



# Oily Wastewater Treatment

*Dan Socci, CEO*

2014



The background of the slide is a composite image. The top and bottom sections show laboratory glassware, including beakers and test tubes, with a soft, blue-tinted light. The middle section is a solid green area with a fine, grid-like pattern. The text is centered in this green area.

Green Chemical Solution for Oil and Remediation Industries

# **ETHICALCHEM BACKGROUND**

# EthicalChem Background

- Recently acquired the intellectual property assets of VeruTEK Technologies Inc.
- Provides plant-based, green chemical solutions for the oilfield and remediation industries

| <b>Oilfield Technologies</b>   | <b>Remediation Technologies</b>   |
|--|---|
| <ul style="list-style-type: none"><li>• Viscosity reduction</li><li>• Demulsification</li><li>• Drilling muds removal</li><li>• Wellbore cleaning</li><li>• Oily wastewater separation</li></ul> | <ul style="list-style-type: none"><li>• SEPR<br/><i>(Surfactant Enhanced Product Recovery)</i></li><li>• S-ISCO<br/><i>(Surfactant-enhanced In Situ Chemical Oxidation)</i></li></ul> |

The background of the slide is a composite image. The top and bottom sections show laboratory glassware, including a beaker and test tubes, with a soft, blue-tinted light effect. The middle section is a solid green area with a fine, grid-like pattern. Overlaid on the bottom part of the green area are faint, semi-transparent chemical structures and molecular formulas, such as  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{C}$ , and  $\text{H}_2\text{O}$ , which are slightly out of focus.

Green Chemical Solution for Separation of Oily Wastewater

# **HOUSTON AREA CASE STUDY**

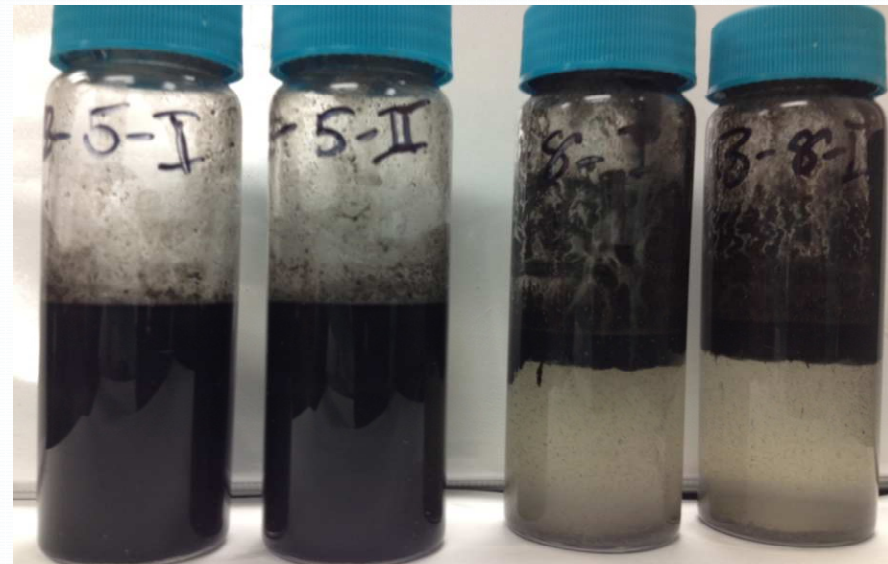
# Background

- Oilfield service company
- Large tanks of oily wastewater
- Exceeds local TX discharge limits for multiple parameters
- Primary goal of reducing hydrocarbons in water
- Sent samples to EthicalChem lab



# Lab Testing

- Bench scale tests were conducted to determine treatment conditions
- EthicalChem's Green-synthesized Nano-iron Activator (GnA) was evaluated with hydrogen peroxide
- Excellent separation achieved
- Tests conducted in duplicate

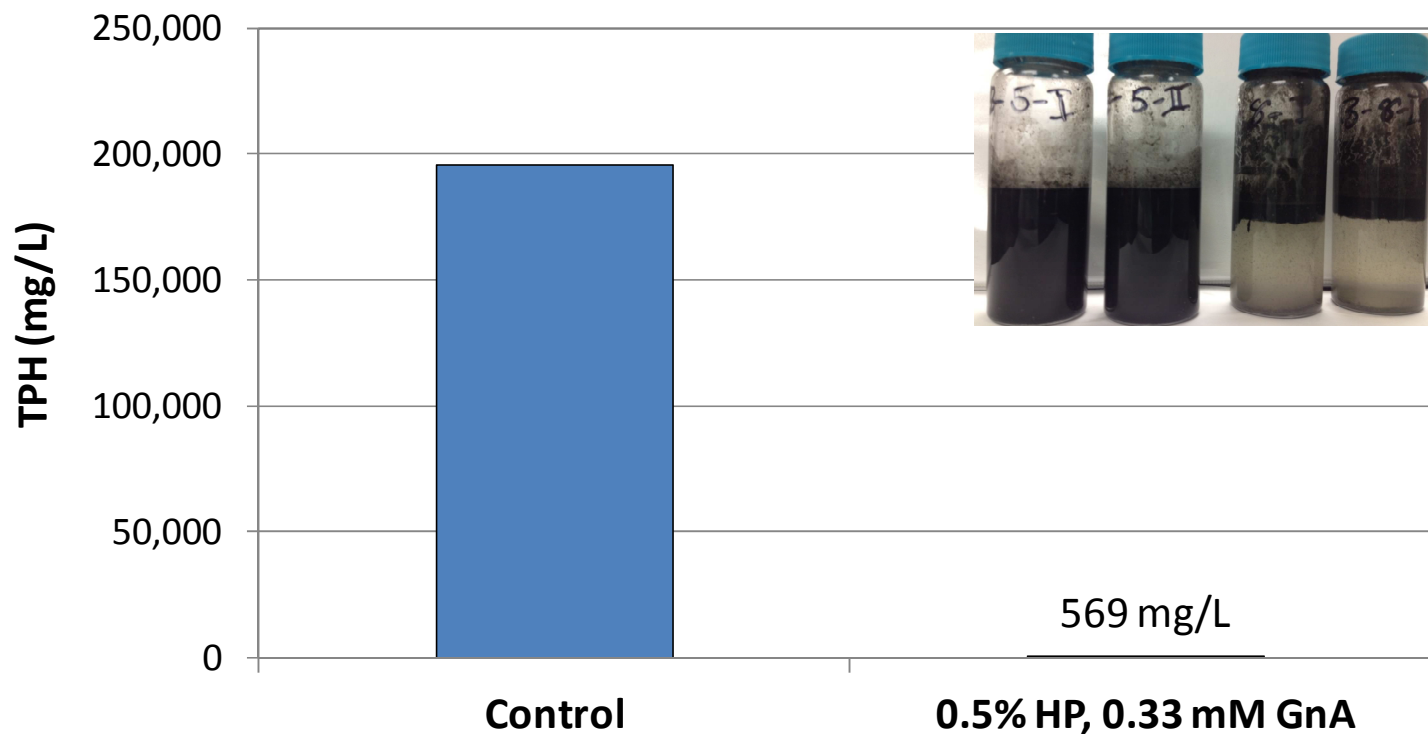


Controls

Treated

# Houston Area Case Study

## Oily Wastewater Treatment Aqueous Phase TPH Concentrations



Notes:

1. Post treated sample had 2 phases, TPH analysis represents the aqueous phase
2. Results represent average of 2 duplicates

# Full Scale Trial

- Successful results led to full scale trial at facility
- 15,000 gallons treated
- GnA and peroxide were pumped simultaneously into tank
- Dosing and recirculation lasted 2.5 hrs
  - 1.6 GPM GnA dosing
  - 4 GPM peroxide dosing
  - 120 GPM recirculation
- Tank was left to settle overnight





# Results

Oily wastewater separated overnight following treatment

Oil and water phases were analyzed

- 2,000 gallons (of 15,000) was usable oil
  - Oil was 96% pure
- Water met discharge limits and is reused in other cleaning applications at the facility



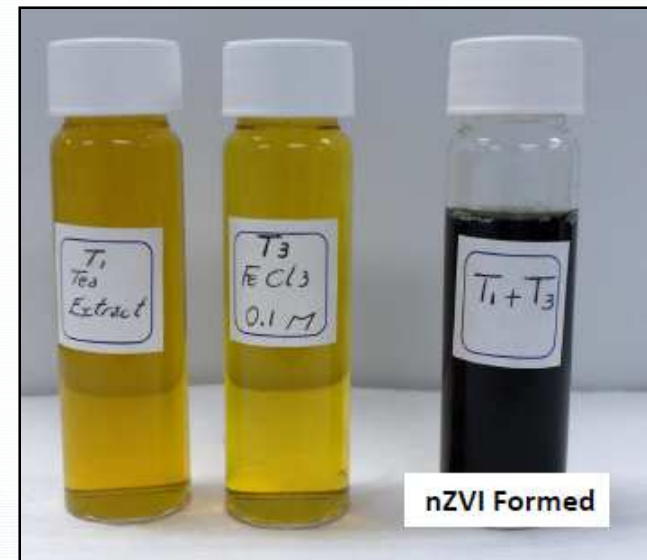
The background of the slide is a composite image. The top portion shows a close-up of a glass beaker containing a clear liquid, with a blurred laboratory setting in the background. The bottom portion features a green grid pattern overlaid on a faint image of chemical structures and laboratory equipment. The text is centered on the green grid.

Green-synthesized Nano-Iron Activator

# **GNA TECHNOLOGY**

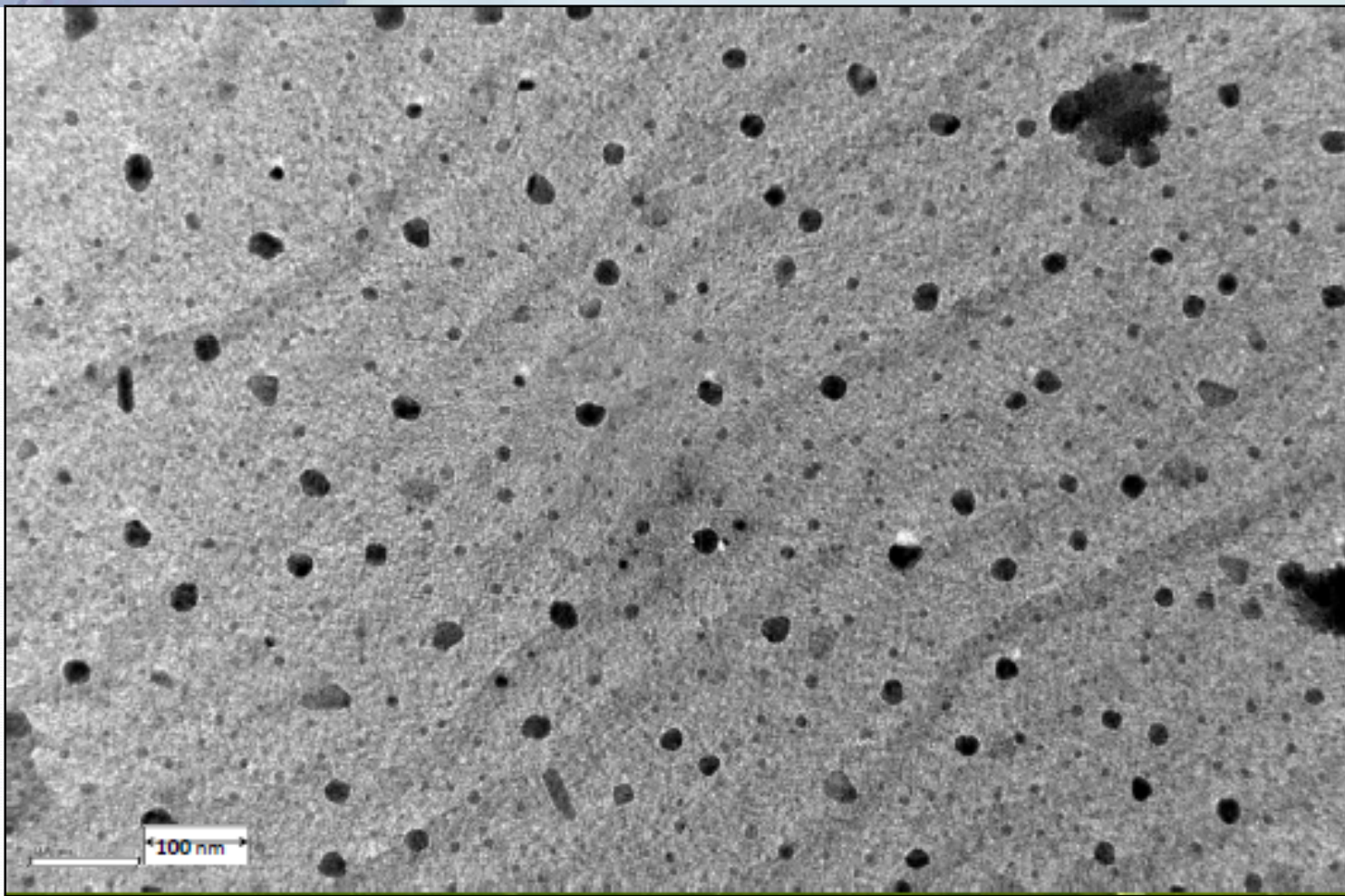
# Synthesis of GnA

- Developed in collaboration with US EPA
- Nano-iron synthesized through a non-hazardous process
- Metal salt + polyphenols = metal nanoparticle
- Nano size creates increased surface area of iron resulting in enhanced activation of peroxide



# Synthesis of GnA

TEM image of GnA Synthesized Using  $\text{FeCl}_3$  and Polyphenols



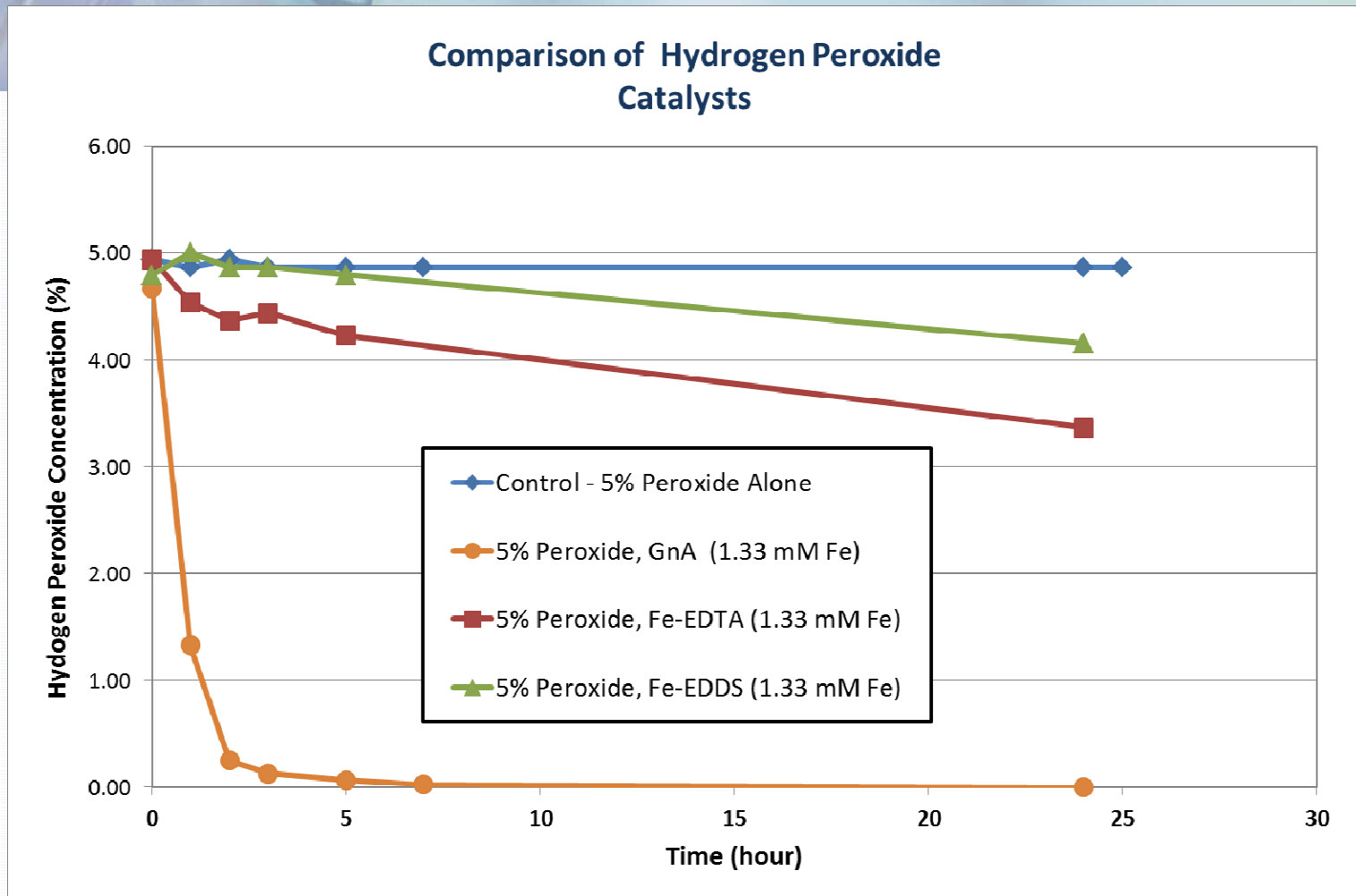
Particle Size = 10-200 nm

# GnA Activation of Peroxide

Early study was conducted by EthicalChem to compare GnA against two conventional chelated iron activators.

- GnA was tested against two chelated iron activators – FeEDTA and FeEDDS for activation of peroxide
- All activators were tested at 1.33 mM (concentration as iron)
- Initial concentrations of hydrogen peroxide were 5% in each reaction
- Hydrogen peroxide concentration was measured over time

# GnA Activation of Peroxide



➤ GnA activates peroxide significantly faster than the chelated iron

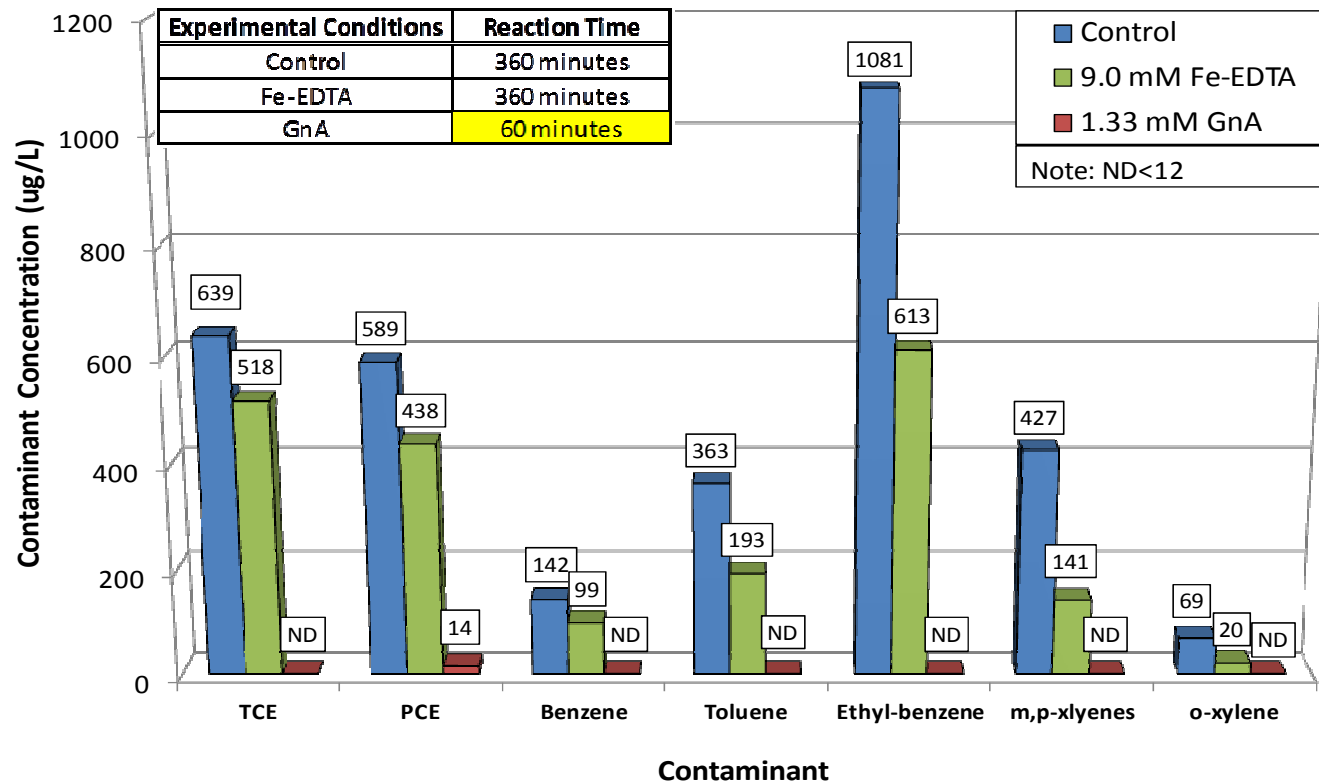
# GnA Activation of Persulfate

A third-party study was conducted to compare GnA vs FeEDTA activation of sodium persulfate on VOC destruction.

- Effectiveness measured on rate of contaminant destruction (BTEX, TCE, PCE)
- Test Conditions:
  - 5 g/L sodium persulfate used
  - Lower Fe doses in GnA than FeEDTA:
    - GnA at 1.33 mM Fe
    - FeEDTA at 9.0 mM Fe
  - Reaction Times:
    - Control = 360 min
    - FeEDTA = 360 min
    - GnA = 60 min

# GnA Activation of Persulfate

**Destruction of Contaminants with 5 g/L Sodium Persulfate  
VeruTEK's Green Nano Activator (GnA) vs Fe-EDTA**



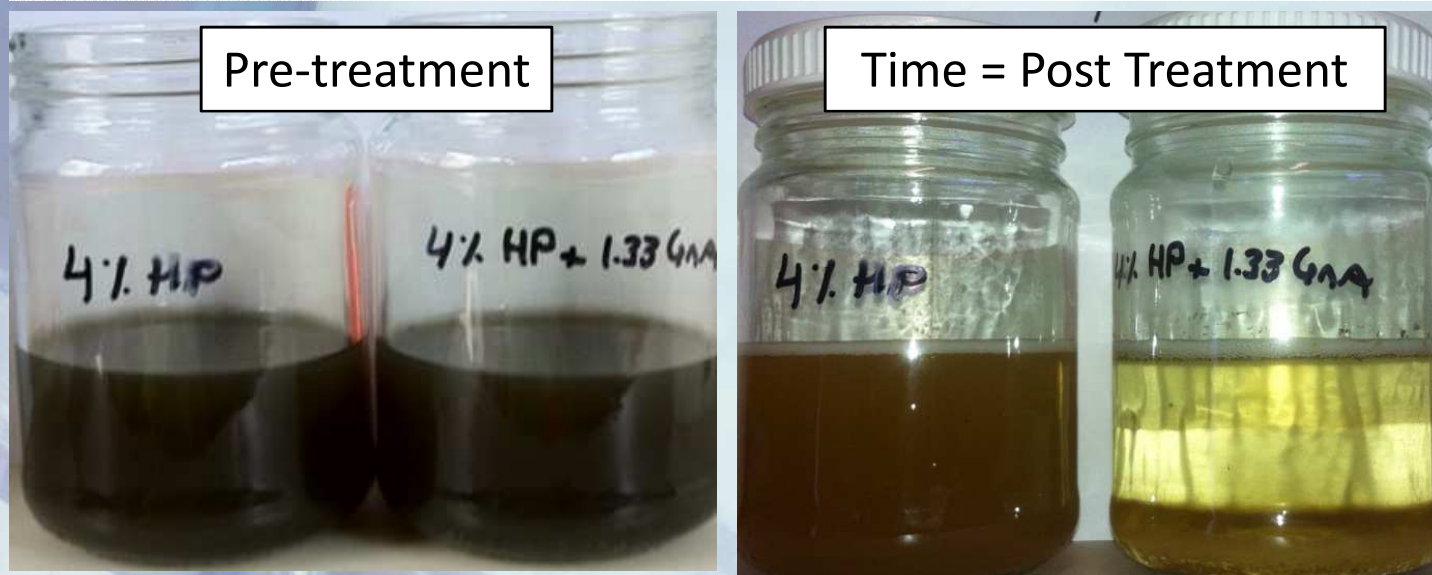
➤ **GnA activates the persulfate more rapidly for effective contaminant destruction**

- *After 60 minutes, GnA activated persulfate destroyed 100% of TCE, benzene, toluene, ethyl-benzene and total xylenes relative to the control*



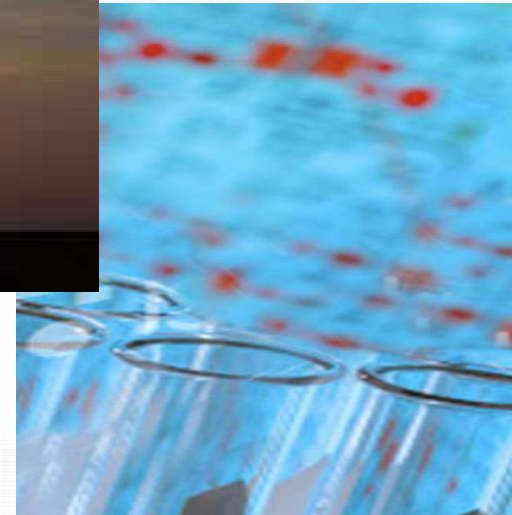
# GnA Treatment of Extracted MGP Fluid

- Treatment of wastewater tanks after implementation of SEPR
- Left Jar – 4% Hydrogen peroxide only
- Right Jar – 4% Hydrogen peroxide with 1.33 mM GnA



- TPH Concentrations:
  - Initial = 1,302 ppm
  - Day 5:
    - ❖ 4% HP = 348 ppm
    - ❖ 4% HP with 1.33 mM GnA = 22.1 ppm

# Thank you.



**EthicalChem  
USA**

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