

# TOC Removal

## Physical Removal of Particulates

Coagulation, Filtration

Enhanced

Precipitative (Lime) Softening

Enhanced

## Adsorption

Granular Activated Carbon

GAC

Powdered Activated Carbon

PAC

Anion Exchange Resin

MIEX

Macroreticular Resin

XE340

## Oxidation

$\text{KMnO}_4$ ,  $\text{O}_3$ ,  $\text{ClO}_2$

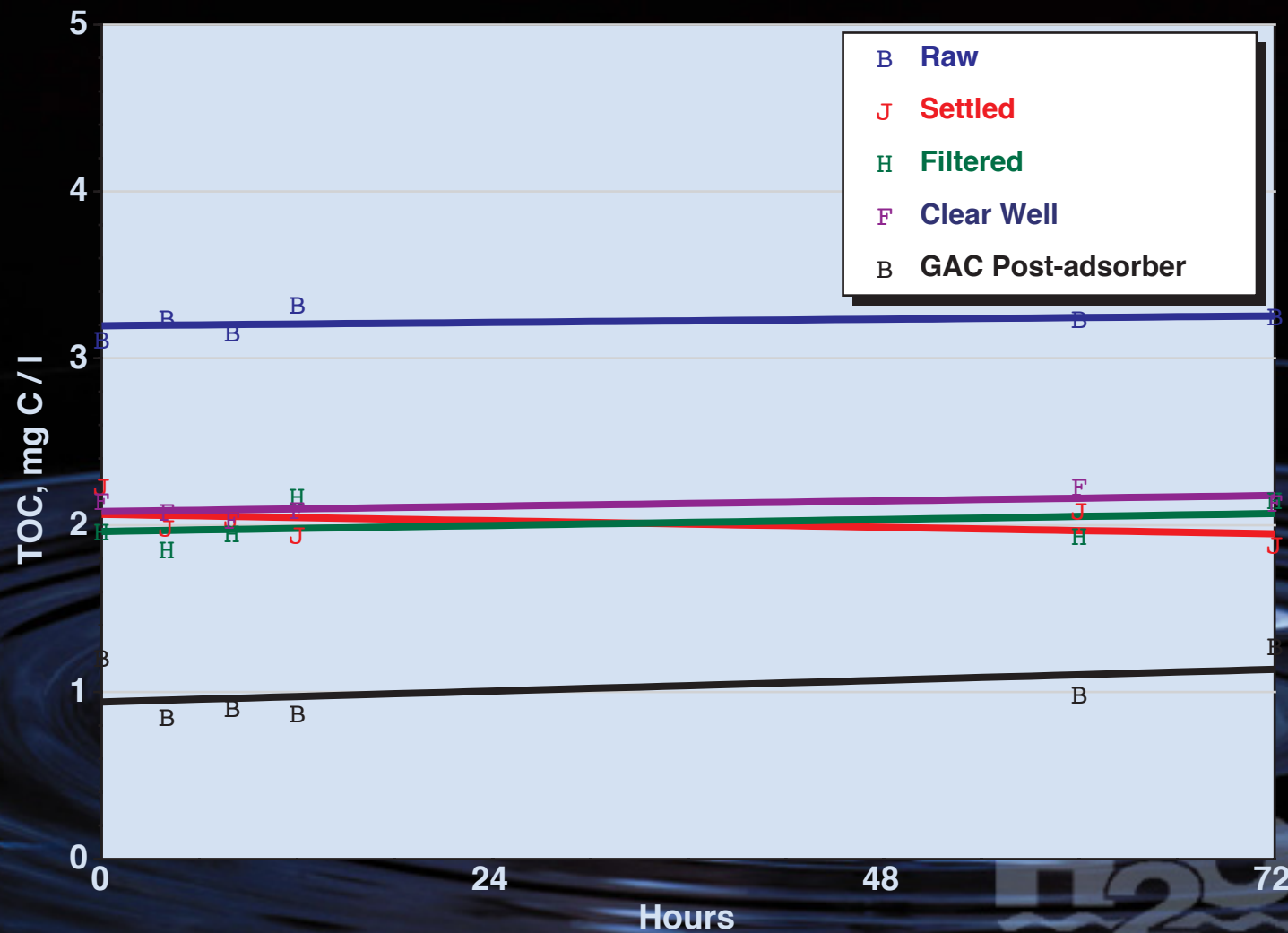
**H<sub>2</sub>O'C**  
ENGINEERING

A photograph showing a row of approximately 15 vertical glass columns, each containing a dark granular material (likely activated carbon) at the bottom and a lighter liquid or material above. The columns are mounted on a wooden frame and have various valves and pipes attached. The background shows a laboratory setting with a white door on the right.

# **Granular Activated Carbon**

**Fabricated at the University of Missouri-Columbia, the first pilot plant study of the removal of THM and TOC on GAC and macroreticular resins was conducted at the Kansas City water treatment plant in 1976-1977.**

# GAC Post-Adsorption for TOC





# THM Formation

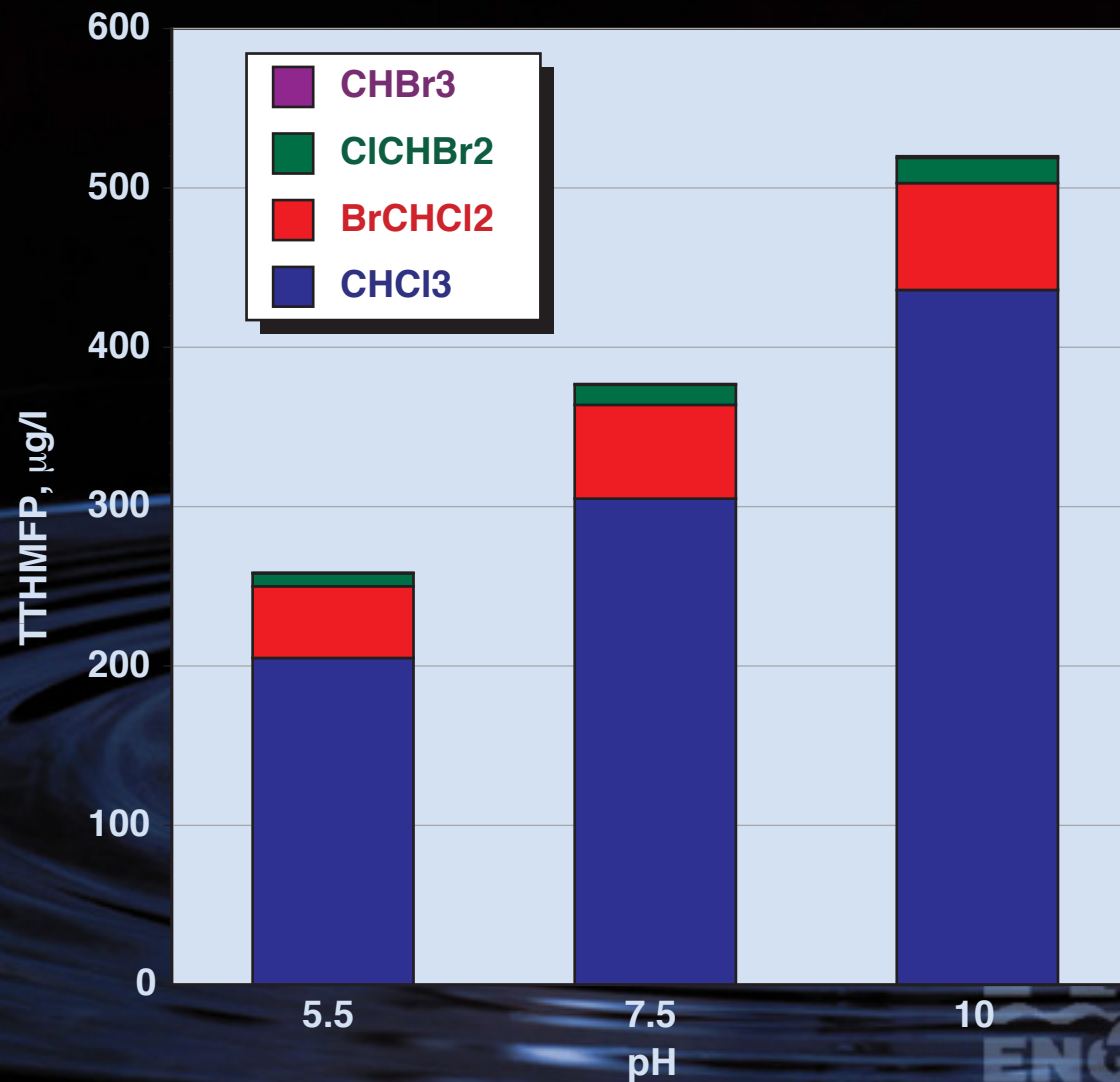
pH

Time

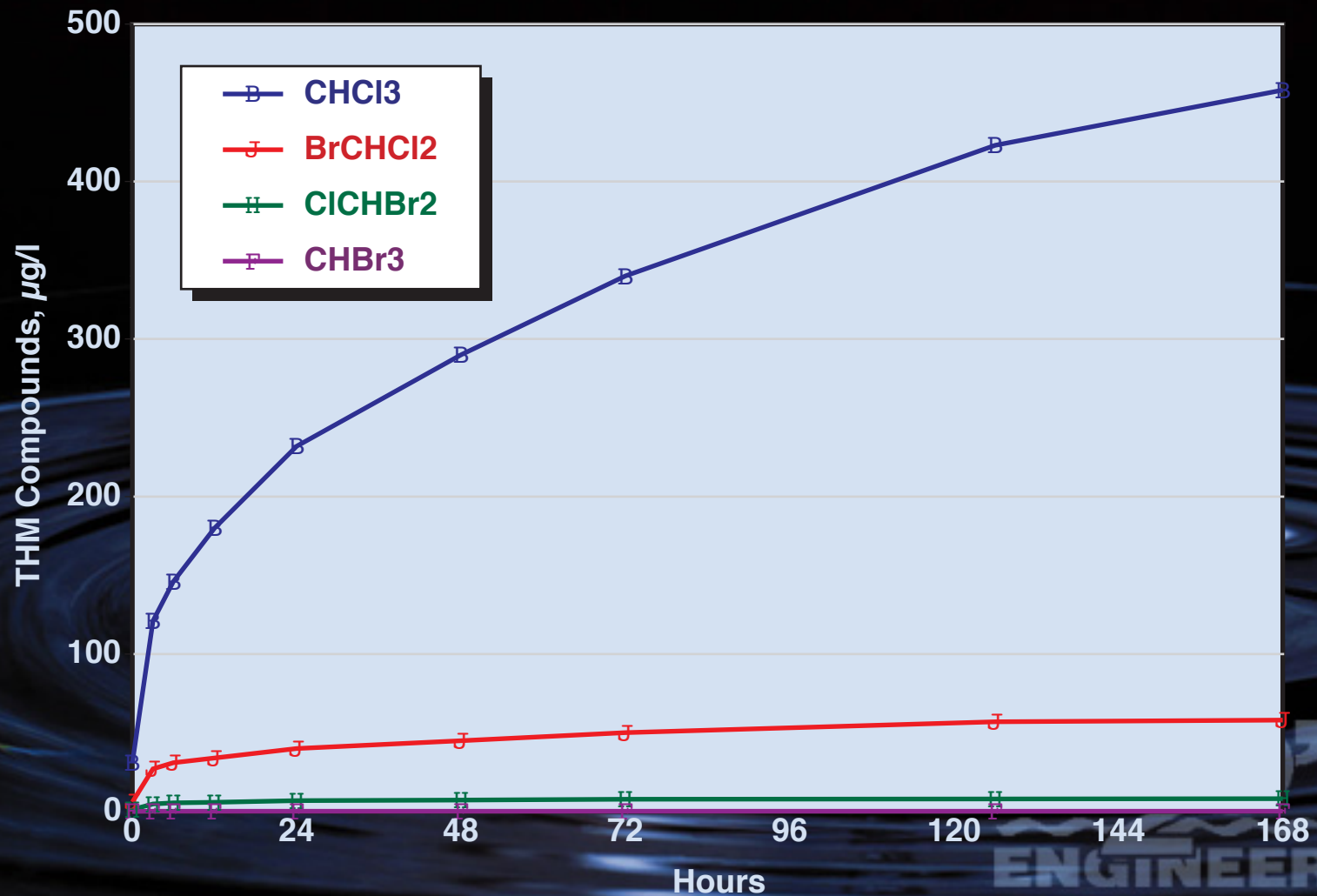
Temperature

H<sub>2</sub>O'C  
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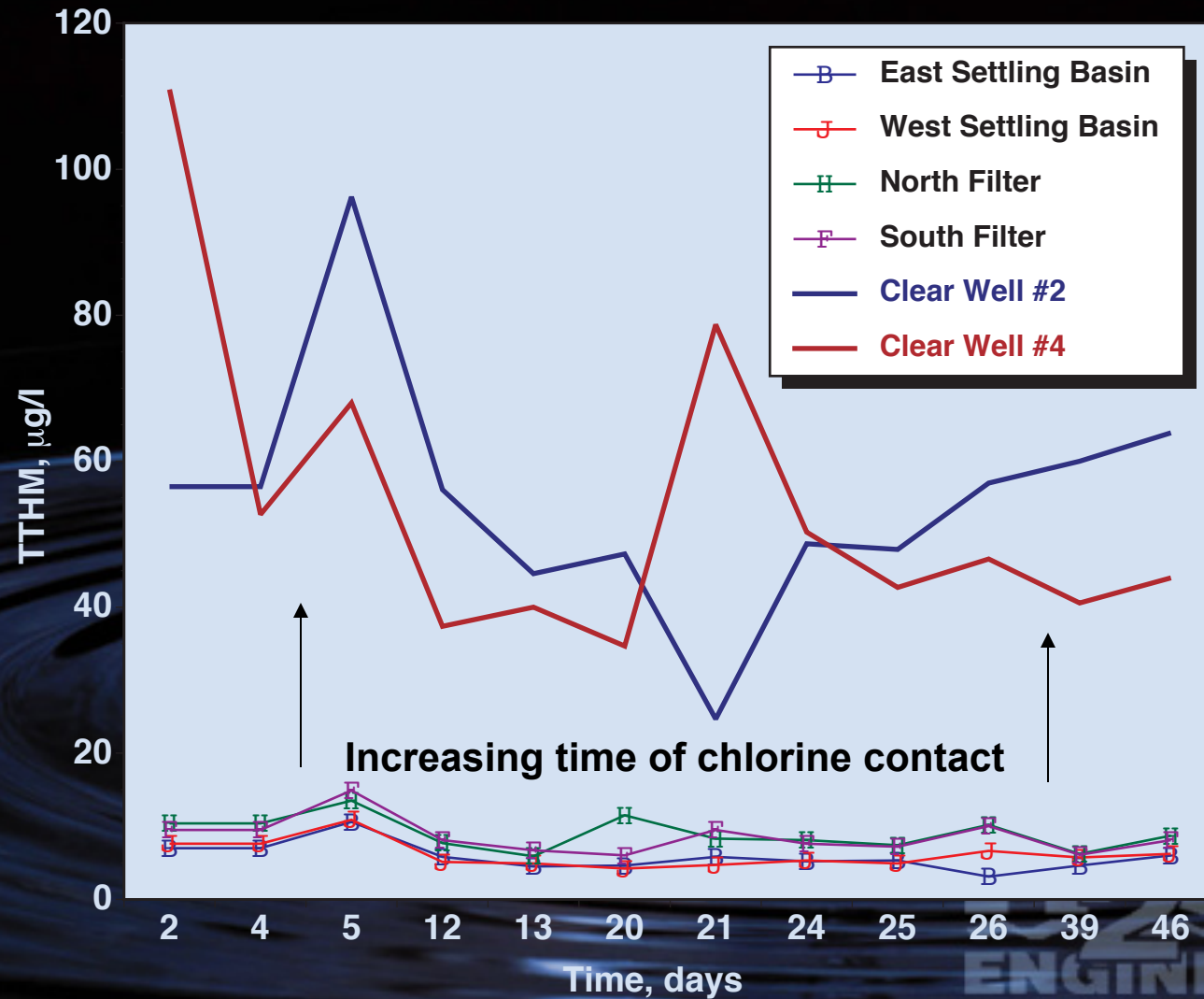
# Effect of pH on TTHMFP - St. Louis, MO



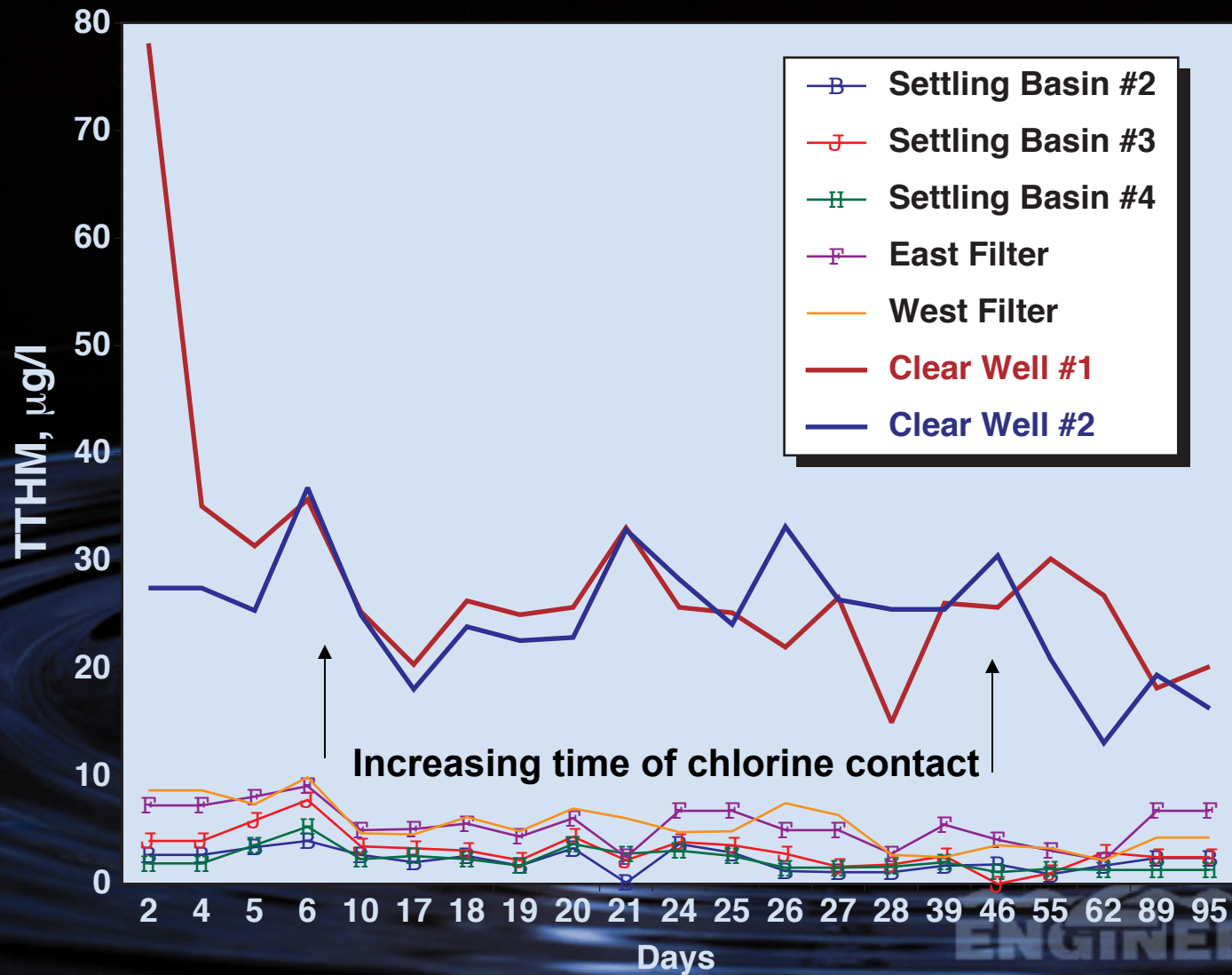
# Rate of TTHM Formation Mississippi River - St. Louis



# TTHM Formation During Treatment

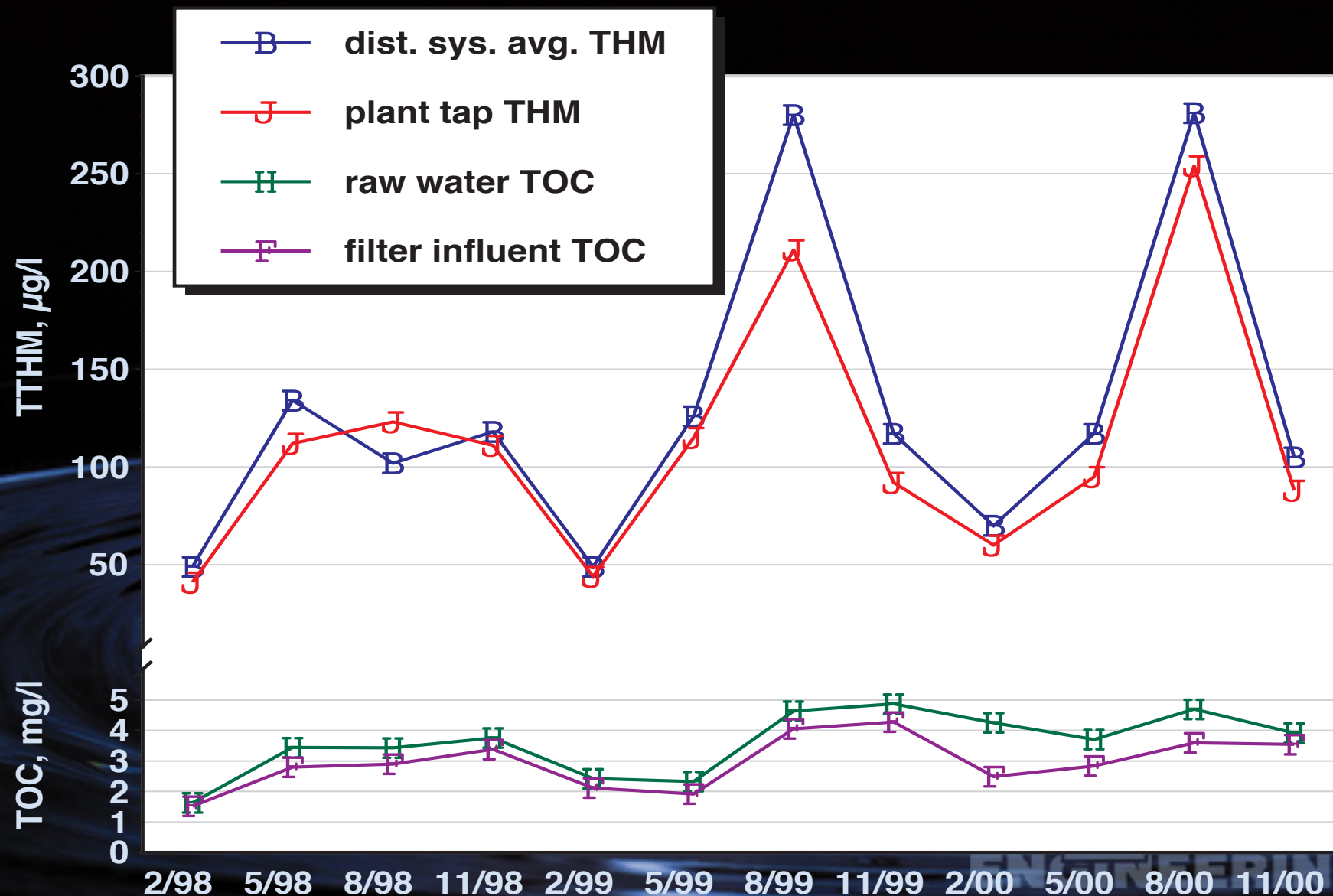


# TTHM Formation During Treatment

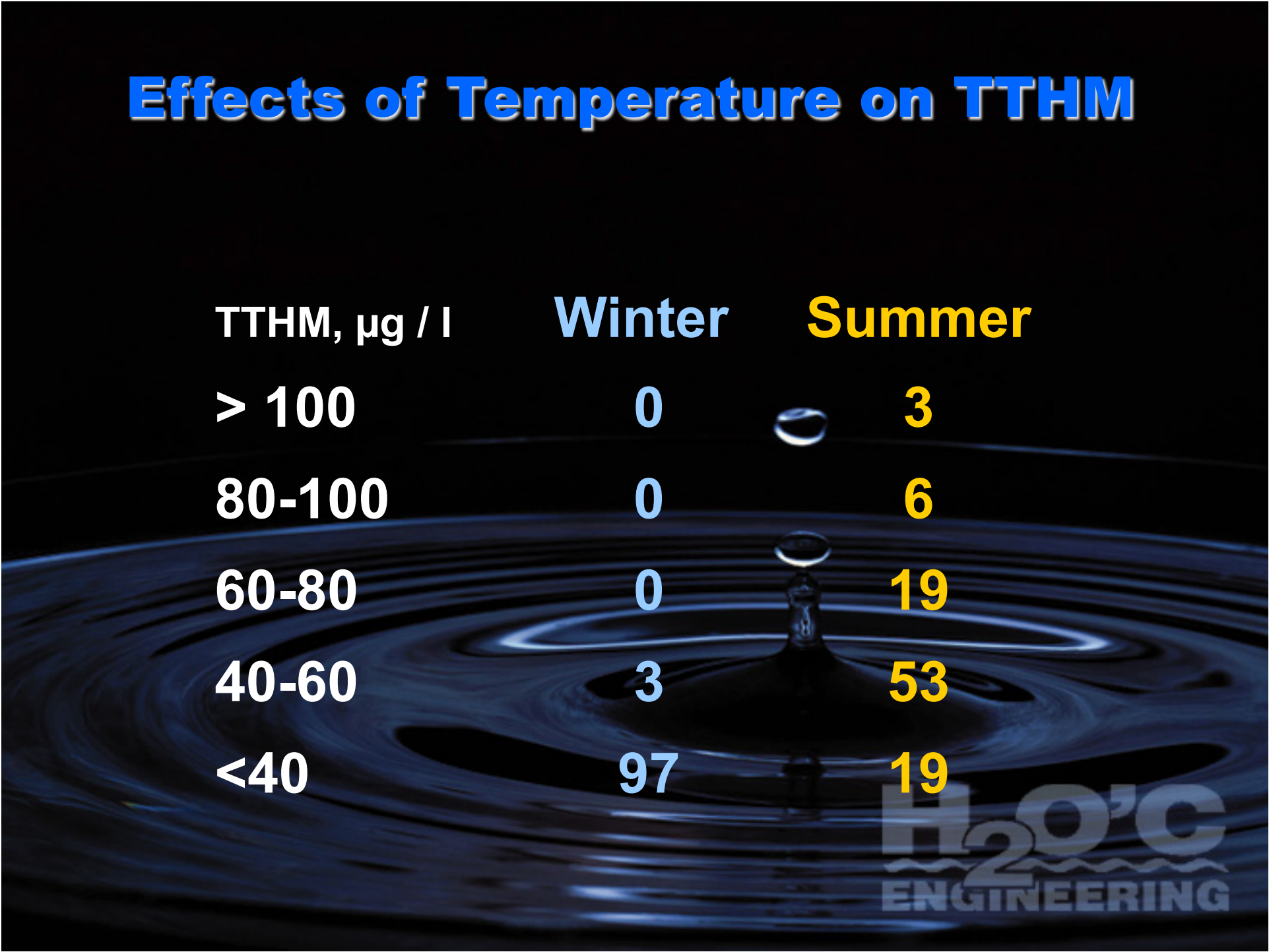




# Seasonality of THM Formation



# Effects of Temperature on TTHM



TTHM, $\mu\text{g} / \text{l}$	Winter	Summer
> 100	0	3
80-100	0	6
60-80	0	19
40-60	3	53
<40	97	19

**H<sub>2</sub>O'C**  
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# THM Removal

Aeration

Air stripping

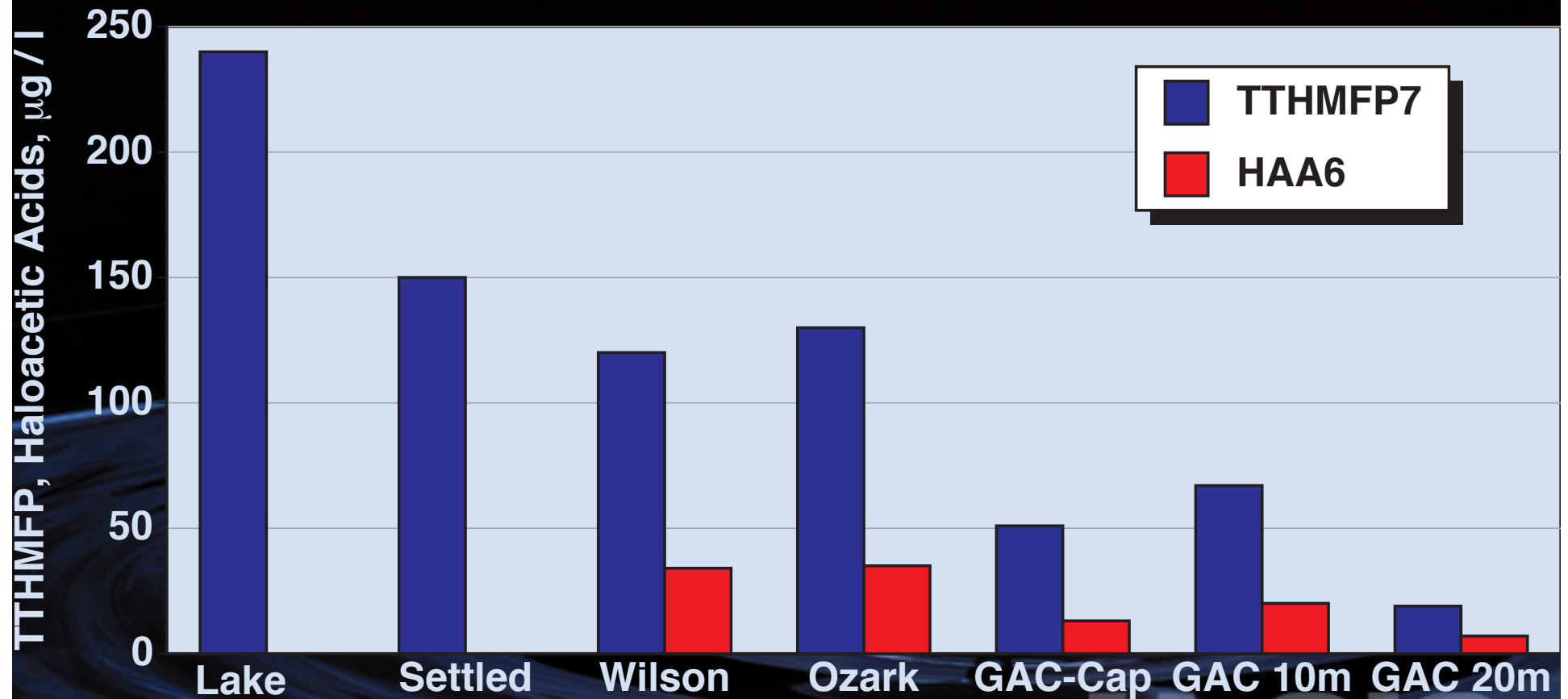
Adsorption

Activated Carbon

Synthetic Exchange Resins

H<sub>2</sub>O'C  
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# TTHMFP and HAA Removal on GAC



H<sub>2</sub>O'C  
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# Effect of PAC, $\text{KMnO}_4$ on TTHMFP

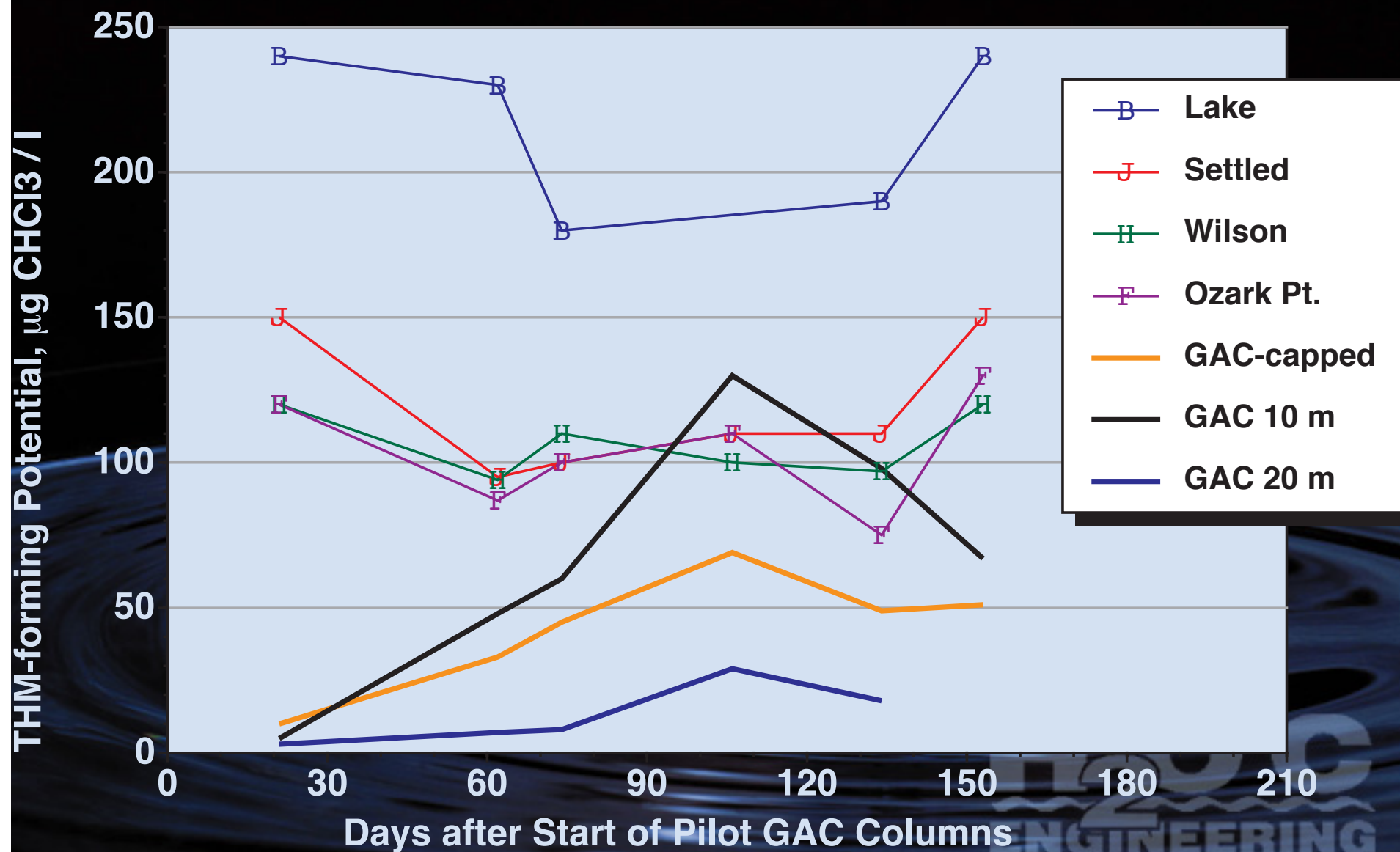


PAC

$\text{KMnO}_4$

PAC +  $\text{KMnO}_4$

# GAC Post-Adsorption for TTHMFP



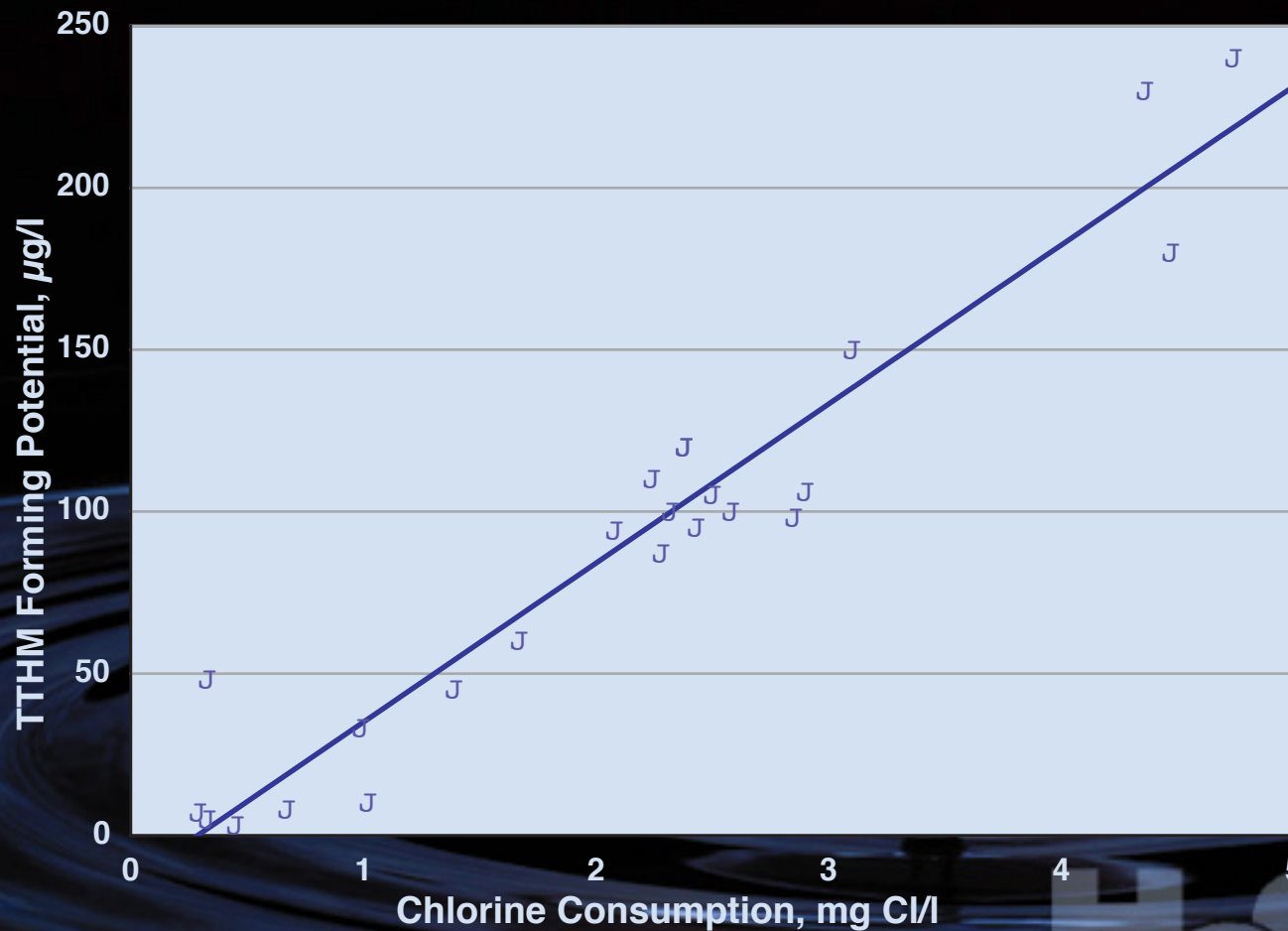
# **Trihalomethane Formation Potential (TTHMFP)**

**Determination of maximum potential for TTHM formation after seven days in distribution system**

- **Add chlorine to water in excess of seven day chlorine demand**
- **Measure TTHM after seven days**



# TTHMFP and Chlorine Consumption





# Dechlorination

Sulfur Dioxide	$\text{SO}_2$	$\wedge$	$\text{SO}_4^{2-}$
Sodium Sulfite	$\text{Na SO}_3$	$\wedge$	$\text{SO}_4^{2-}$
Activated Carbon	$\text{C}$	$\wedge$	$\text{CO}_2$