

ICorr Corrosion Awareness Day

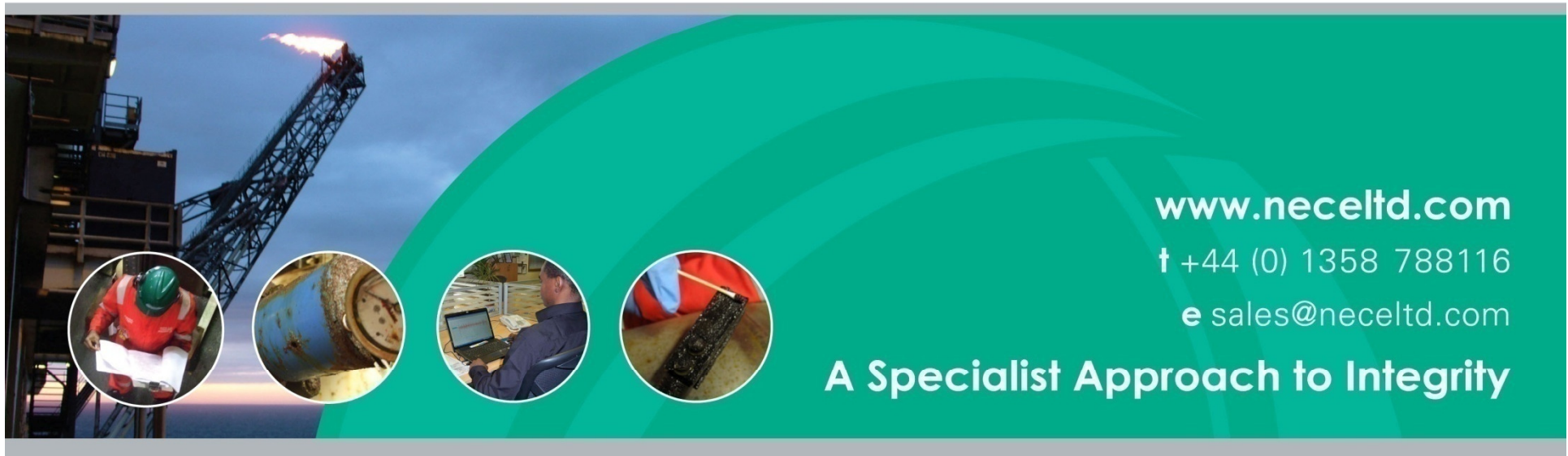


Oilfield Microbiology

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Consultant Microbiologist

26/08/2014

A horizontal banner with a green background. On the left, there is a photograph of an oilfield flare stack at dusk. Below this are four circular inset images: a worker in a red safety suit and green helmet, a close-up of a corroded metal pipe, a person working at a laptop, and a close-up of a dark, textured surface. On the right side of the banner, contact information and a slogan are displayed in white text.

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A Specialist Approach to Integrity

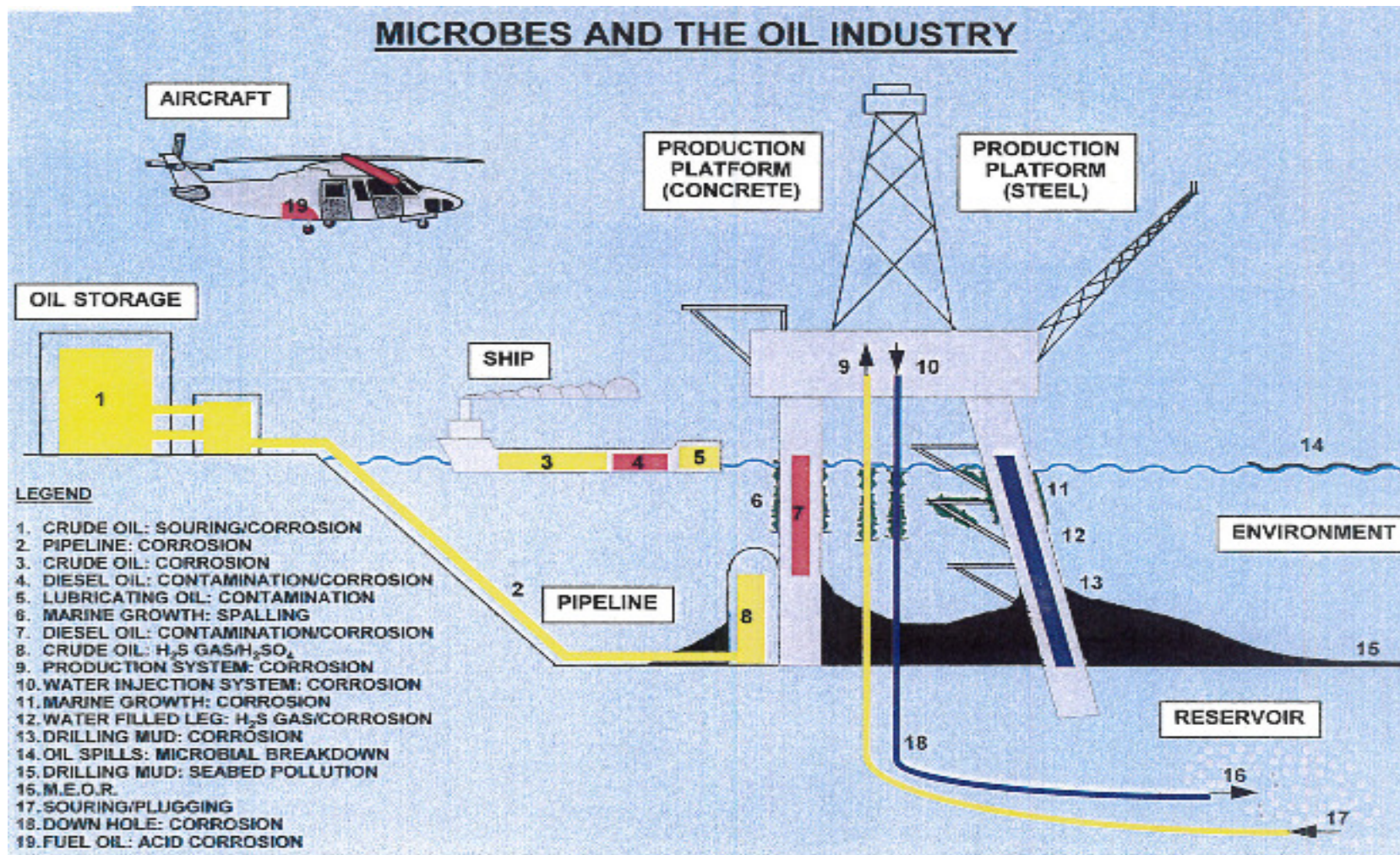
Corrosion Monitoring • Microbial Services • Consultancy • Chemical Optimisation • Specialist Surveys

West Pitmillan Business Centre, Foveran, Ellon, Aberdeenshire AB41 6AL





Oilfield Microbiology



*Adapted from Sanders and Hamilton, 1986



Oilfield Microbiology

The aim of oilfield microbiology is to generate appropriate data in order to:

- predict locations, vessels, pipework, systems at risk
- prioritise areas for treatment
- apply and monitor appropriate strategies to mitigate against the effects of microbiologically influenced corrosion (MIC)





Oilfield Microbiology

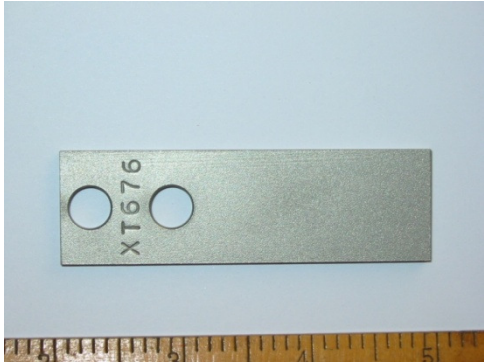
- **Systems:**
 - Production,**
 - Water Injection**
 - Produced Water Reinjection (PWRI)**
 - Ballast water**
 - Seawater Cooling**
 - Cooling/heating**
 - Firewater**
 - Diesel storage and distribution**
- **Samples:**
 - Planktonic – water, crude, diesel, cooling medium**

 - Sessile – biofilm from coupons, bio-sidestreams and/or other intrusive devices.**





Sessile Samples - Coupons



Direct system exposure



**Sessile
Microbial
Samples and
Weight
Loss analysis**



Oilfield Microbiology

Testing for : sulphate-reducing prokaryotes (SRB)
general heterotrophs
acid-producing bacteria
nitrite-reducing bacteria
bacteria and fungi in diesels
nitrate-reducing bacteria

sulphate-reducing archaeobacteria (SRA)
archaeobacteria
methanogens

Techniques: traditional viable counts (MPNs)
molecular techniques – qPCR, FISH, DAPI

Chemistry: pH, sulphide, bisulphite, Volatile Fatty Acids (VFAs),
chlorine residuals, iron, nitrite, nitrate etc



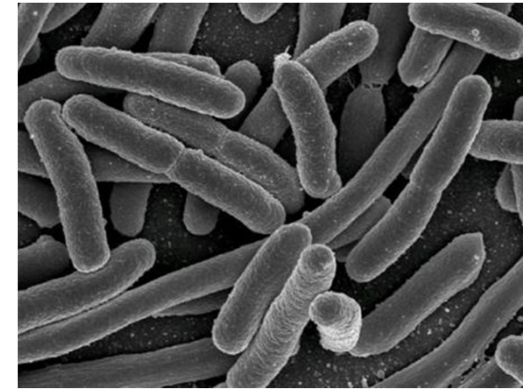


Oilfield Microbiology

Biocide application:

- strategies
- monitoring programmes
- optimisation

Lab and field based biocide trials against planktonic/sessile bacteria



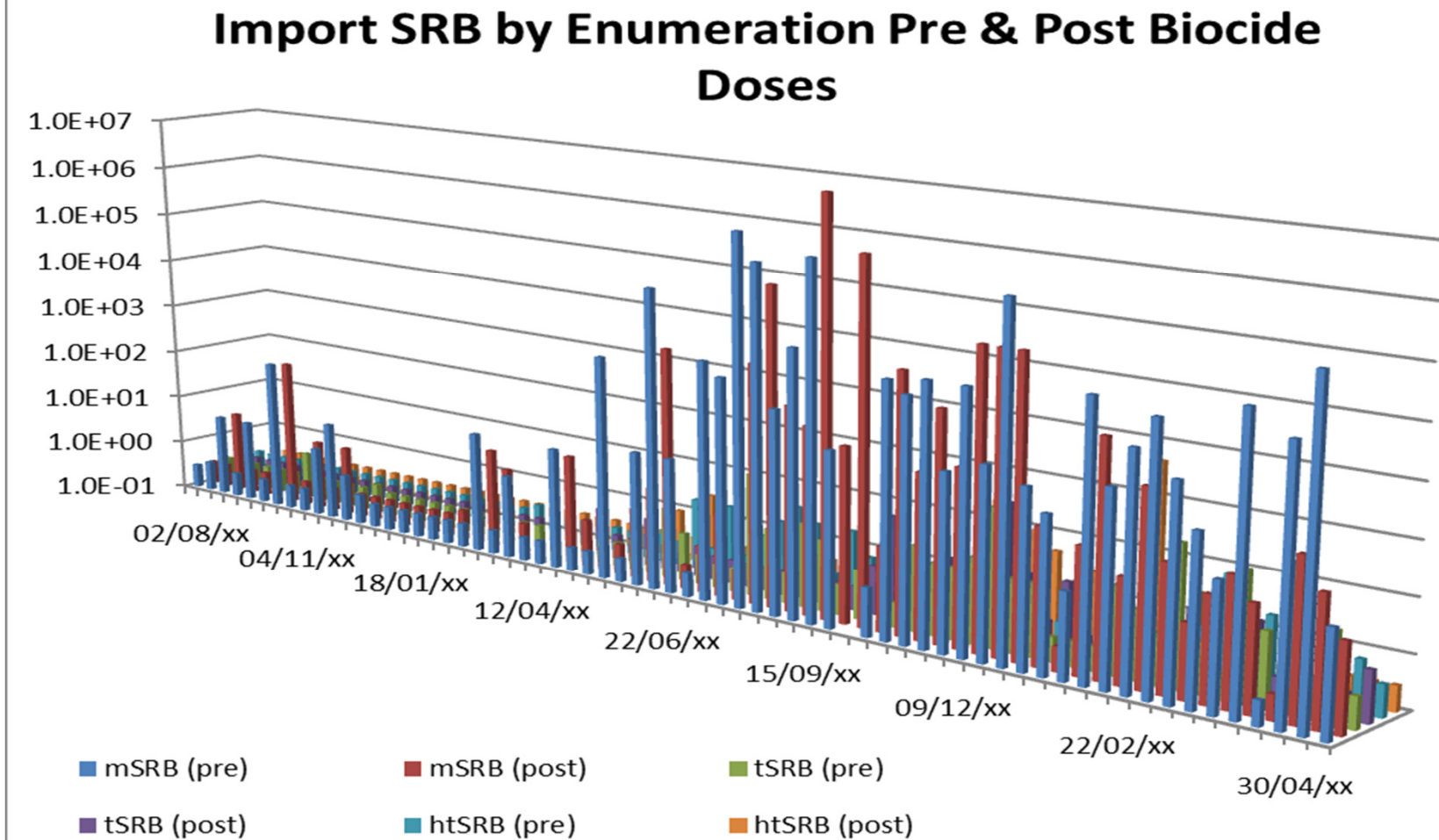
Data Trending

Data Trending and Interrogation

- **All data should be graphed/trended on a regular basis – pipelines, drains, deaerator tower etc**
- **Trending of data pre and post biocide applications – especially if a long term project**
- **Biocide treatments can then be optimised**
- **Monitoring essential**



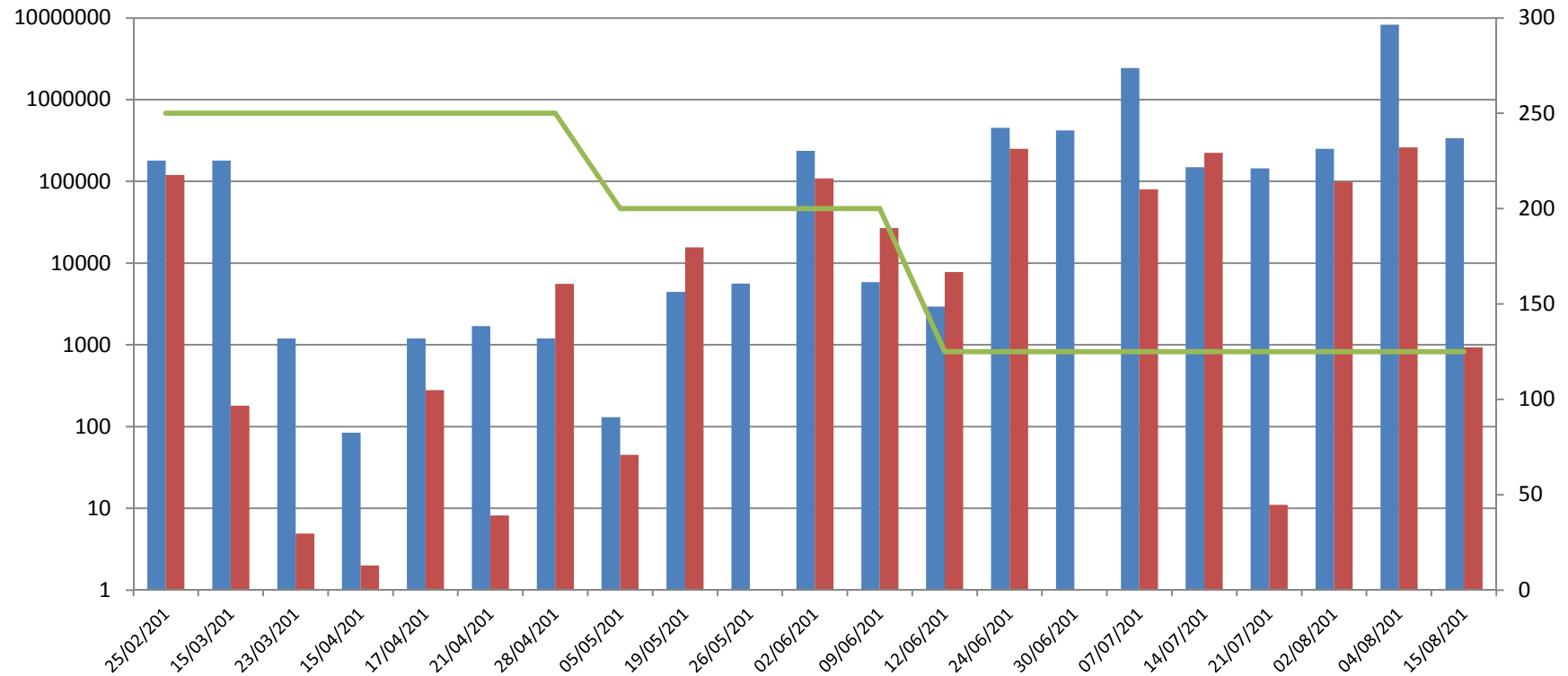
Data Trending



Data Trending

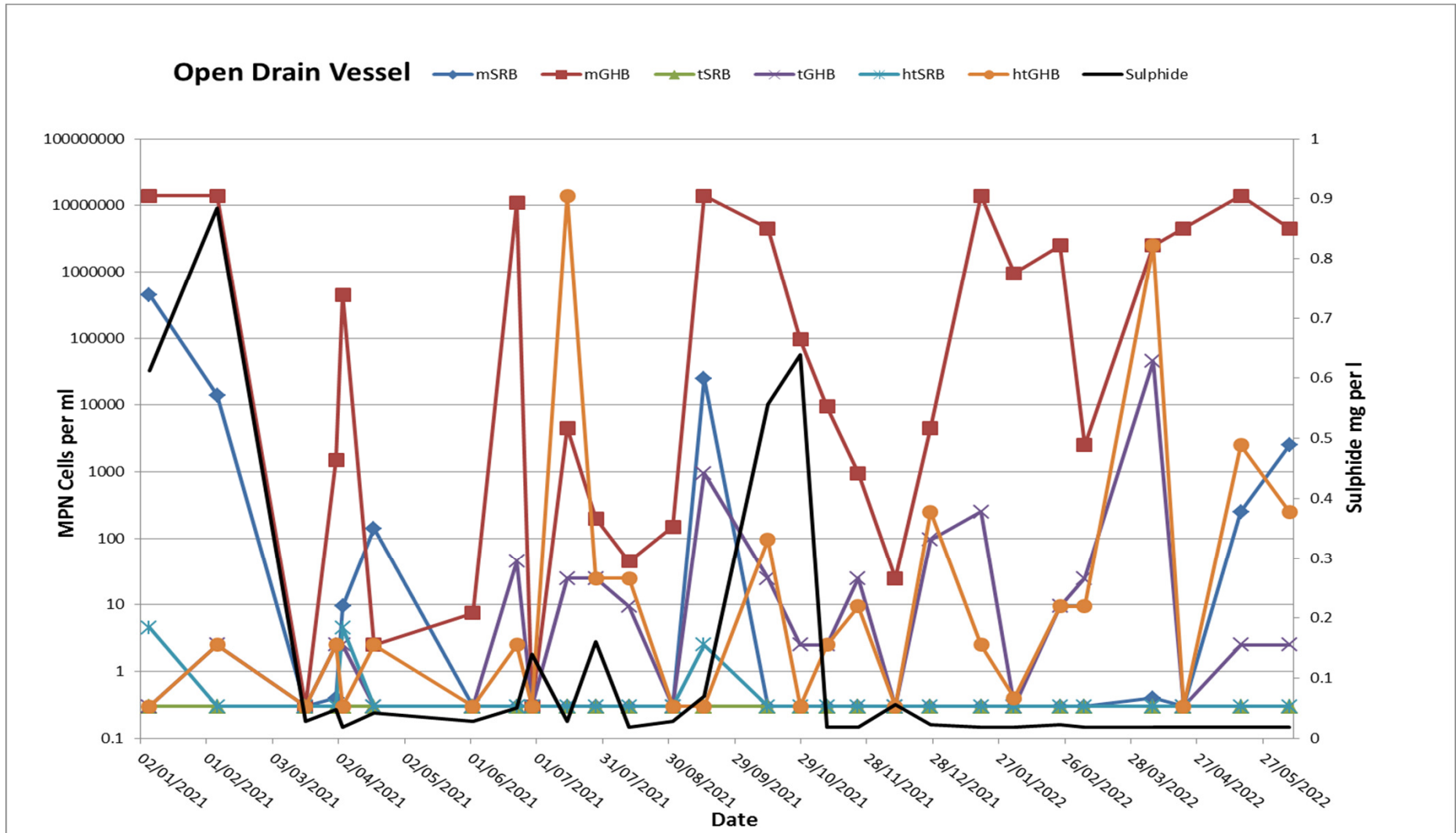
SRA Numbers by qPCR Pre & Post Biocide Doses

■ SRA (Pre)

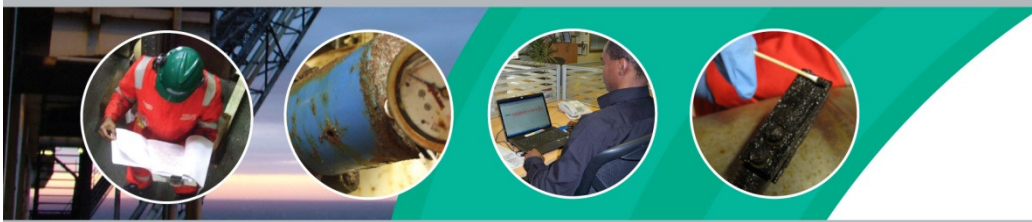




Data Trending



Data Trending



WORKSCOPE		
System	Current status	Actions required
PRODUCTION	Moderate to high planktonic SRB, low to moderate sessile SRB with low corrosion and moderate pitting rates. Risk of MIC.	Regular kill dose of biocide required. Post biocide planktonic samples should sent in for analysis.
WATER TREATMENT VESSELS	Moderate thermophilic SRB at Vessel B water outlet, low numbers at the remaining locations. Low sulphide levels. SRB growth and activity still occurring across vessels with a high risk of MIC.	Close monitoring required as early intervention may be required to ensure control is maintained.
DRAINS	Low thermophilic SRB in <i>Closed Drains</i> , moderate sulphide levels measured. Low risk of contamination being recirculated and of MIC	No immediate action currently required. Regular monitoring should be maintained.
WATER INJECTION	Low planktonic and sessile SRB numbers, sulphide levels below detection limit. Moderate to high corrosion and pitting rates. Risk of microbial proliferation and MIC	System currently under reasonable control. Further investigations required to determine the cause of the high pitting measured at CC-XOX-017. The use of molecular techniques such as qPCR should be used to confirm or eliminate the role of MIC.
DIESEL SYSTEM	Low aerobic bacteria, yeast and mould enumerated from all the tanks sampled. Low particulate contamination, fungal fragments and water content.	No immediate action is required as the diesel tanks are currently under good control and water content is at a minimum. Regular monitoring should be maintained.
FIREWATER SYSTEM	No SRB, but high GHB measured in all the hydrants sampled. No residual chlorine, high potential risk of biofouling.	A regular firewater ring main flushing routine should be implemented to prevent stagnation and bring in freshly chlorinated water.
Green	Good Control, Low Risk, No Immediate Action Required	
Yellow	Requires Careful Monitoring/Possible Early Intervention	
Red	Risk Of MIC, Urgent Action Recommended	



Thank you for your time!
Any Questions?