What Lies Beneath

Healthcare Estates
7th October 2014

Envirosafe UK Ltd

Content

- Introduction to the speaker
- GRP tanks
- Sterilisation techniques
- Pseudomonas Aeruginosa in new systems
- Questions

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- **BSC Hons. Degree in Chemistry & Management**
- **5 Years as a Chemical Water Treatment Rep – esp. Steam Boilers in Hospitals.**
- **6 Years predominantly Commercial Water Treatment – Legionella Compliance**
- **3 Years - Commercial & Industrial Water Treatment**
- **8 Years MD & Consultant for Envirosafe UK Ltd – Water Risk Assessments and Consultancy.**

Why GRP Tanks?

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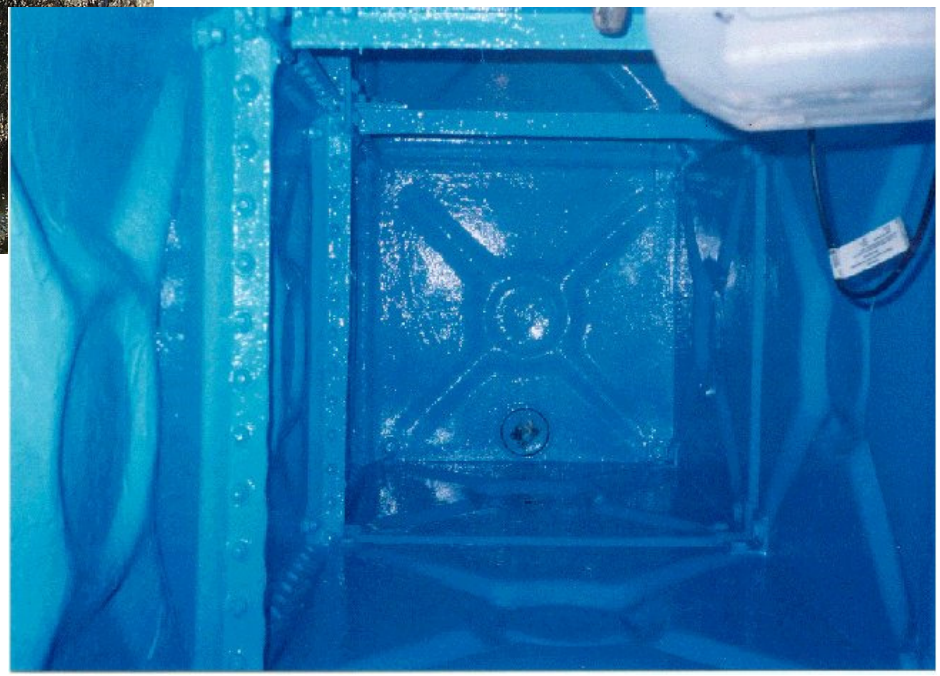
Why GRP Tanks?

Why GRP Tanks?

Before

After



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Why GRP Tanks?

Mould growing in poorly mixed paint

Types of GRP Tanks

Hot Pressed
Sectional

Hand laid-up
one piece

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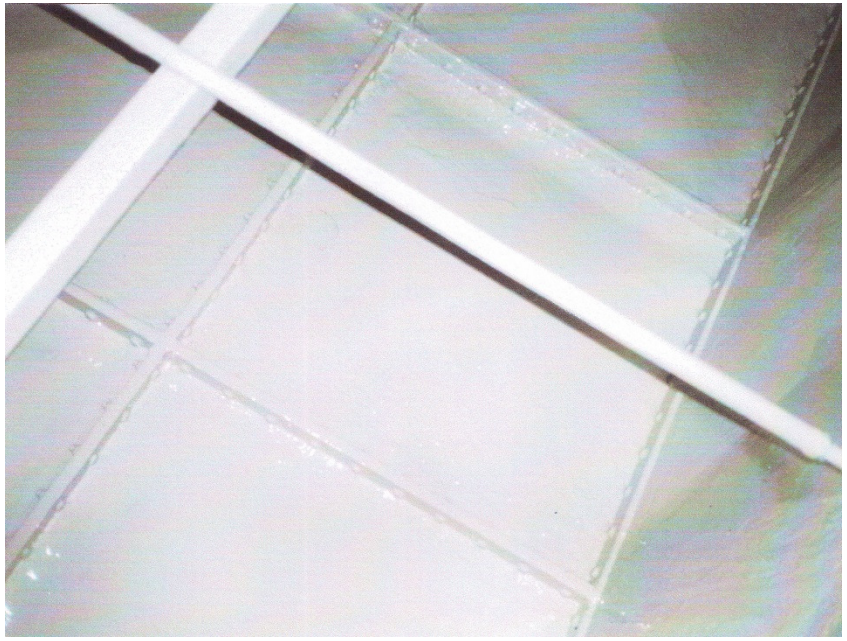
Problems with GRP Tanks

Early examples bled sealant and could leak



Resulted in recoating with flexible paint

Problems with GRP Tanks

Mild Steel Bolts – causing most of the debris in the tank!

Half plastic coated bolts – where's the logic?

Problems with GRP Tanks

Concealed Structures
DH EFA/2013/004
HSG274 Part 2 Fig 2.12 Moderate Risk

Replacement with Stainless Steel Supports

Photo By expresswatertanks.co.uk

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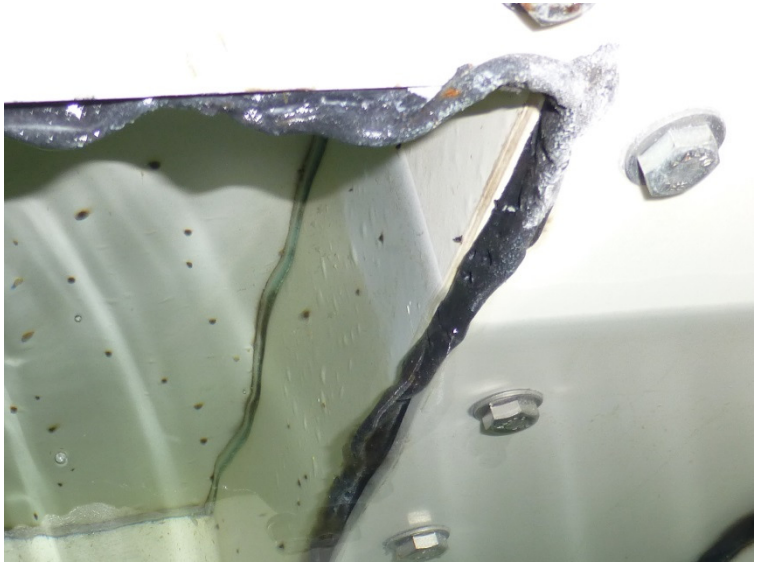
Problems with GRP Tanks

Gel Coat Failure – HSG274 P2. Fig 2.12 High Risk

Tank installed in 2013



Gel coat failure in 2013 on side hatch only

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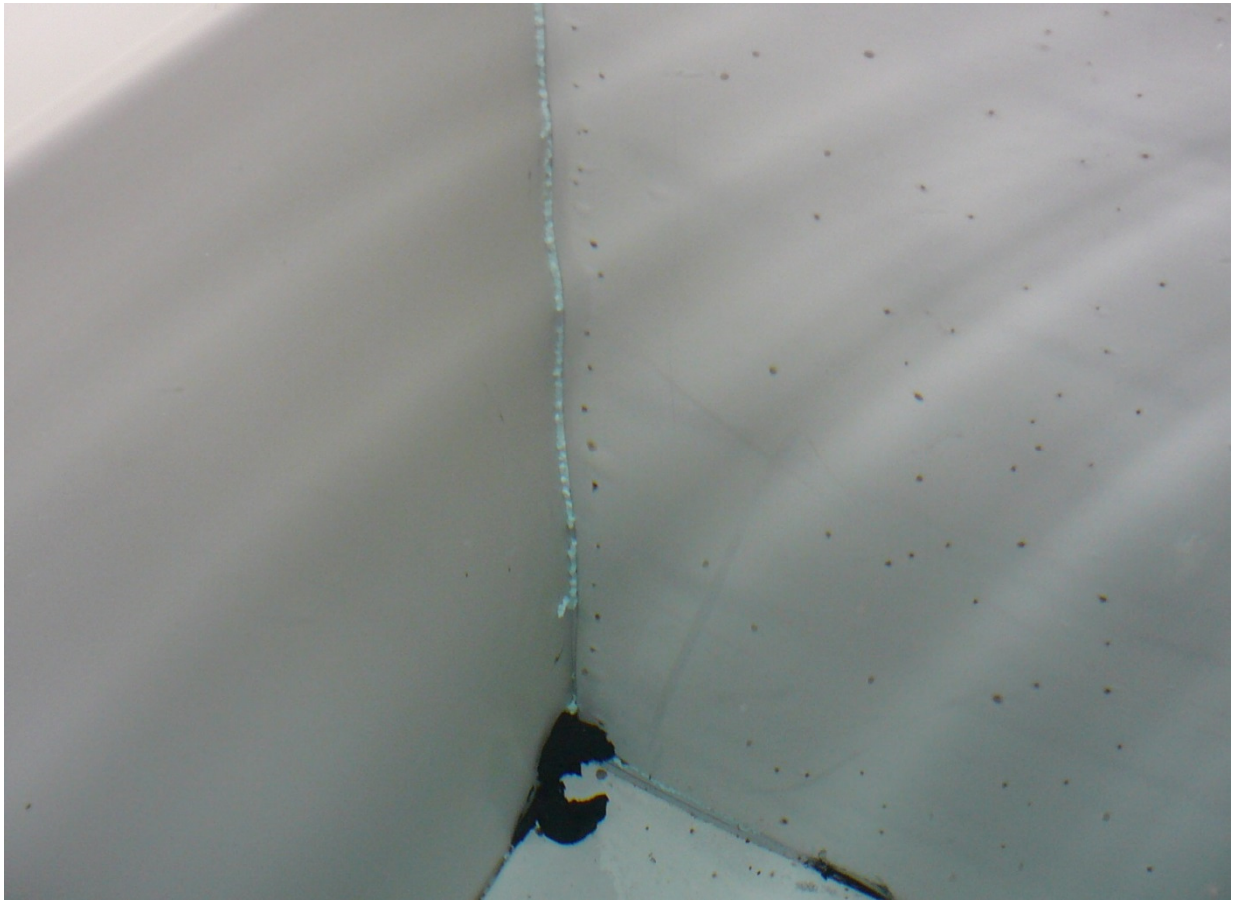
Problems with GRP Tanks

Gel Coat Failure



One Section is fine, the adjacent one is covered in cysts

Problems with GRP Tanks

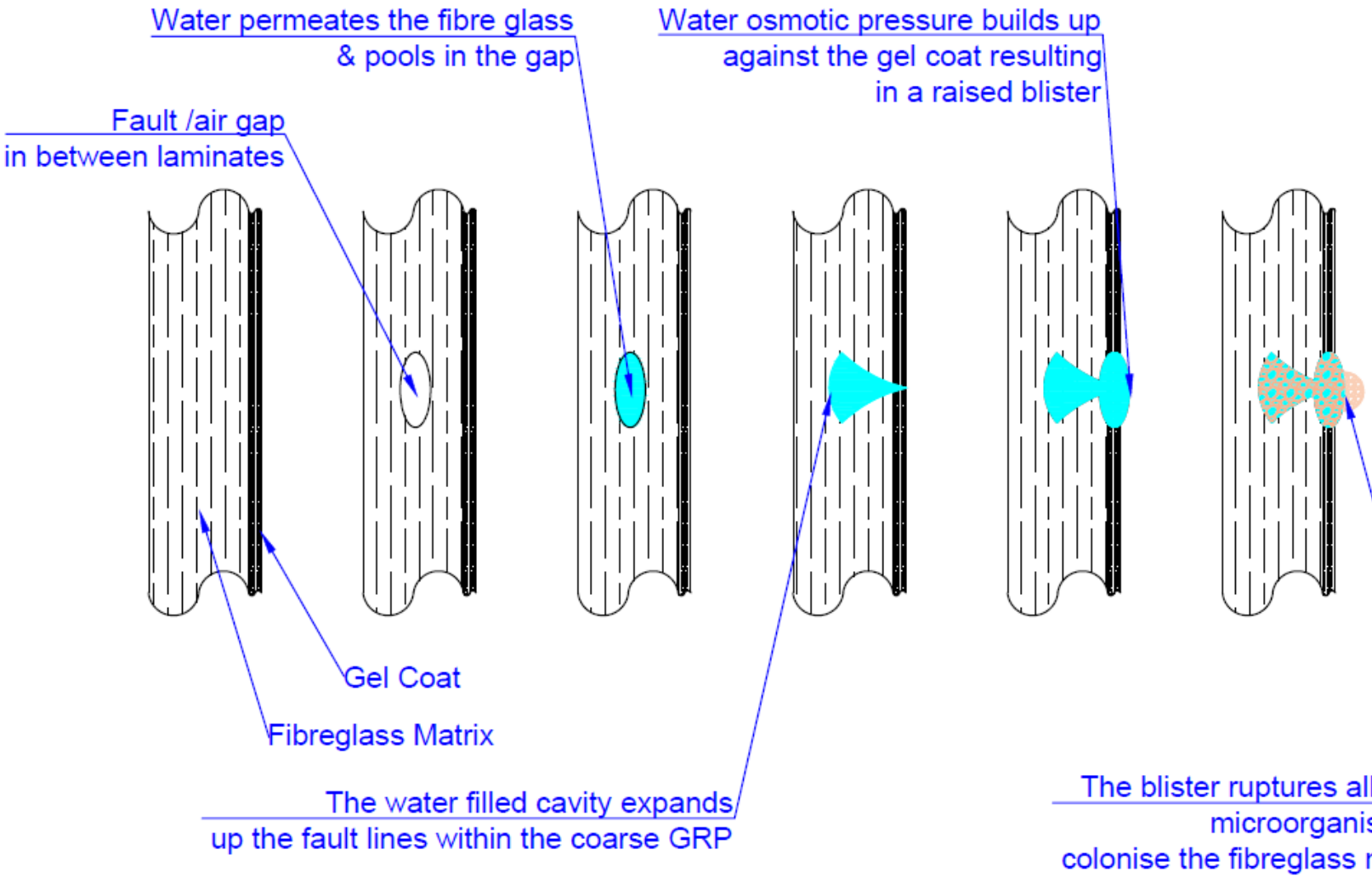
Gel Coat Failure

One piece tank – corners often fail due to either inconsistent brush application of gel coat resin or insufficient pressure when rolling out the air between layers of fibreglass.

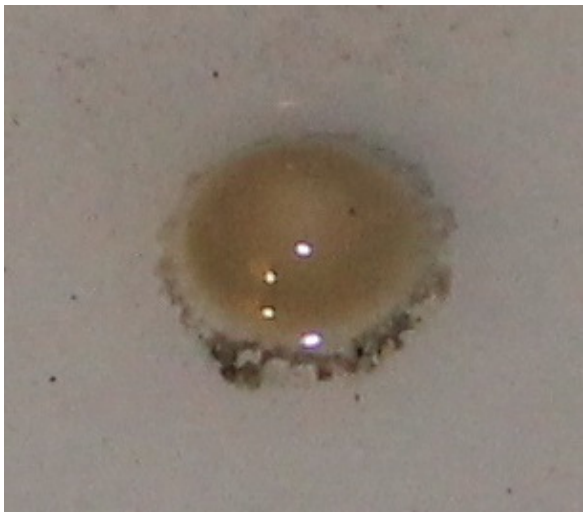
Bubbled/blistered surface is the first signs of osmosis

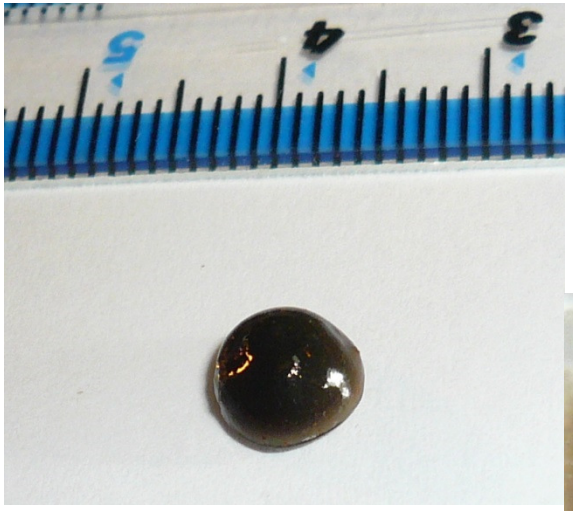
Gel Coat Failure

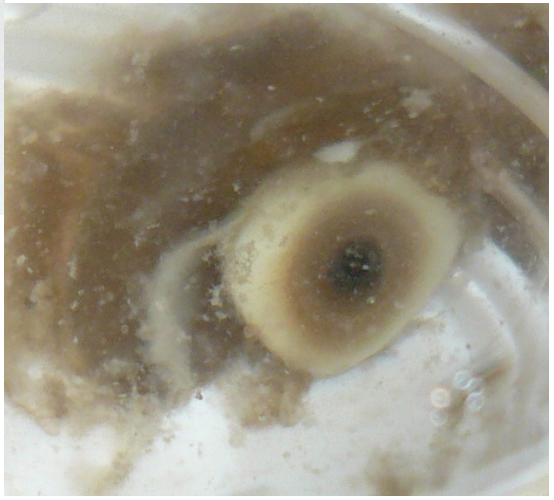
One mechanisms of failure



Gel Coat Failure
Why should we care?



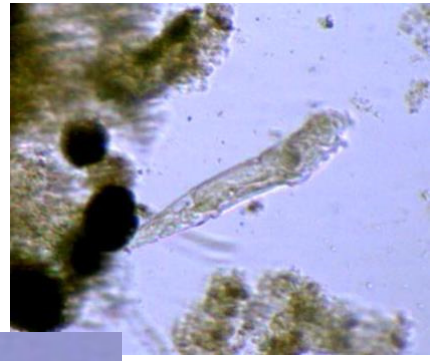


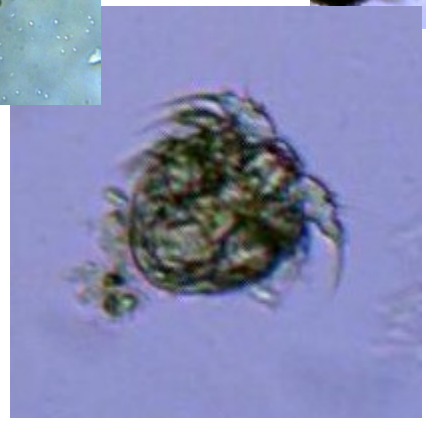
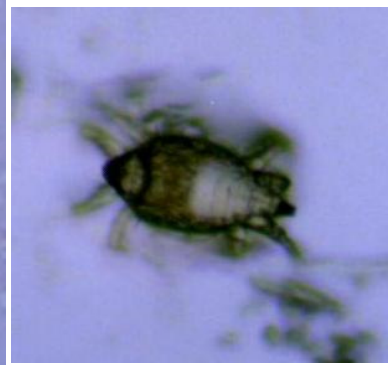


Gel Coat Failure
Why should we care?







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Nematodes & biofilm

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Tank Cleaning

- **Naturally, when faced with worms swimming around in your cold water storage tank, the first response is to clean the tank.**
- **Unfortunately we found that the cysts (and worms) were visibly back within 2 weeks.**
- **Chlorination tried at double the recommended concentration of chlorine for double the time (>100mg/l free chlorine for 2 hours) – cysts removed from the tank surface prior to chlorination.**
- **Nematode within the biofilm still alive up to 36 hours in 100mg/l chlorine!**

BS8558:2011 / HSG 284 Part 2 2014
Chlorination

- **BS8558:2011 Table 13**

Initial free chlorine concentration mg/L	Contact period h:min	Minimum residual free chlorine measured at the end of the contact period mg/L
3.1	16:00	1.9
5	10:00	3
10	05:00	6
15	03:20	9
20	02:30	12
25	02:00	15
30	01:40	18
40	01:15	24
50	01:00	30

BS8558:2011 / HSG 284 Part 2 2014
Chlorination

- The chlorine contact time table was derived from testing the effectiveness of chlorine of free floating bacteria in a laboratory environment.
- Hundreds of papers have been written, high-lighting the poor performance of chlorine against biofilms.
- The water treatment industry has spent the past 20+ years advocating alternatives to chlorine due to its short comings.
- Bromine, ammonium bromide, chlorine dioxide & hydrogen peroxide have all been used to replace chlorine (only the latter 2 in drinking/potable water).

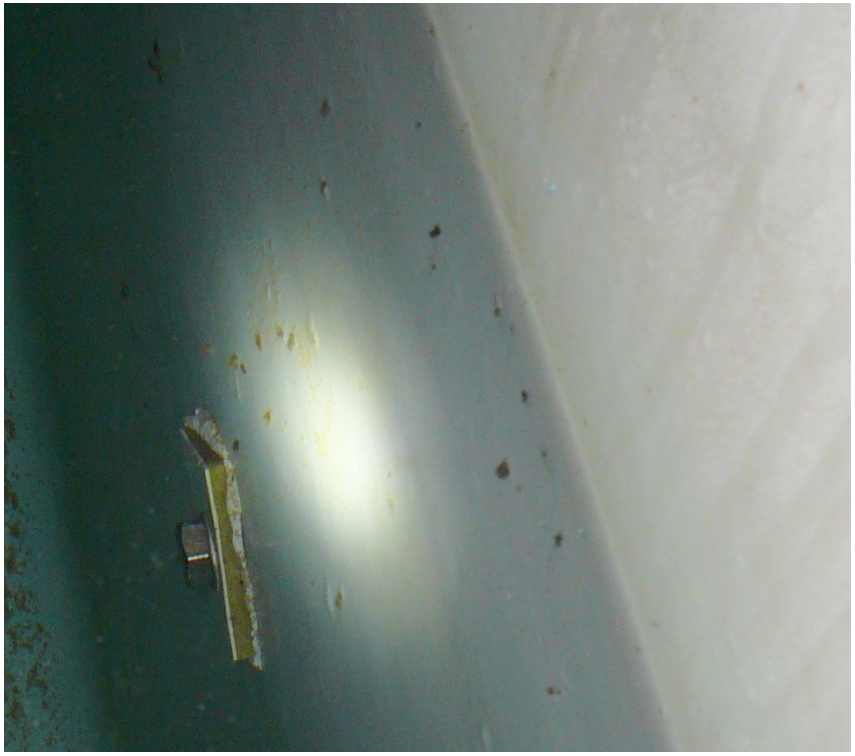
Low-tech biocide comparison study

	Time taken until dead Nematode worms are first noted	Time taken until all Nematode worms are dead
Sodium Hypochlorite @100mg/l	28 Hours	78 Hours +
Bromine (from BCDMH) @100mg/l as Cl	3 Hours	20 Hours
Ashland Generox 100 stabilised ClO_2 @100mg/l as Cl	3 hours	20 Hours
B&V Abulox Hypochlorous acid solution @100mg/l	20 Hours	78 Hours
Aquatreat Peroxysil 50 Stabilised hydrogen peroxide solution @200mg/l	1 Hour	8 Hours
Huwa San TR50 Stabilised hydrogen peroxide solution 100mg/l	1 Hour	78 Hours

Tank Cleaning - Field Trial

- **Peroxysil 50 on 4 tanks at 1000mg/l for 16 hours.**
- **The tanks were cleaned (cysts were removed) prior to chlorination to expose the GRP surface to the biocide.**
- **This strength of biocide is advocated for cooling towers where biofilms are often present.**
- **One tank was poorly balanced and cysts regrew within a month (tank water was at 25°C)**
- **Remaining 3 tanks are much improved but not 100% clear after 1 year.**

Tank recoating



Before

After £4000!
Better but not 100%

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Supplementary Dosing

- **Chlorine Dioxide is widely used in hospitals to support the water hygiene regime, especially as down service chlorinations are often impractical.**
- **The results seen so far are variable. Where a good (possibly above potable level) reserve is maintained the cysts are controlled. Where ClO_2 reserves are borderline cysts may reform after cleaning.**

Pseudomonas Aeruginosa & new installation disinfection

- **Back in 2009 we started working with Homerton Hospital & the HPA following the refurbishment of their SCBU ward.**
- **The plumbing contractor had failed to carryout an adequate chlorination of the pipework and a biofilm had been allowed to become established.**
- **Working with the HPA we agreed on what levels of pseudomonas aeruginosa were deemed to be acceptable – these levels were then adopted by the HPA and have since become HTM04 addendum.**

Pseudomonas Aeruginosa & new installation disinfection

- **Chlorination No1 - >80mg/l chlorine for 1 hour**
  - Results were poor after 5 days.
- **Chlorination No2 - >80mg/l chlorine for 1 hour, all plastic filters removed from Markwik IR taps and boiled.**
  - Results deteriorated after 2 weeks (still working on <80cfu PA per ml being acceptable)
- **Chlorination No3 - >80mg/l chlorine for 2 hours, outlets bagged and soaked for >1 hour**
  - French Limits adopted – pseudomonas levels still too high on cold services

Pseudomonas Aeruginosa & new installation disinfection

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Pseudomonas Aeruginosa & new installation disinfection

- **Markwik auto flushing stopped due to Nurses complaints**
- **Flushing points installed behind IPS panels.**
- **UV taps proposed to Steri-spray at Combating Legionella conference 2011**
- **New UV- taps developed & tested**
- **Belfast SCBU hits the news**
- **First batch of UV-taps diverted to Belfast by DH.**

Pseudomonas Aeruginosa & new installation disinfection

- **TMV taps removed from the SCBU on site and replaced with old-fashioned mixers.**
  - Results improved, but still not <1cfu/100ml
- **Chlorination No4 –Hot water cross linked to cold for the whole ward. >100mg/l chlorine for 2 hours @60°C plus supplementary ClO_2 dosing fixed.**
- **Results all clear.**
- **New standard adopted for all refurbishments on site. Where possible all services are chlorinated at high temperatures.**

Pseudomonas Aeruginosa & new installation disinfection - Conclusions

- **Chlorine on its own cannot penetrate Pseudomonas Aeruginosa biofilms within a practical time frame.**
- **The combination of thermal disinfection and chlorine helps remove grease & oils from new pipework that chlorine alone cannot.**
- **The combination of thermal disinfection and chlorine is very effective at removing biofilms.**

- **Any Questions?**