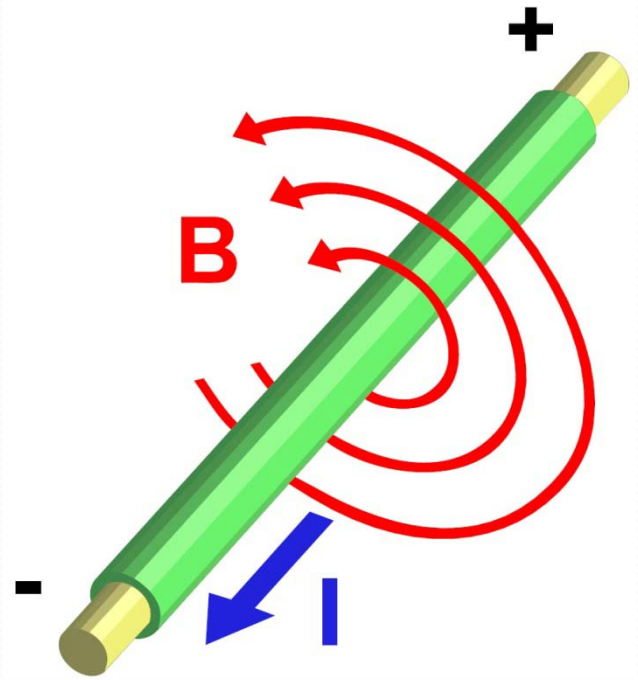
Protection of Sea Water Cooling Systems

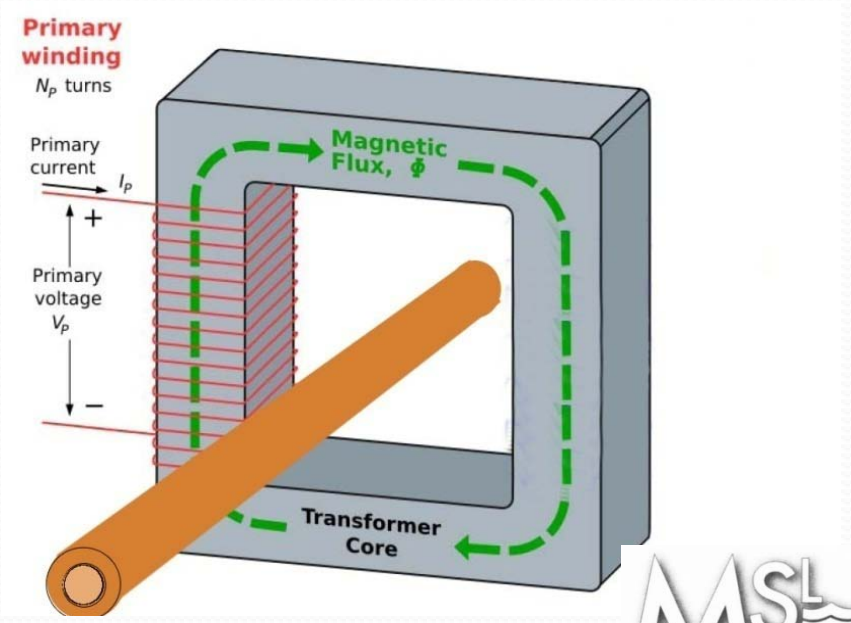
MSL Oilfield Services and CLEARFLOW Technologies

Ruwais, April 14 2010

Introduction to the Technology

A new Patented Technology –ClearFlow- has been introduced to the Downstream Industry which induces high frequency AC signals resulting in the successful mitigation of common scales and bio-fouling.

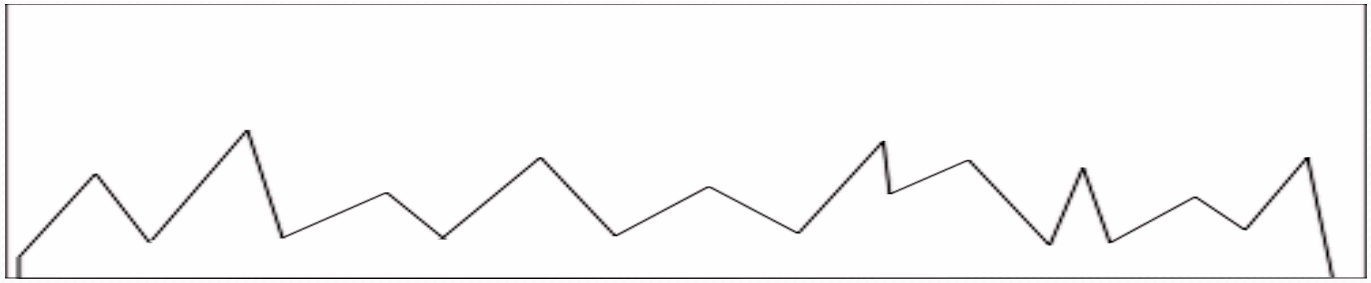




I = High frequency current induced by Magnetic field B

Scale Control: ClearFlow Theory

- **Saturation** is the point at which the maximum amount of substance that can be dissolved in solution is reached, for a given T and P.
- **Super saturation** is achieved only if the point of saturation is changed due to fluctuations in T or P or both.
- Normally, when super saturation is reached, the ions are attracted to sites along the pipe wall where scale precipitates and adheres, Heterogeneous precipitation.



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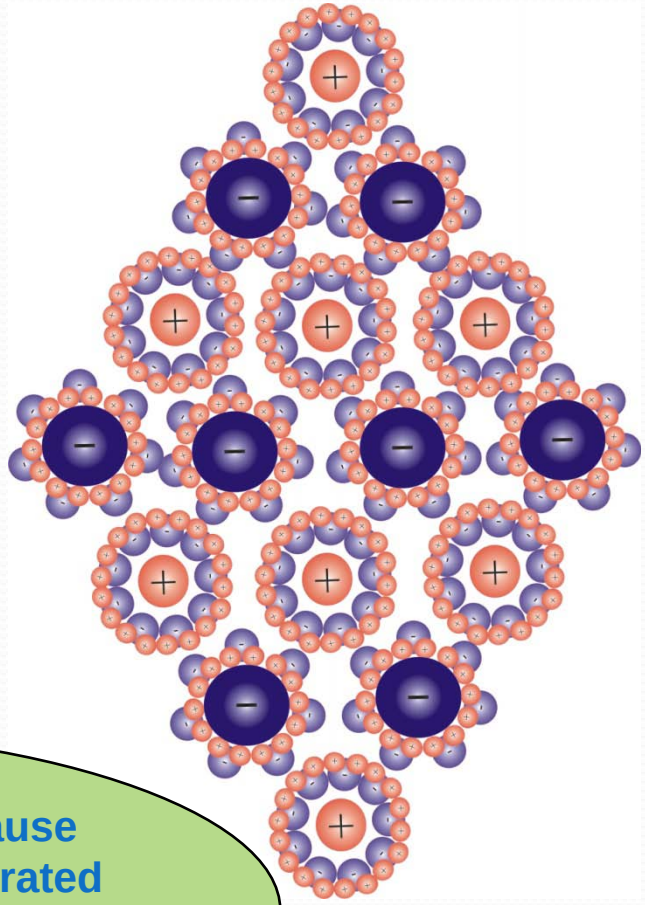
ClearFlow Theory

ClearFlow does not prevent precipitation, it only changes the physical location where precipitation occurs. By inducing an electric field across the pipe diameter, ions are drawn together in clusters in solution. To form seed crystals molecules of the substance to be precipitated must exist in solution. Cations and anions must be grouped together.



A nuclear cluster is formed because of the varying electric field generated by the ClearFlow device allowing the ions to move into position

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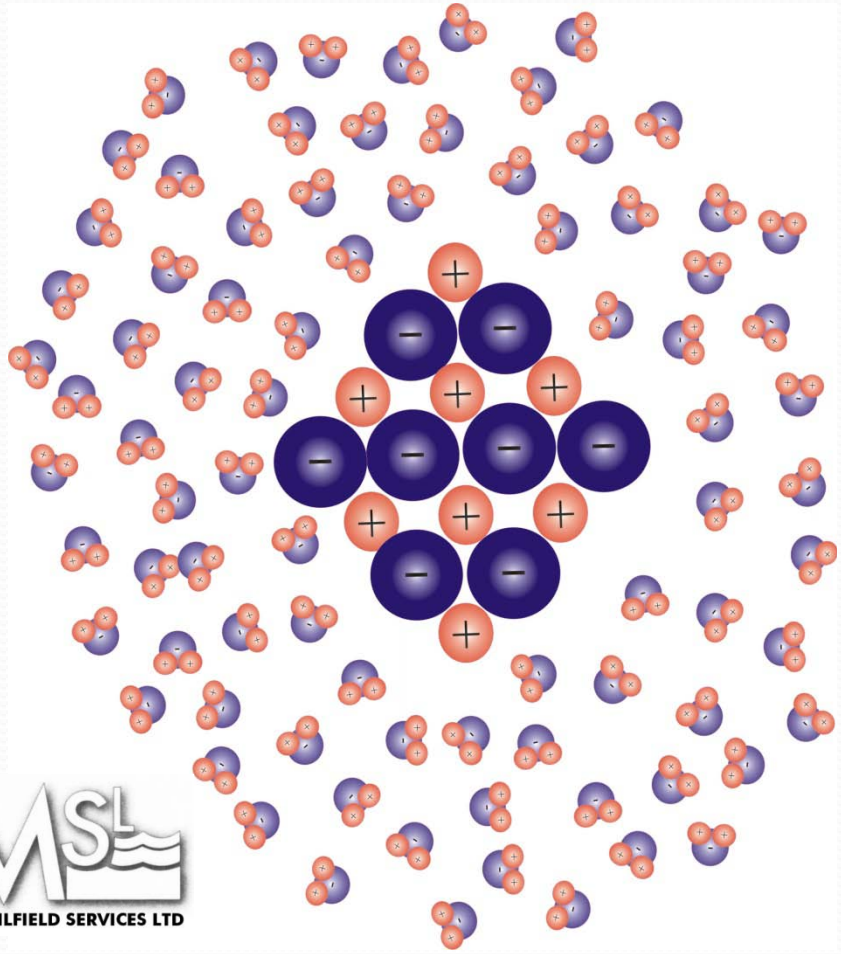
ClearFlow Theory



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The seed crystals formed by the collision of ions remain in suspension so that when super saturation occurs these crystals act as sites for homogeneous nucleation. This reduces the level of dissolved ions so shifting the super saturation point.

The result is that existing calcium scale formed by Heterogeneous nucleation already present on the pipeline surface dissolves back into solution.

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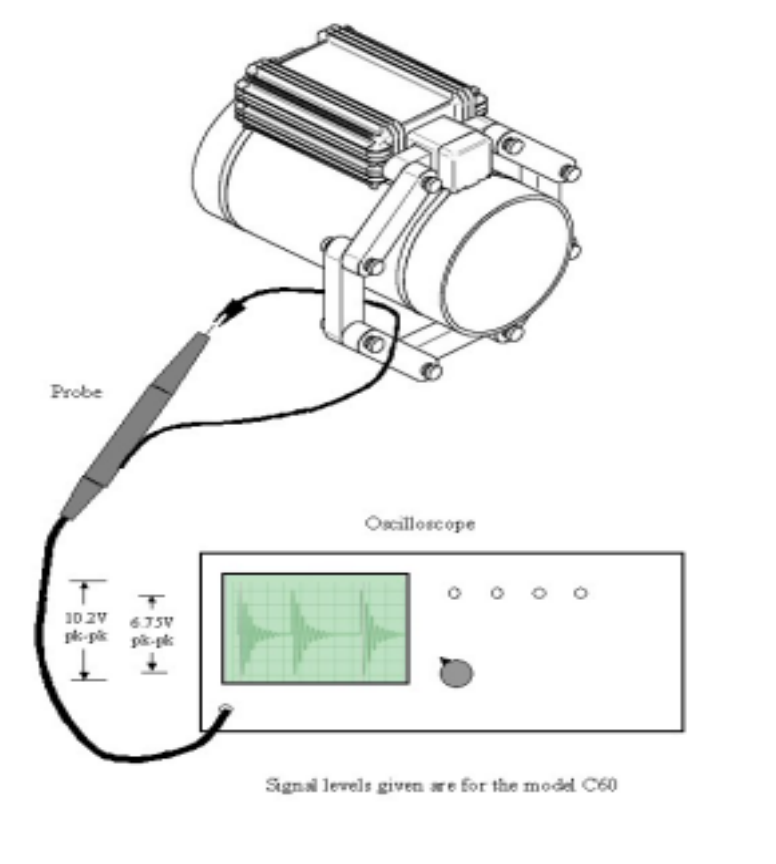
Testing



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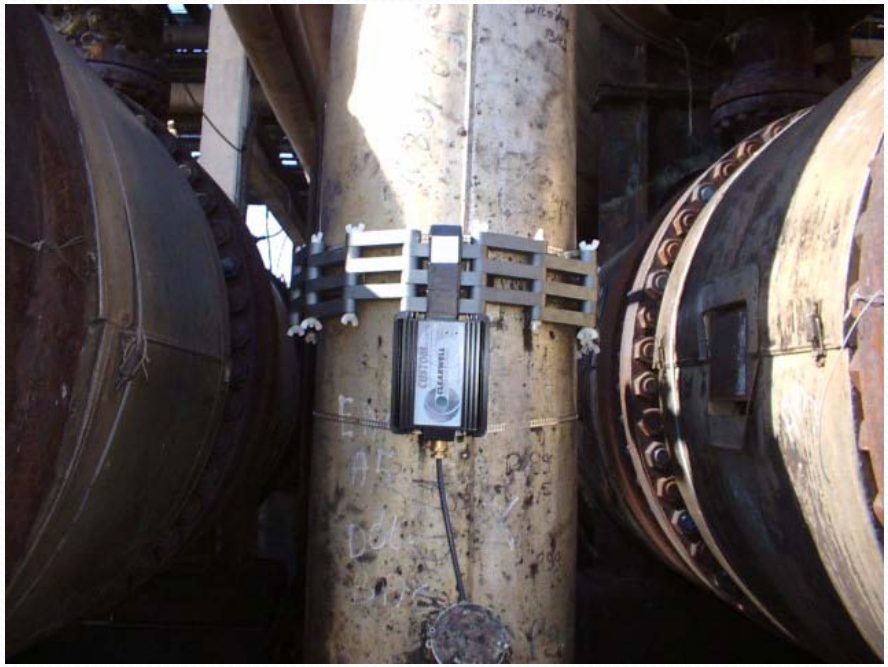
Extensively used in the Oil Industry for Flow Assurance as ClearWELL



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In Addition to scale prevention the system offers two other benefits

1. Bacteria Control
2. Bio fouling Prevention

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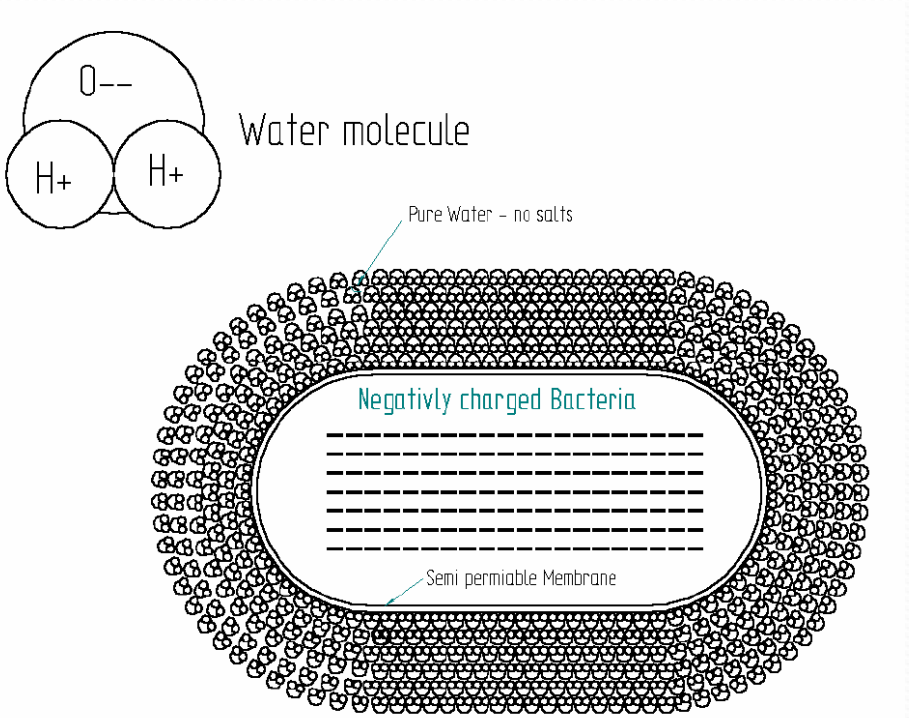
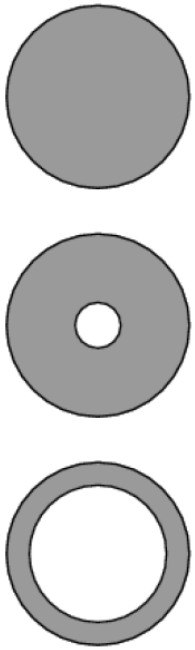
1. Lysis

- As the Bacteria passes through the ferrite ring, its charge attracts water molecules around the bacteria weakening the membrane by osmotic force and killing the bacteria



2. Skin Effect

The skin effect is where alternating current tends to avoid travel through the centre of a solid conductor, limiting itself to conduction near the surface. This effectively limits the cross-sectional conductor area available to carry alternating electron flow, increasing the resistance



Cross-sectional area of a round conductor available for conducting DC current

"DC resistance"

Cross-sectional area of the same conductor available for conducting low-frequency AC

"AC resistance"

Cross-sectional area of the same conductor available for conducting high-frequency AC

"AC resistance"

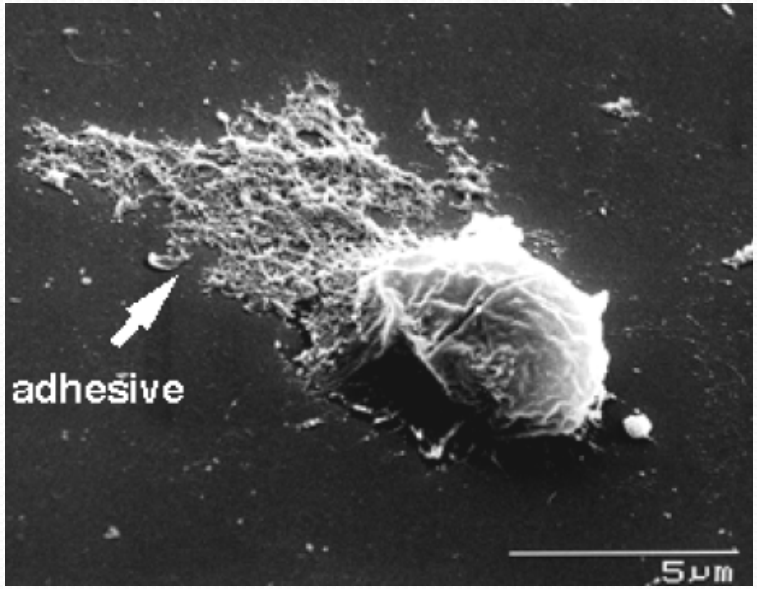
of that conductor above what it would normally be for direct current.

Skin effect: skin depth decreases with increasing frequency.

Skin Effect

Sticky bio films of bacteria colonize the surfaces providing the foothold for larger macro foulers (mussels larvae) to attach to the pipes and condensers' surfaces.

Without the presence of this bacteria film the larvae tentacles will not be able to get a secure foothold and will be swept away with the flow (see here below picture)



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Typical application:

The Problem

Before

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The Answer

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The Answer – After 2 weeks

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Current applications

Current applications

Application	Location	Time
Cooling Towers	Venezuela	2007
Process Plant – Heat exchangers	South of France	2006
Gas Plant	Venezuela	2008
Power Station – sea water inlet	Taiwan Hong Kong	2004 2003
Cooling Tower Commercial center	France Holland	2005 2002

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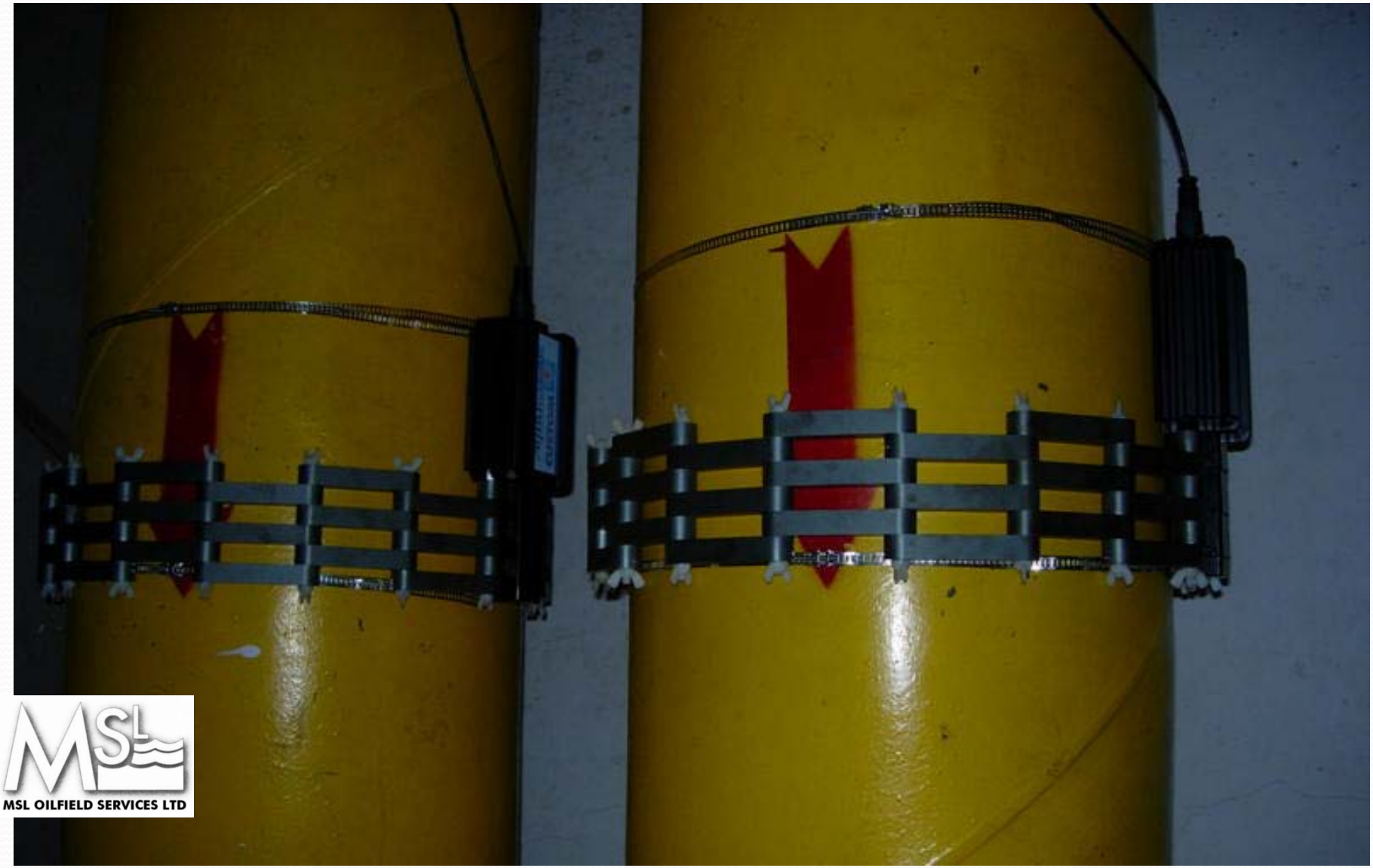

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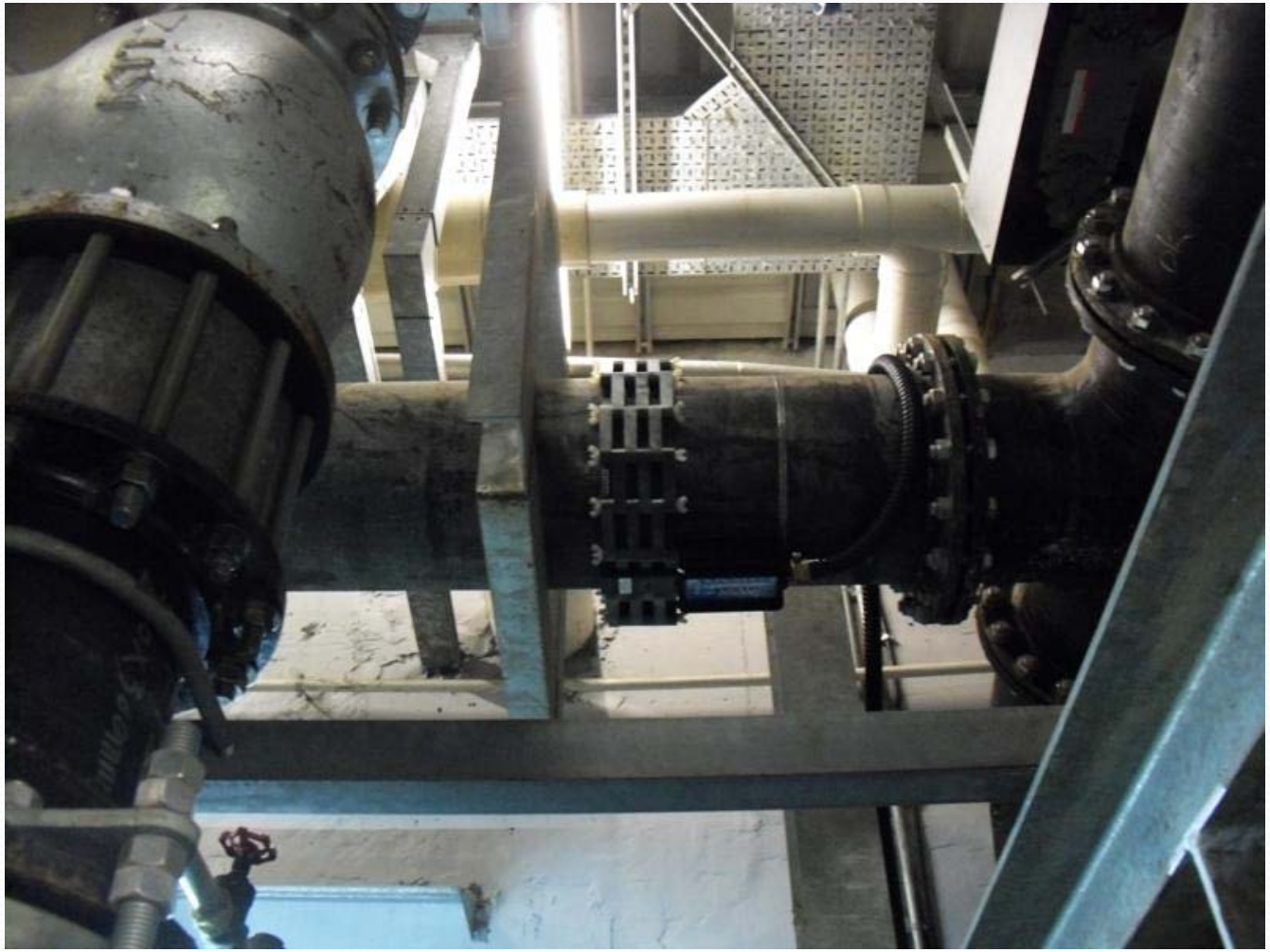

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Thank you for your attention

Any questions?