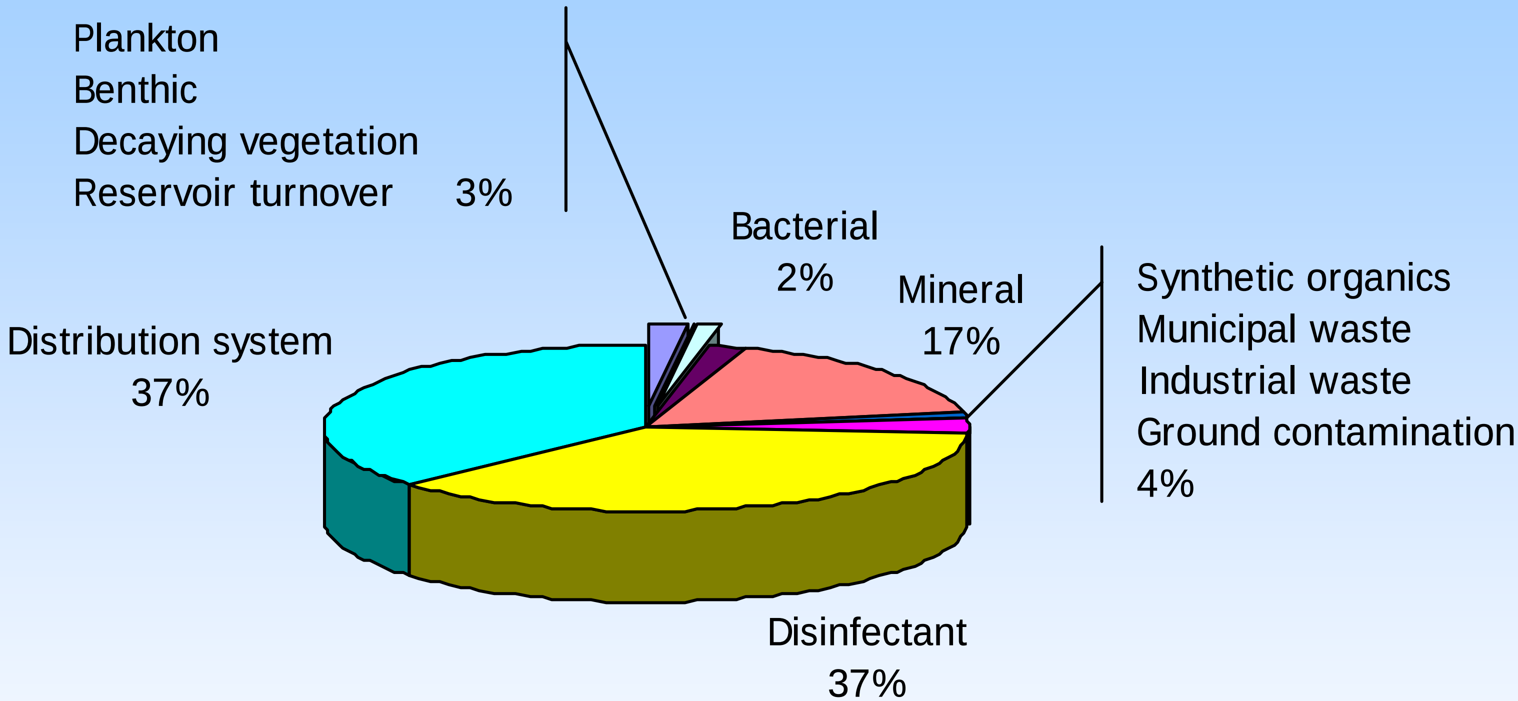
OVERVIEW

- Sources of Taste and Odor Compounds
- Effective Treatment Mechanisms
- Comparison of Ozone to Advanced Oxidation
- Ancillary Benefits of Advanced Oxidation Drinking Water Treatment

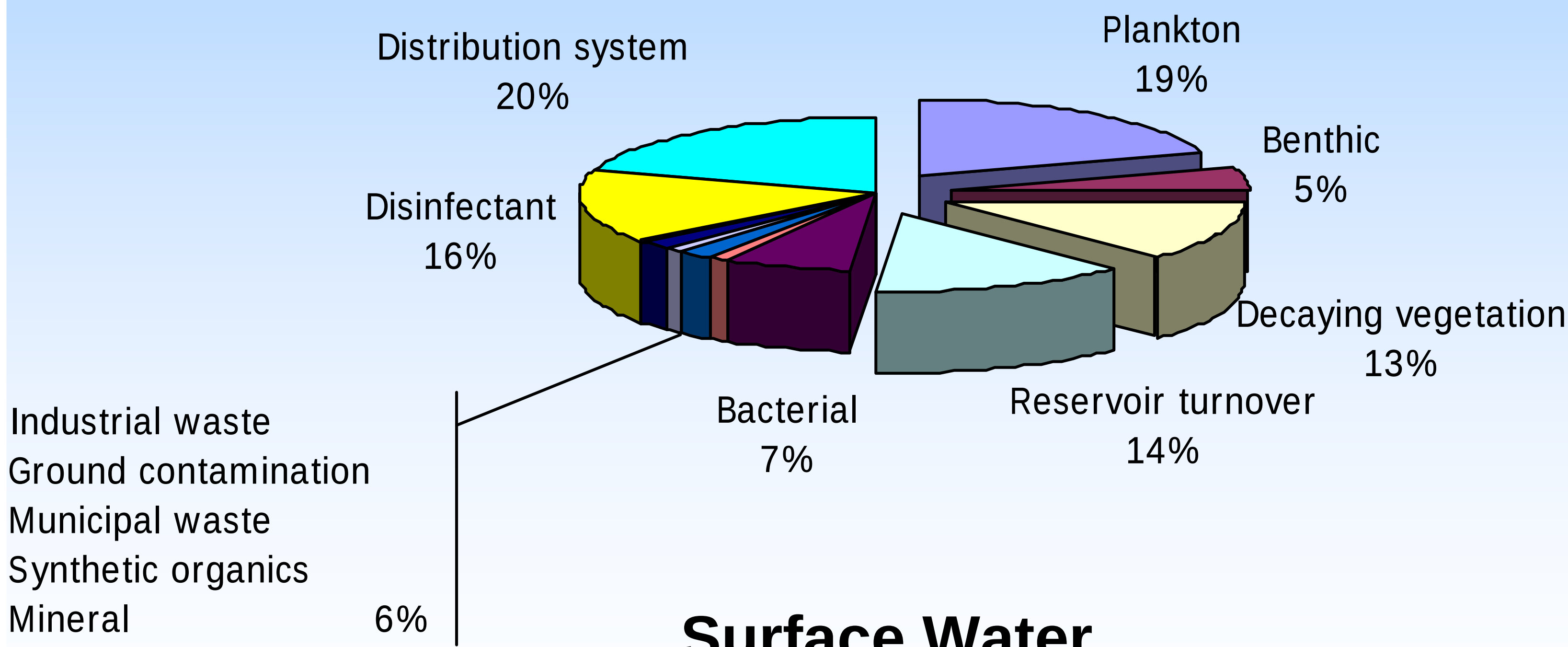
Taste and Odor Survey



Groundwater

Suffet et al., 1996. AWWA Taste and Odor Survey

Taste and Odor Survey



Surface Water

Suffet et al., 1996. AWWA Taste and Odor Survey

Sources of Taste and Odor Compounds

Compound	Taste and Odor Source	Drinking Water Source	Typical Threshold Odor Concentration, ng/L
Geosmin	Cyanobacteria	SW	4
2-Methylisoborneol	Cyanobacteria, Actinomycetes	SW	9
Mercaptans	Microcystis, Cyanobacteria	SW	NA
2,3,6 Trichloroanisole	Bacterial metabolite	Wine	7
Iron and Manganese	Thermal stratification, O_2 depletion, anaerobic bacterial action	GW and SW	40,000
Sulfides	Thermal stratification, O_2 depletion, anaerobic bacterial action	GW and SW	100
Chlorine	Disinfection residual	GW and SW	200,000
MTBE	LUSTs	GW and SW	20,000

Taste and Odor Impacts

- **Secondary Maximum Contaminant Levels**
  - Color 15 units
  - Odor 3 TON units
  - Iron 0.3 mg/L
  - Manganese 0.5 mg/L
- **Impacts Palatability and Consumer Confidence**
- **Taste and Odor as Sentinel Compounds**
  - May be Indicative of Elevated TOC
  - Elevated TOC acts as precursors to THMs
  - THMs are Primary MCLs

Taste and Odor Treatment

- **Source Control**
  - **Watershed management**
  - **Algaecides**
- **Aeration**
- **Conventional Surface Water Treatment**
  - **Coagulation, Mixing, Flocculation, Filtration (Media or Membrane)**
- **Supplemental Treatment**

Supplemental Taste and Odor Treatment

- **Activated Carbon**
  - **PAC (B600-05)**
  - **GAC (B604-05)**
  - **BioGAC**
- **Ion Exchange Resin**
- **Oxidation**
  - **Chlorine (B301-04)**
  - **Permanganate (B603-03)**
  - **Ozone**
  - **Advanced Oxidation**

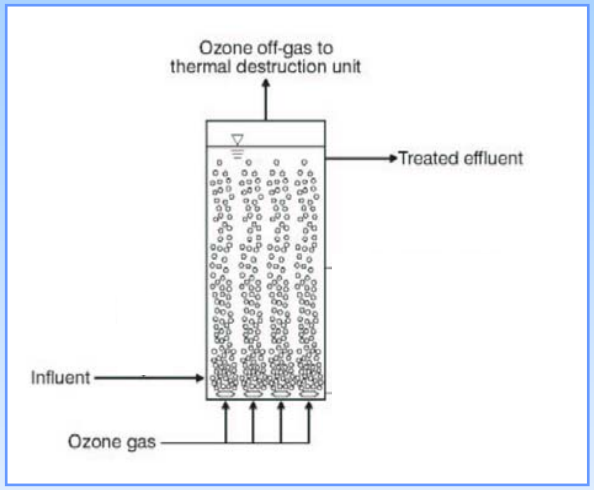
Geosmin and MIB Removal

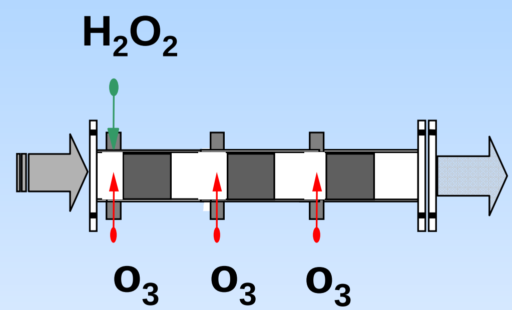
Treatment	Feed Rate, mg/L	Removal, %	
		Geosmin	MIB
Powdered activated carbon	10	40	62
	25	52	65
Potassium permanganate	0.8	42	28
Chlorine	2	45	33
Hydrogen peroxide	1	50	72
Ozone	2.5	94	77
Ozone and hydrogen peroxide	2.5	97	95

Source: Table 8-2, MWH, 2005.

Adapated from Kawamura, 2000.

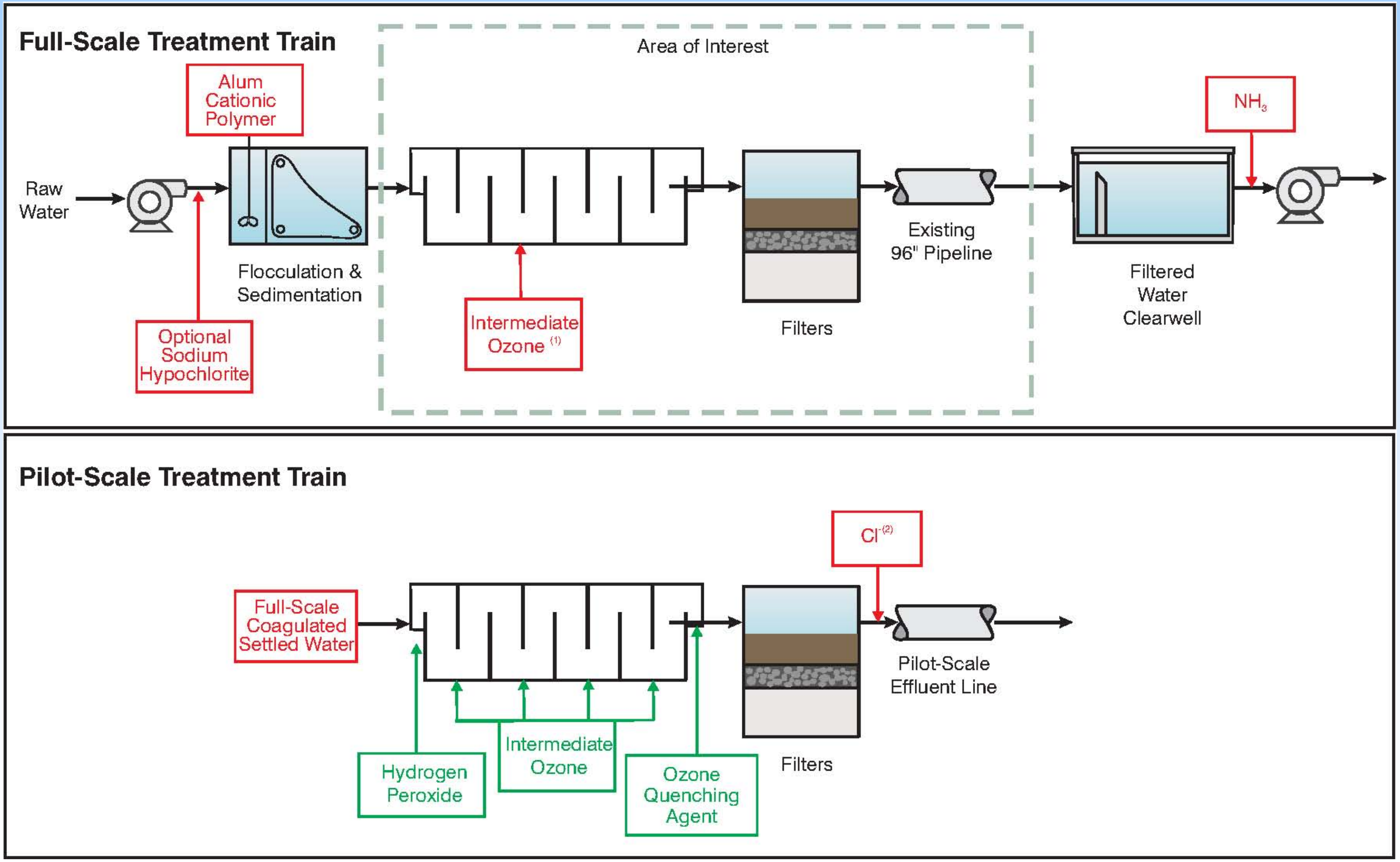
Comparison of HiPOx to Ozone



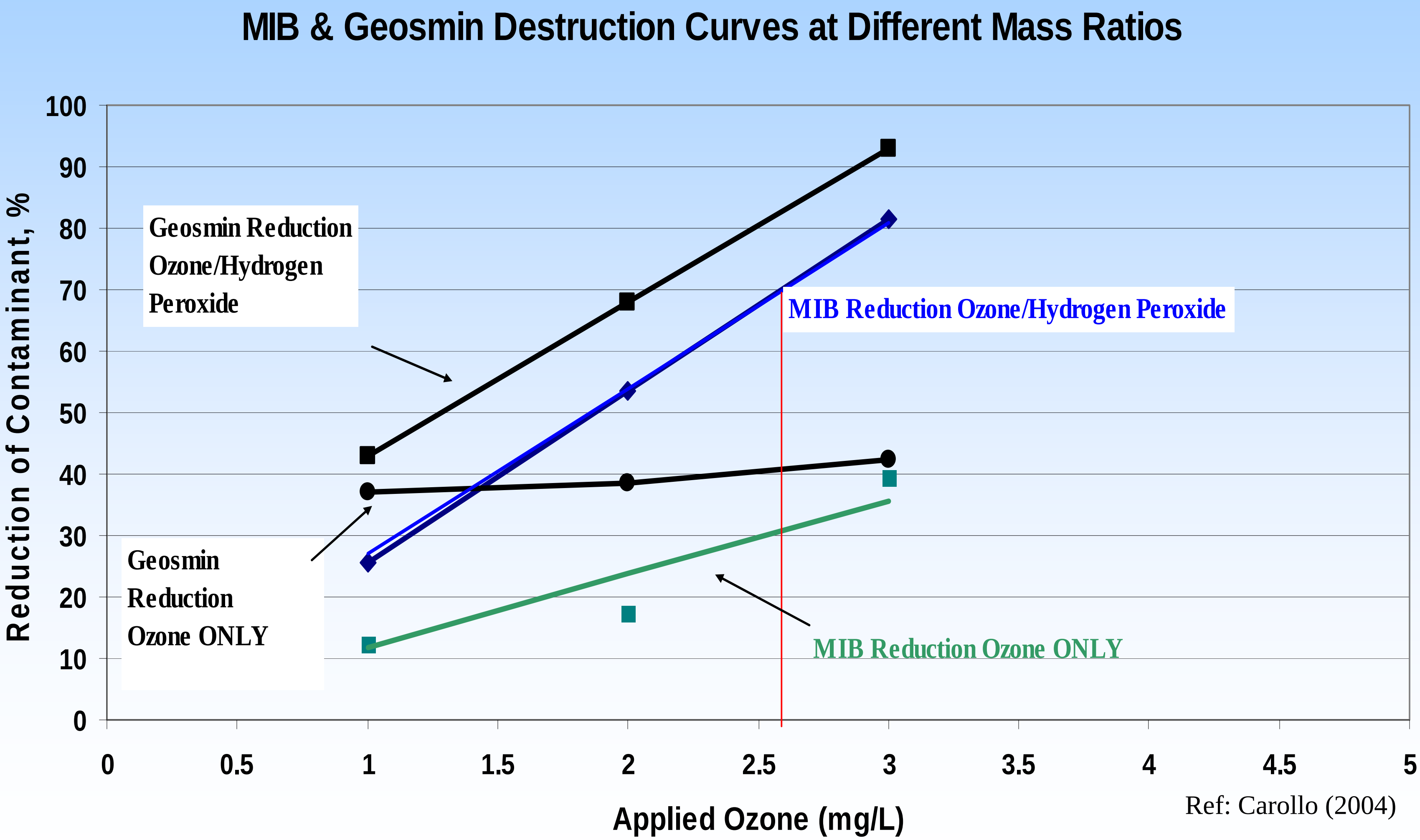


	Conventional Ozone	HiPOx
Oxidant	O_3	O_3, OH•
EOP, V	2.08	2.80
Contactor	Baffled tank`	Plug flow
Hydraulic Residence Time	Minutes	Seconds
Hydraulic Efficiency, t_{10}/T, %	50 - 75	>90
Dosing Regime	Single injection point	Distributed injection
Operating Pressure, psi	Ambient	5 – 40

Comparison of HiPOx to Ozone Utility A

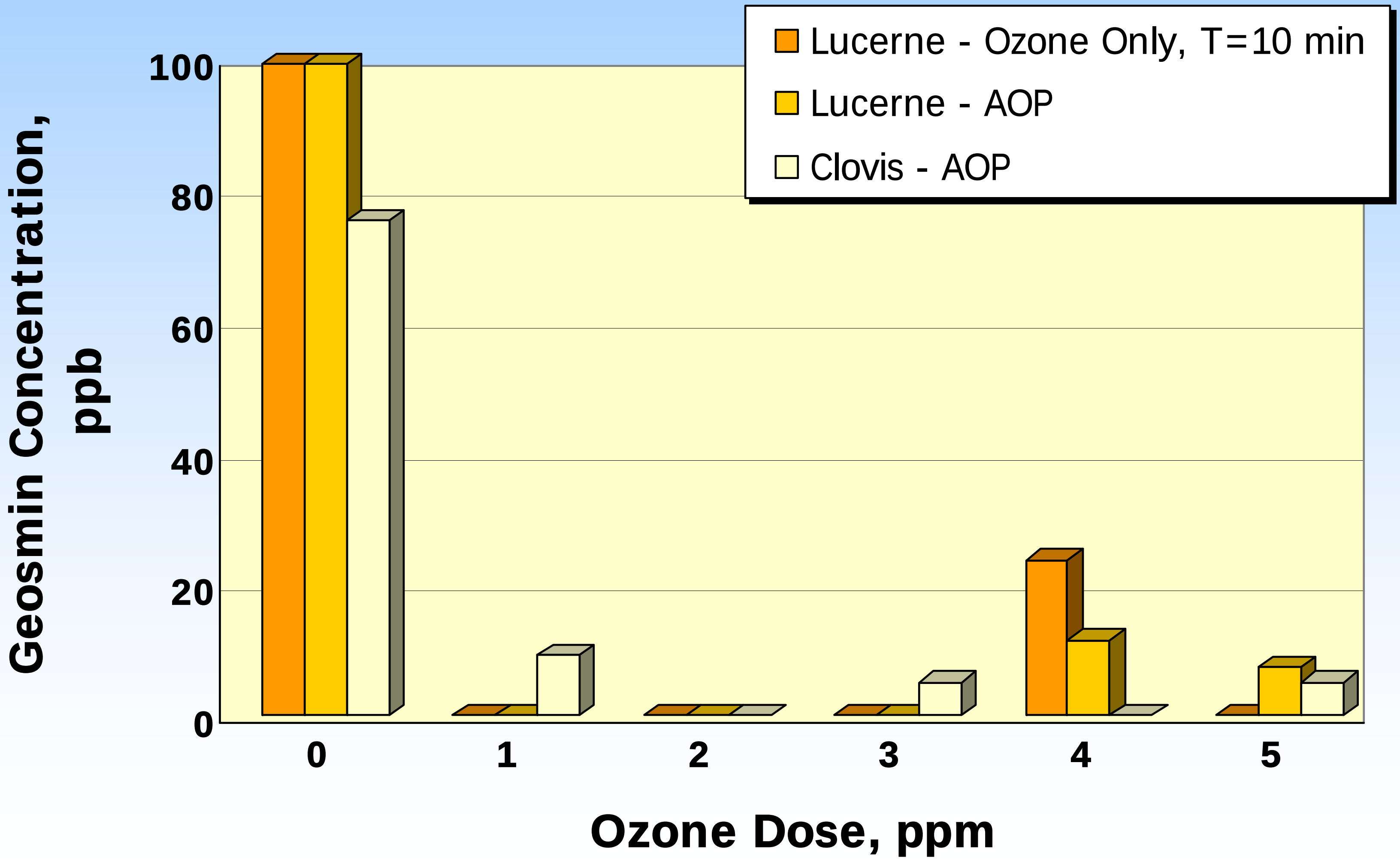


Comparison of HiPOx to Ozone
Utility A



Ref: Carollo (2004)

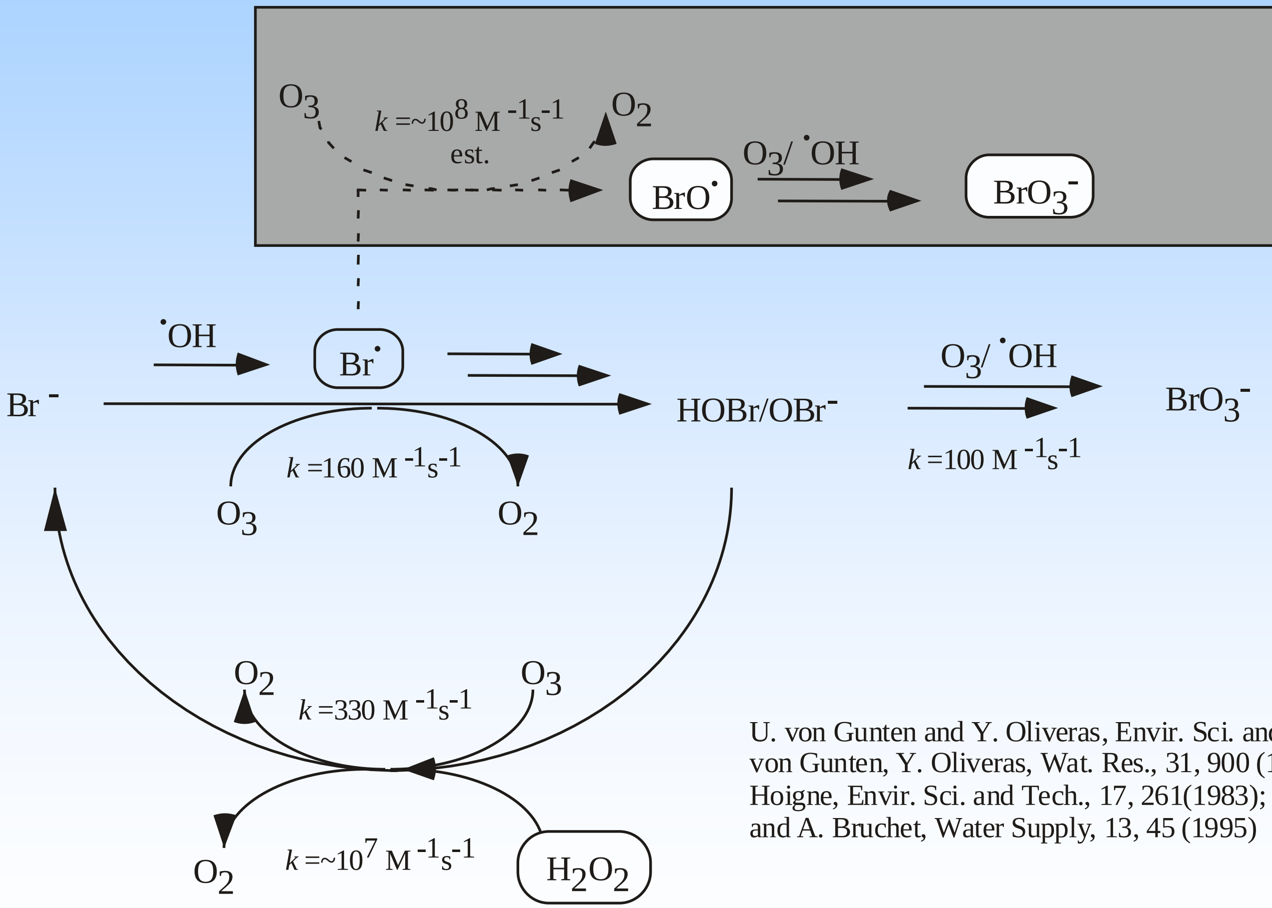
Comparison of HiPOx to Ozone Geosmin Destruction



Ancillary Benefits

- **Residual Control**
- **Disinfection (with appropriate Contact Time)**
- **Disinfection Byproduct Control**
  - **Trihalomethane Formation**
  - **Bromate Formation**
- **Trace and Emerging Contaminants**

Bromide – Bromate Chemistry



U. von Gunten and Y. Oliveras, Envir. Sci. and Tech., 32, 63 (1998); U. von Gunten, Y. Oliveras, Wat. Res., 31, 900 (1997); W.R. Haag, and J. Hoigne, Envir. Sci. and Tech., 17, 261(1983); U. von Gunten, J. Hoigne and A. Bruchet, Water Supply, 13, 45 (1995)

Summary

- The most significant taste and odor problems are algae-related compounds with nanogram per liter threshold concentrations
- Ozone is an effective treatment
- Ozone/Peroxide Advanced Oxidation using HiPOx is an improvement on Ozone treatment
  - Removes a higher percentage of trace compounds
  - Achieve threshold concentration
  - Use less ozone in the process
  - Multiple benefits include disinfection credit, disinfection byproduct control and trace contaminant destruction