

# Disinfection of Wastewater with Peracetic Acid (PAA) and UV Combined Treatment: A Pilot Study

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## Disinfection & Reuse Symposium



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# Disclaimer

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# Need for Wastewater Effluent Disinfection

- Wastewater effluent is loaded with infectious agents such as bacteria, viruses, protozoans and helminths.
- These infectious agents must be inactivated before WW effluent can be discharged to protect public health.
- WWTP must comply with the permit limit for bacteria.

# Methods of Wastewater Disinfection

- Conventional Methods
  - Chlorine products: gas, liquid, solid.
  - UV irradiation.
  - Ozone.
- Alternative Methods
  - Peracids: Peracetic acid (PAA), Performic acid (PFA).
  - PAA+UV.

# Alternative Disinfection Methods At MSD

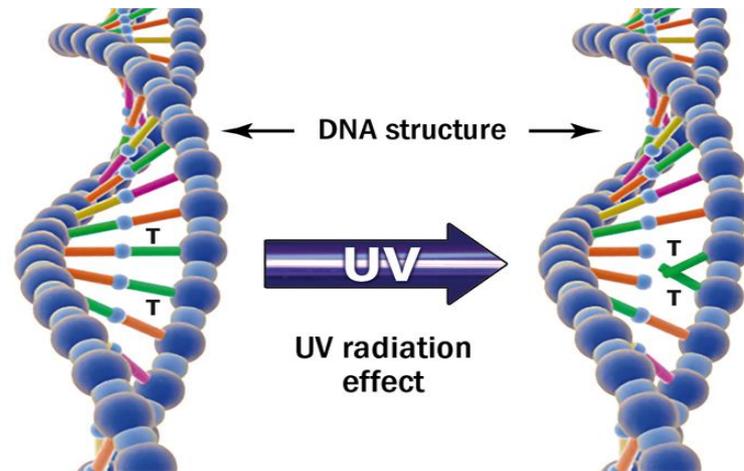
- In 2016, MSD conducted a pilot study at its Little Miami WW treatment plant with peracetic acid (PAA).
- PAA was supplied by PeroxyChem.
- Results suggest that PAA is a better disinfectant over sodium hypochlorite.
- Lower doses and shorter contact time needed.
- PAA disintegrated faster without producing known toxic disinfectant byproducts.

# Combining PAA with UV

- After successful pilot study with PAA, MSD looked at combining PAA and UV.
- MSD operates 5 WWTPs with UV disinfection system.
- Many reports suggest synergistic/additive effect of PAA on UV efficiency.
- Our lab studies show low dose PAA pre-treatment of effluent can significantly improve UV disinfection efficiency.

# Mechanism of Action: UV vs. PAA

UV Irradiation



PAA Treatment



# PAA-UV Study at Muddy Creek Plant

# Objective

Verify that PAA and UV combined treatment offers better disinfection than individual treatments in a full-scale field study.

# Muddy Creek Plant: Aerial View



# Muddy Creek Plant

- 15 MGD on an average day, capable of handling up to 30 MGD.
- Primarily domestic wastewater.
- Activated sludge treatment process.
- UV irradiation for disinfection.
- UV disinfection system is consisted of two banks.
- Each bank has 6 modules of 8 lamps each, i.e., 48 lamps/bank.

# Study Design

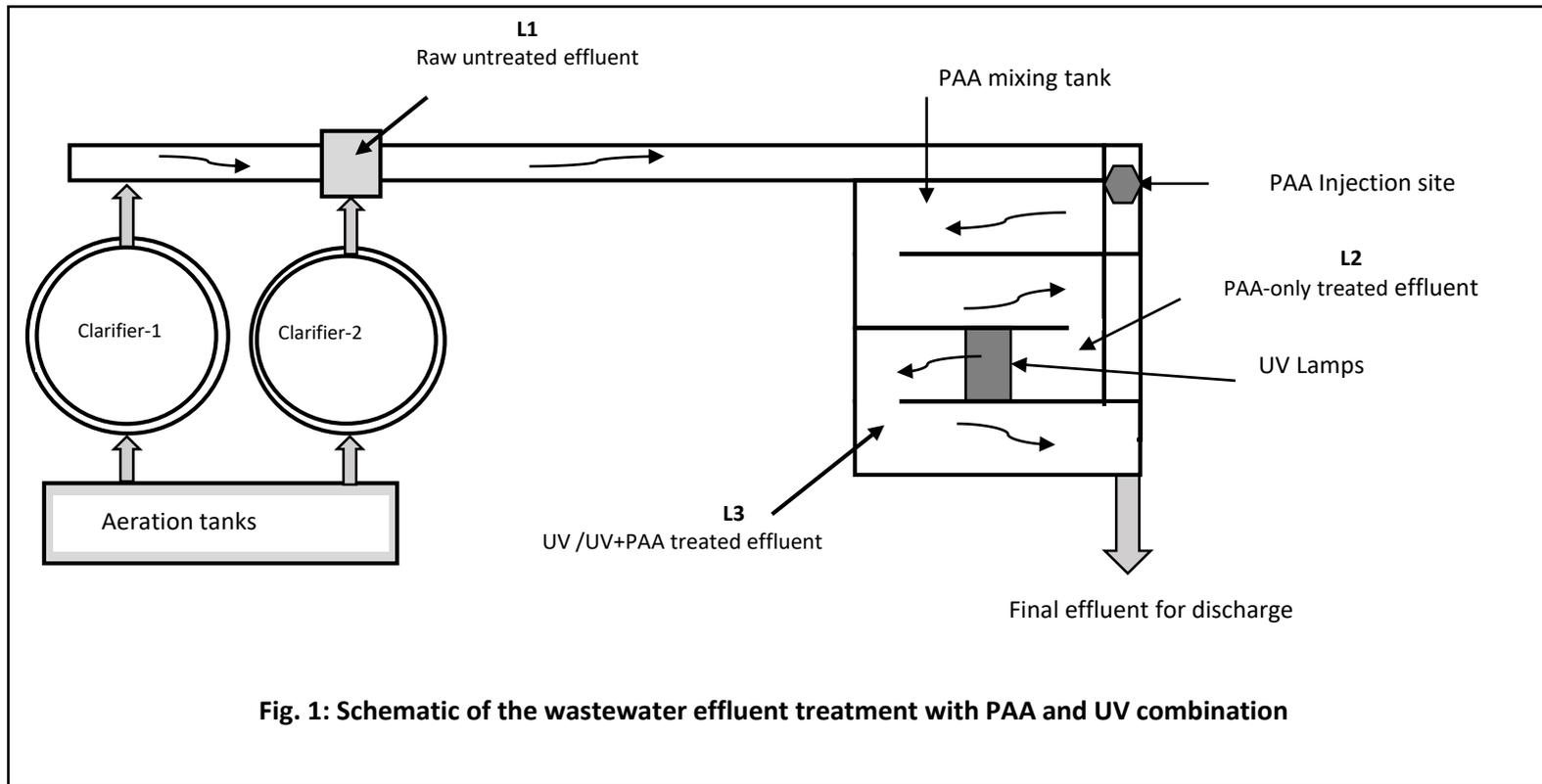
# Study Design.

- It was a full scale plant-level pilot study.
- Effluent was treated with UV, PAA individually or PAA-UV combination.
- For UV , two doses were used: 41 or 89 mJ/cm<sup>2</sup>.
- For PAA, four concentrations were used: 0.75, 1.0, 1.5, and 2.0 mg/L.
- For PAA-UV combination, both UV doses were combined with the four PAA doses.

# Study Design..

- Secondary effluent was characterized before and after the treatment.
- The following parameters were monitored:
  - pH.
  - Total suspended solids (TSS).
  - Chemical oxygen demand (COD).
  - E. coli.
  - Fecal coliform.
  - PAA residual.
  - Flow rate.
  - UV transmittance.
  - UV dose.

# Study Design: Sampling Sites



# Results

# Effect of PAA and UV combined treatment on E. coli inactivation

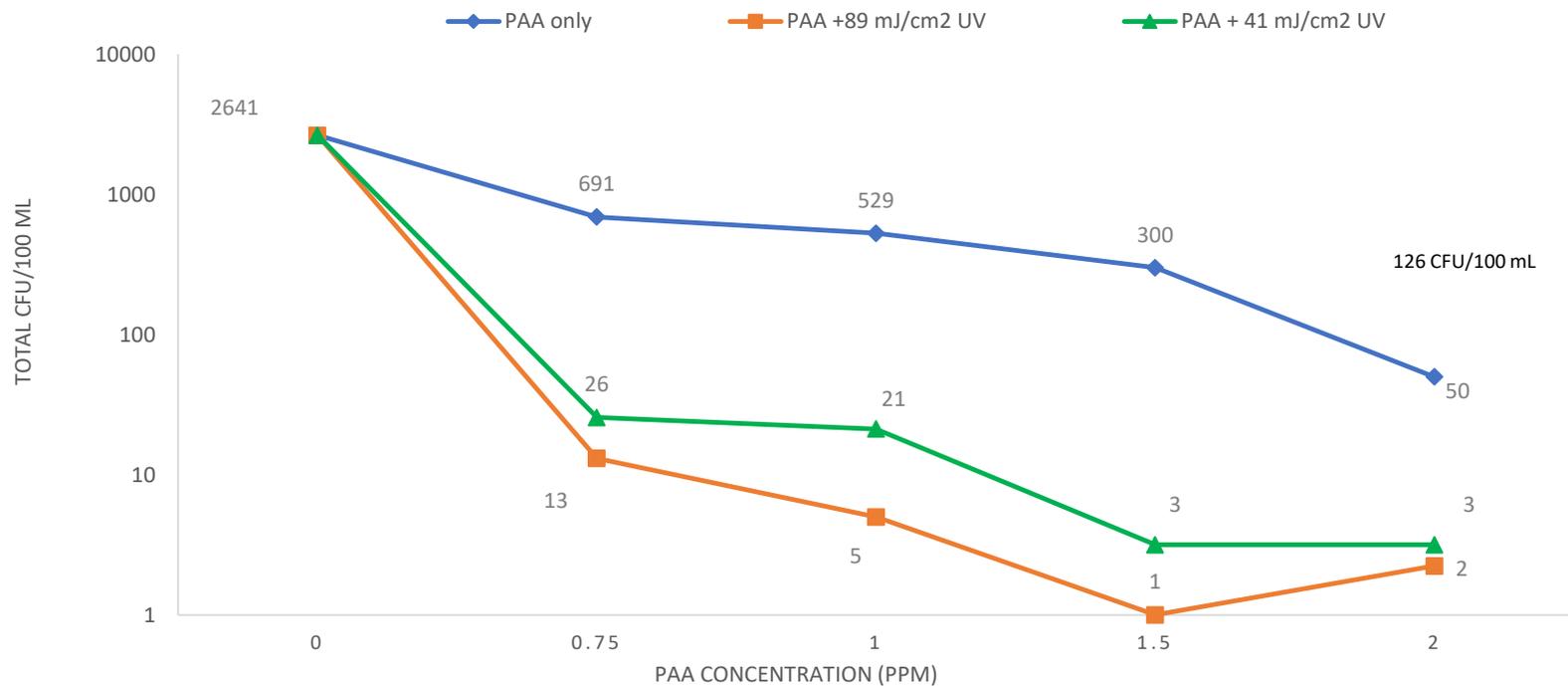
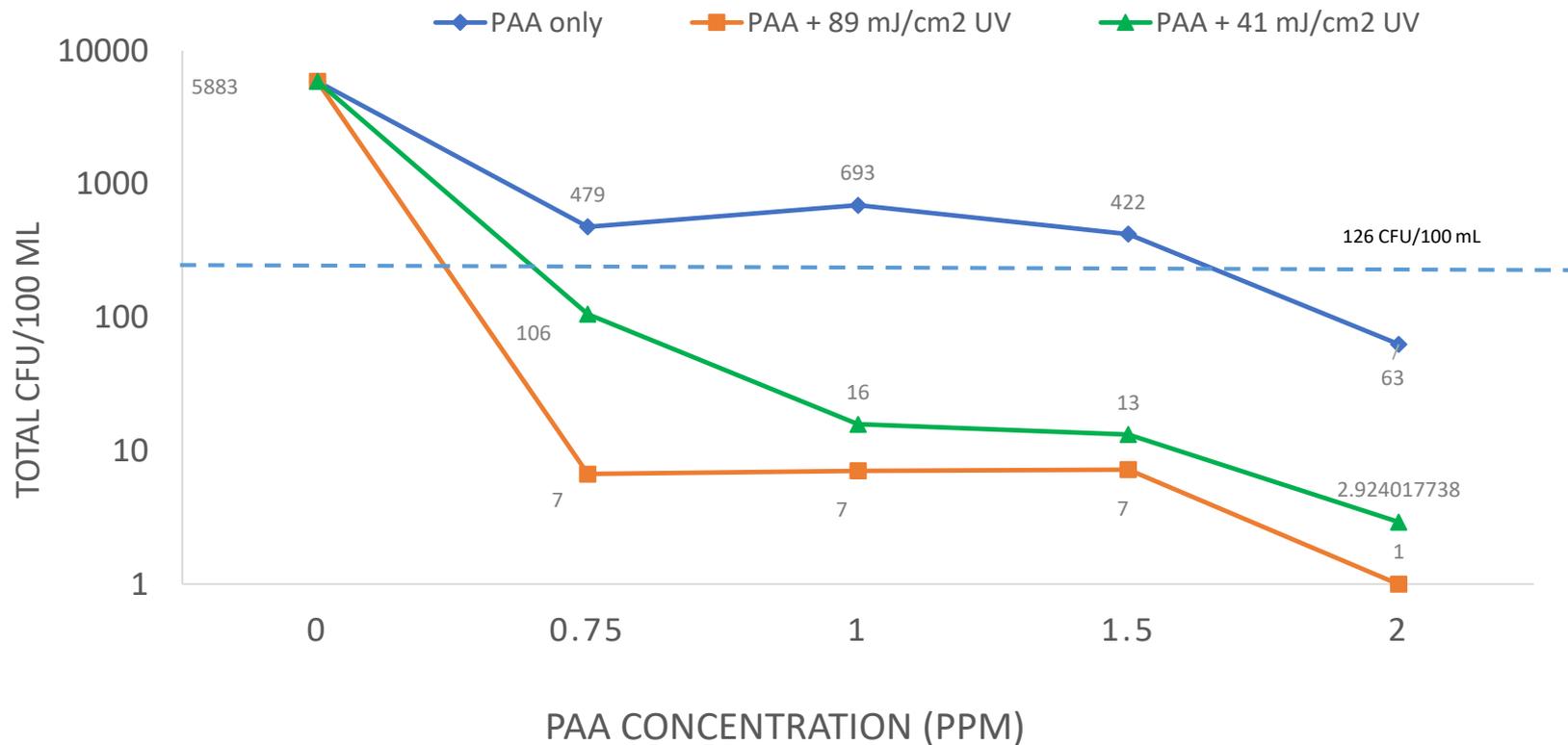
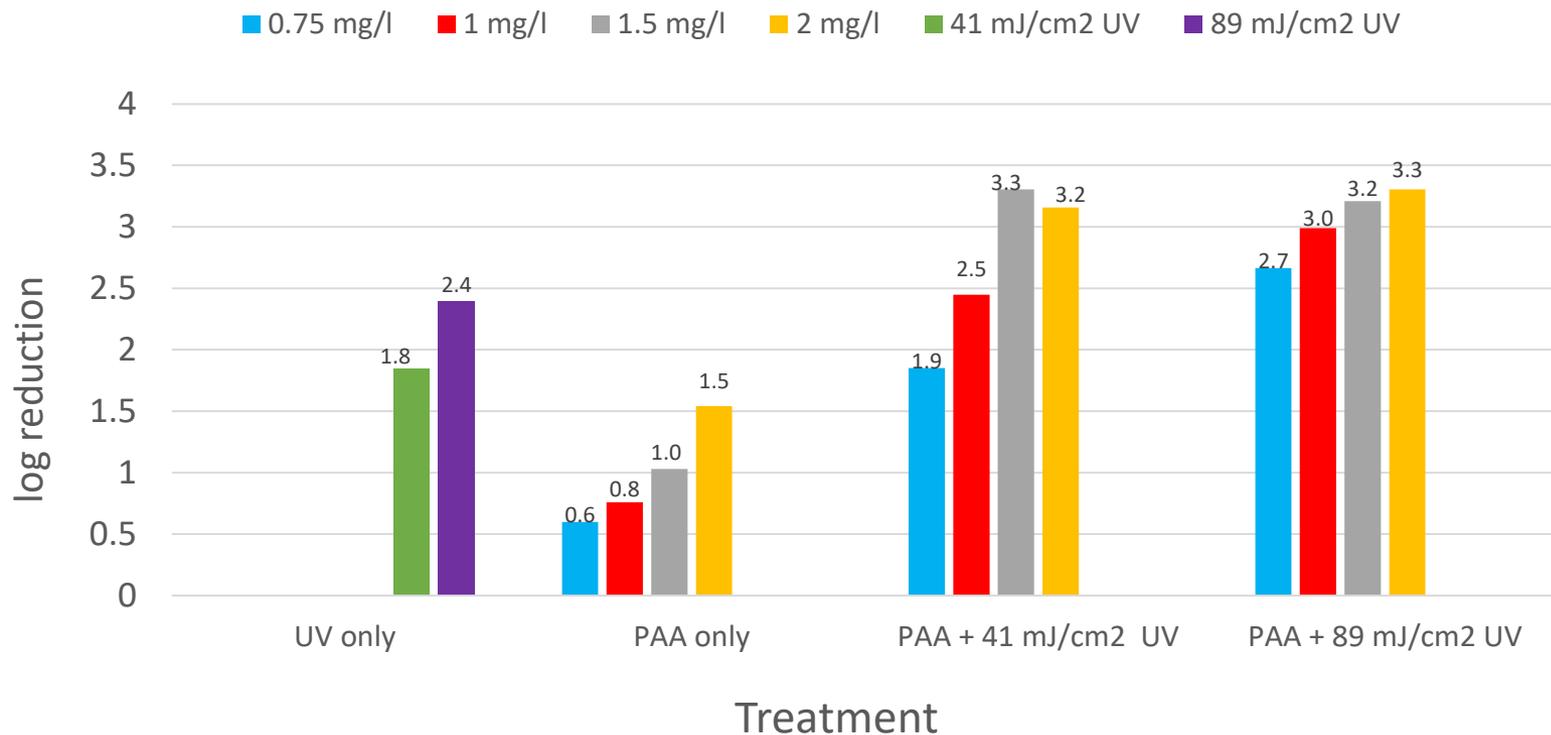


Fig 2- Effect of PAA and UV combined treatment on E. coli inactivation.

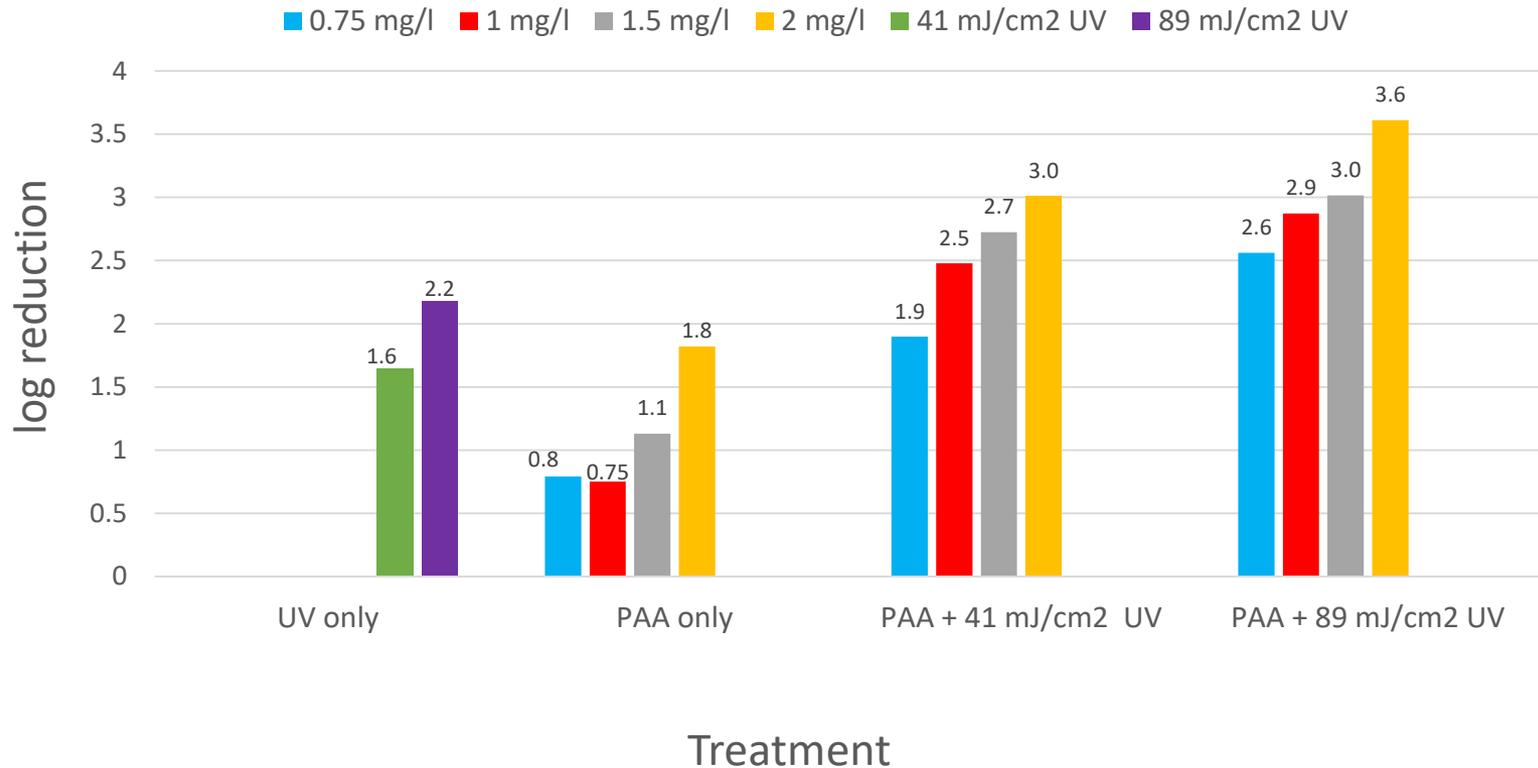
# Effect of PAA and UV combined treatment on fecal coliform inactivation



# Log reduction of E.coli after UV, PAA and PAA+UV treatments



# Log reduction of fecal coliform after UV, PAA and PAA+UV treatments



# PAA Residual (Arithmetic mean; mg/L)

PAA Residual (Arithmetic mean; mg/L)	
Dose	Residual
0.75	0.27
1	0.27
1.5	0.48
2	0.78

(Contact Time 20 min.)

# Effect of PAA on COD and TSS

Effect of PAA treatment on COD and TSS (values are arithmetic mean; mg/L)		
	Control	PAA only
COD	23	20
TSS	1.15	1.12

# Conclusions

- PAA and UV combined treatment is more effective in inactivating microbes.
- 1 mg/L PAA pre-treatment combined with 50% UV (41 mJ/cm<sup>2</sup>) dose can meet permit requirements.
- The increased disinfection efficiency is an additive effect of PAA + UV treatments.
- No synergism was observed.
- Low PAA residuals recorded 20 min after treatment.
- PAA-UV combination treatment has potential of saving energy and reducing treatment cost.

# Acknowledgements

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# Thank you

## Any Questions??