



*The SAFEST WATER In The World*

Microflocculation

# MIOX & Microflocculation

- ▶ An emerging process option, gaining interest for a variety of applications
- ▶ MIOX is continuously investigating the use of Mixed Oxidant Solution (MOS) to induce microflocculation effect
- ▶ Microflocculation can improve performance and/or reduce cost
- ▶ Mixed oxidant solution-induced microflocculation may be right for your application



# What is Microflocculation?

- ▶ A reduction in coagulant demand for the same final (settled water) turbidity
- ▶ **OR** a reduction in final turbidity at the same coagulant demand.



# Benefits of MIOX MOS in Microflocculation

- ▶ Use of mixed oxidant solution in pretreatment can achieve lower settled turbidity levels and reductions of up to 40% in coagulant and polymer required.
- ▶ Customers report faster floc formation and improved settling due to the quality of the formed floc.
- ▶ Controlled dosing facilitates microflocculation while leaving a residual for filter (UF, MF) cleaning and maintenance.
- ▶ Disinfection by-product (DBP) formation can also be reduced due to increased removal of NOM during flocculation.



# MIOX Customers Report:

- ▶ Larger floc that forms more rapidly, even at colder temperatures
- ▶ Heavier floc conducive to good settling compared to chlorine dioxide and chlorine in pre-treatment
- ▶ Increased filter run times, fewer filter CIP cycles
- ▶ Formation of a vortex around the rotating paddle
- ▶ High degree of clarity in both the supernatant and the water between the floc particles
- ▶ Very low turbidity of the supernatant (typically < 0.1 NTU)



# Occurrence of the Microflocculation Effect Can be Predicted

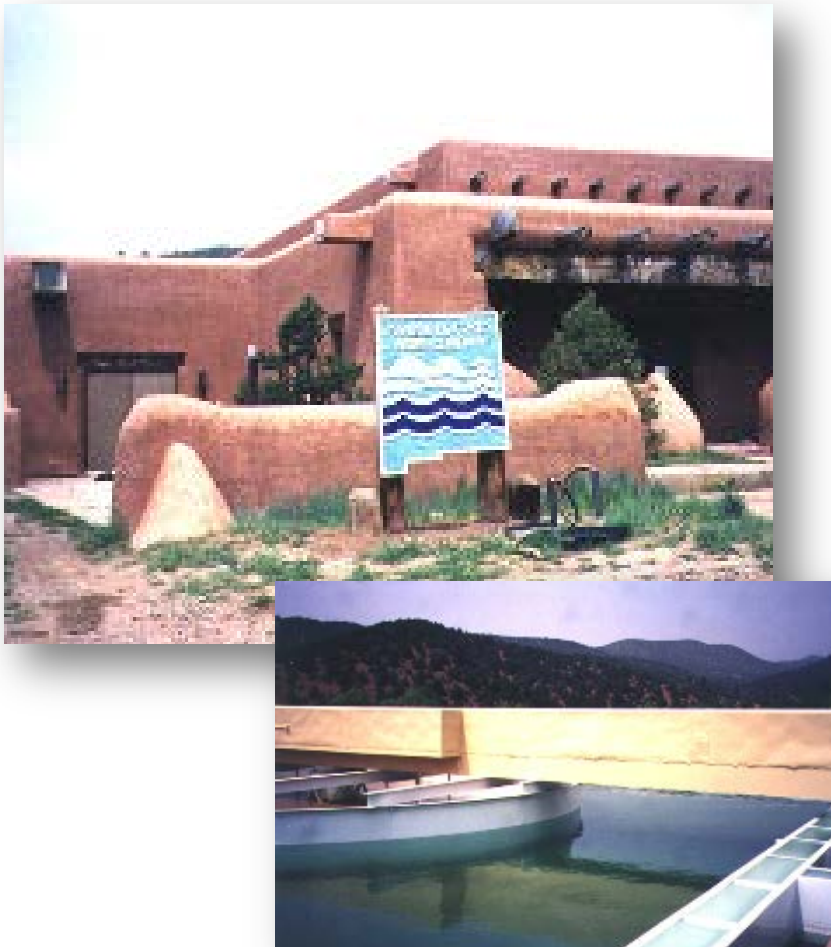
## MICROFLOCCULATION MAY OCCUR WHEN

- $\text{Ca}^{2+} + \text{Mg}^{2+}$  (as Ca)  $\div$  Dissolved Organic Carbon (DOC)  $\geq 10$
- Turbidity  $\div$  DOC
  - $> 0.5$  NTU/mg C/L if  $\geq 2$  NTU
  - $> 1.3$  NTU/mg C/L if = 2-10 NTU
  - $> 2$  NTU/mg C/L if  $> 10$  NTU

Source: Becker and O'Melia (1996)



# MIOX Solutions: Santa Fe, New Mexico



- ▶ 10 MGD SWTP, 6 well sites
- ▶ TTHMs:  
Reduced from  
>60 - >100  $\mu\text{g/L}$  to 33  $\mu\text{g/L}$
- ▶ Microflocculation:  
40% reduction in alum dose,  
settling achieved in <20 minutes,  
even at 38°F
- ▶ Settled Turbidity:  
Reduced from 0.6 NTU to 0.25  
NTU

# Microflocculation Prior to UF: Ider, AL

- ▶ Plant operators were interested in improving the flocculation and sedimentation steps due to the excessive filter backwashing and clean-in-place (CIP) procedures required for MF membranes
- ▶ Raw water analysis predicted a Mixed Oxidant Solution-induced microflocculation effect would occur year round at the DeKalb-Jackson Water Authority
- ▶ Jar tests confirmed the prediction



# Idler, AL Pilot Results

- ▶ Microflocculation effect due to MOS has halved settled turbidity values
- ▶ Filter run times have increased by 15 minutes
- ▶ CIP required 1x every 2 weeks, rather than once every 2 days

	Before MOS	After MOS
Settled Turbidity Average	>1.0 ntu	0.6 ntu
Settled Turbidity Highs	>3.0 ntu	1.5 ntu
Filter Run Times – Standard Backwash with filtered water	45 min	>60 min
Clean-in-Place	2 days	>14 days



# Filter Applications Demonstrate Improved Maintenance

- ▶ Santa Fe, NM – filter runs extended 50% with less water required
- ▶ KOA Kampground, MT– cleaning extended from 2-3 days to 3-4 weeks
- ▶ Las Vegas, NM – backwash cycle doubled from 48 to 96 hours
- ▶ Hazlet, Saskatchewan – backwash extended from 2X per week to once per week, with cleaning time reduced from 30 minutes to 15 minutes
- ▶ Tachikawa pool – cleaning needs have dropped by 2/3, and sand filters at the end of their life were totally renewed with several more years expected



# MIOX Solutions: McAllen, Texas



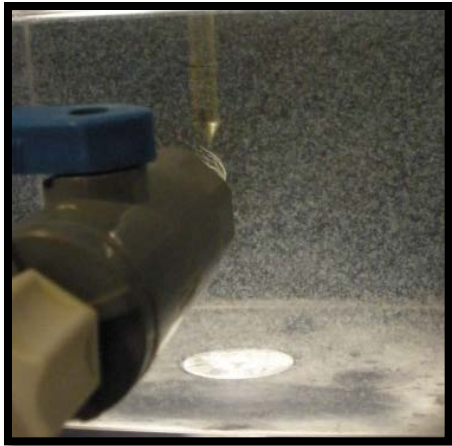
- ▶ Water obtained from Rio Grande, plant capacity is 8.2 MGD
- ▶ Microflocculation jar tests were conducted here and three other regional SWTPs in early 2009
- ▶ All plants showed evidence that MOS could be used to induce microflocculation

# MIOX Solutions: McAllen, Texas

- ▶ Jar tests at the McAllen North Plant in Texas successfully demonstrated the Mixed Oxidant Solution-induced microflocculation effect in these waters

<b>Jar Number</b>	<b>Aqualum dose (mg/L)</b>	<b>ClO<sub>2</sub> dose (ppm)</b>	<b>MOS dose (mL)</b>	<b>Settled Turbidity (NTU)</b>	<b>pH</b>	<b>Floc Size</b>
1	70	0.0	0.0	1.05	7.4	Pinpoint
2	65	1.4	0.0	0.93	7.5	Pinpoint/ pinhead
3	60	0.0	0.25	0.64	7.6	Pinhead /snowflake

# Floc from the MIOX MOS + Aqualum Test was Larger and Settled Faster.



Aqualum only



$\text{ClO}_2$  +  
Aqualum



Mixed Oxidant Solution +  
Aqualum

# Turbidity was Reduced using Less Aqualum when used with MIOX MOS

