

# An experiment on rust and scale inside water pipes with IOREX

Experiment Institution : FP Innovations

Experiment Period : July, 2017 - Present

## An experiment on Corrosion control of water pipes with IOREX

ผลทดสอบ “การใช้ IOREX ควบคุมยับยั้งการผุกร่อนของท่อน้ำประปา”

### Materials and Methods

1. Conditions (2 total): steel pipe ; with and without IOREX system
2. Flow rate: 0.5 m/sec , Water source: tap water , Temperature: 25 °C ± 2 °C
3. Test running time: 336 hours (water samples to be collected every 72 hours for a total of 30 samples).  
\*14 days

### ■ Corrosion Rate by Weight Loss Calculation

Sample	Weight loss (mg)	Corrosion rate (mpy)
CS - IOREX	10.14	1.80
CS - IOREX	10.01	1.77
CS	13.16	2.33
CS	12.68	2.25

The average corrosion rate :

with IOREX 1.79 mpy, without IOREX 2.29 mpy.

→ The result seems to indicate that the corrosion rate was relatively reduced by 21.8% with IOREX. \*14 days

\* Corrosion data from Experiment

\*\*With IOREX = สามารถลดอัตราผุกร่อนลง 21.8% ภายใน 14 วัน / 2 สัปดาห์

### ■ Visual Comparison

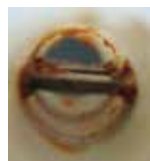
Carbon steel pipes after being exposed in the water loops for 336 hours. (Left) with IOREX system, (right) pipe exposed without the IOREX filter



(inner surface)



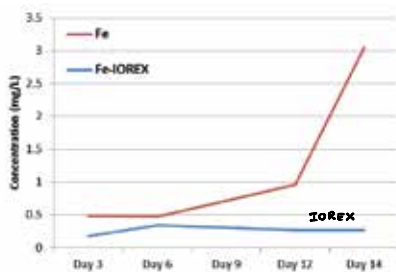
(surfaces and in the surrounding areas)



Without IOREX system had a lot more deposits (relatively large, dark and round). \*14 days

\*\*With IOREX = สามารถป้องกันการก่อตัวของตะกรันและไบโอฟิล์ม ไม่ให้จับตัวที่ท่อ

### ■ ICP (Inductively Coupled Plasma) Analysis



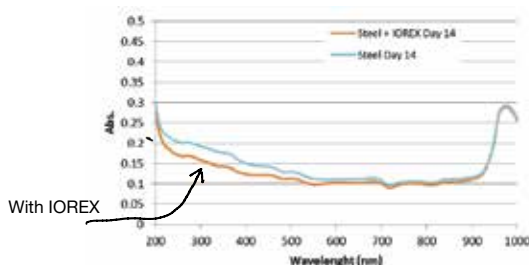
ICP analysis : The water without the IOREX system had 11 times more dissolved iron ions by the end of the test.

→ The result seems to indicate that IOREX is very efficient in control rusting process.

\* ICP Results for Experiment

With IOREX = มีปริมาณ เหล็ก ที่ละลายน้ำต่ำมาก แสดงถึงมีประสิทธิภาพที่ดีมากในการหยุดและยับยั้งกระบวนการเกิดสนิมได้เป็นอย่างดีมากกว่าปกติมากถึง 11x เท่า

### ■ UV –Visible Measurements



With IOREX system had lower UV light absorbance after the end of the test.

→ The results seems to indicate that accelerated corrosion is relatively low with IOREX.

With IOREX = ท่อมีการดูดซับ UV น้อยกว่าแสดงว่า ท่อมีอัตราการผุกร่อนต่ำ

Without IOREX = ท่อมีการดูดซับ UV สูงกว่าแสดงว่า มีอัตราการผุกร่อนที่มากกว่า

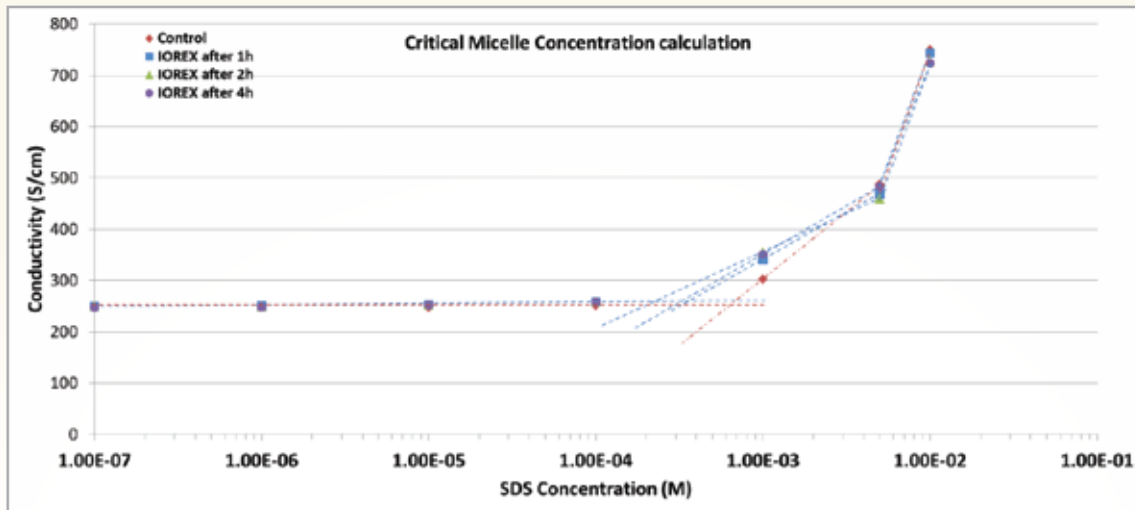
\* Effect of IOREX on water absorbance values by day during Experiment

# An experiment on water softening effect with IOREX

ผลทดสอบ : “ประสิทธิภาพของการทำให้น้ำอ่อนตัวลง ด้วย IOREX ”

## Materials and Methods

1. Measure the critical micelle concentration (CMC) using sodium dodecyl sulfate (SDS) as surfactant
2. 100 ppm of CaCl<sub>2</sub> was added to the test water to simulate moderate hardness conditions.
3. The conductivity was measured 1, 2 and 4 hours after the addition of SDS into the water loops.
4. The temperature was controlled at 25 °C ± 2 °C, and the water flow set a 0.5 m/s.



\* CMC Calculation for the control loop and the loop with the IOREX filter.

Figure shows the change in conductivity with SDS concentration in water. The CMC was calculated by extrapolating the trend of the initial plateau, when conductivity values remain stable, and the second region of the graph when the first sudden increase in conductivity was measured.

	1st CMC With IOREX	1st CMC control	Difference
Surfactant Concentration	$2.2 \times 10^{-4}$ M	$6.22 \times 10^{-4}$ M	2.81 times

\* Effect of IOREX on water softening as estimated by CMC

Table shows the effect of IOREX on water softening. The loop without the IOREX system needed 2.81 times more SDS to reach the CMC.

→ The water drained through a IOREX is softening 2.81 times more than the water without the IOREX.

น้ำที่ผ่าน IOREX มีประสิทธิภาพให้น้ำอ่อนตัวลง (Softening) ถึง 2.81X เท่า

# An experiment on conversion of rust in pipes into a magnetite

\* Currently in progress

## Materials and Methods

1. Conditions (2 total): steel pipe only with and without IOREX system
2. Flow rate: 0.5 m/sec , Water source: tap water; Temperature: 25 °C ± 2 °C
3. Test running time: 12 months (water samples collected every month for the first 6 months for a total of 12 samples).

## ■ SEM and XRD analysis

Characterization of scale samples with SEM and XRD analysis prior to start of test; and after 6, 9 and 12 months of exposure of the loop with the IOREX system. SEM and XRD will only be done at the beginning and at the end of the experiment for the control sample.