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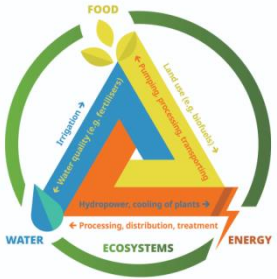
Essential expertise for improving chlorine biocontrol performance.

ENWANEX audit: bridging the water/energy knowledge gap.

ENergy/WAter NEXus (ENWANEX)



- All-cooling processes have a link with energy consumption/efficiency.
- In water cooling systems bio-film (sessile bacteria) are the single most important contributor to a decreased energy efficiency profile
- Often these inefficiencies are un-known and /or unquantified.
- IMCHLO's "ENWANEX" approach bridges that gap….

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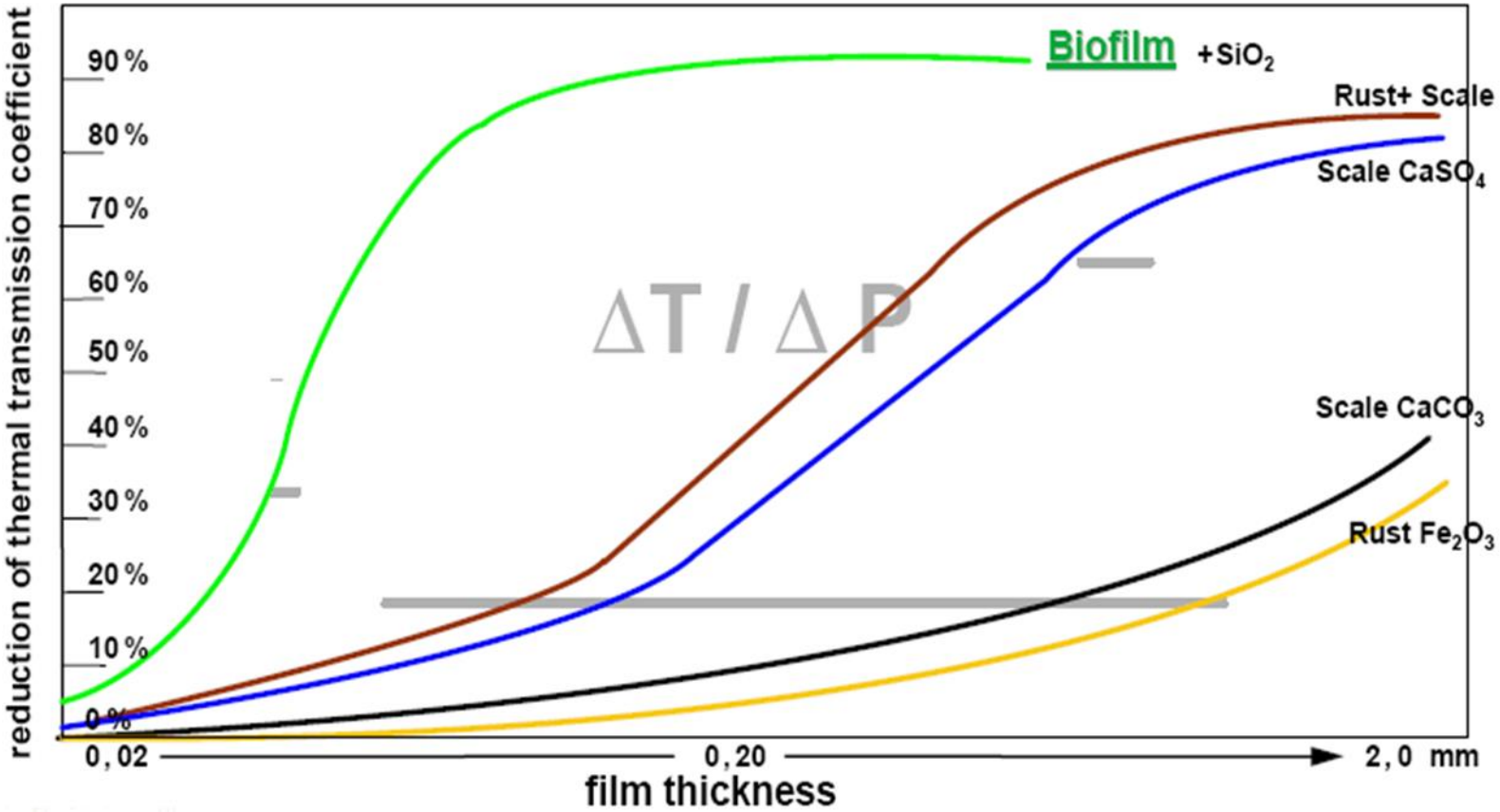
Isolating proterties of deposits



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IMCHLO's ENWANEX audit approach

- Cooling system MOC audit → IMCHLO to understand link with your business profile and your specific water-energy nexus situation.
- Determining the critical exchangers
- Agree on energy/water nexus value of critical exchangers
- Share design specs of critical exchanger (s)
- Make a ENWANEX audit proposal with indication of expected audit results

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ENWANEX a Step-wise approach

1. Select a critical, system representative, exchanger.
2. Determine the “energy/water value nexus” of the exchanger
3. Collect design data of the selected exchanger
4. Generate a exchanger specific pinch calculation sheet → links any heat transfer resistance increase to energy deficiency.
5. Install plug&measure “ENWANEX-audit” measuring equipment
6. Measure base line → determine bio-film isolation cost
7. Evaluate improvement alternatives.

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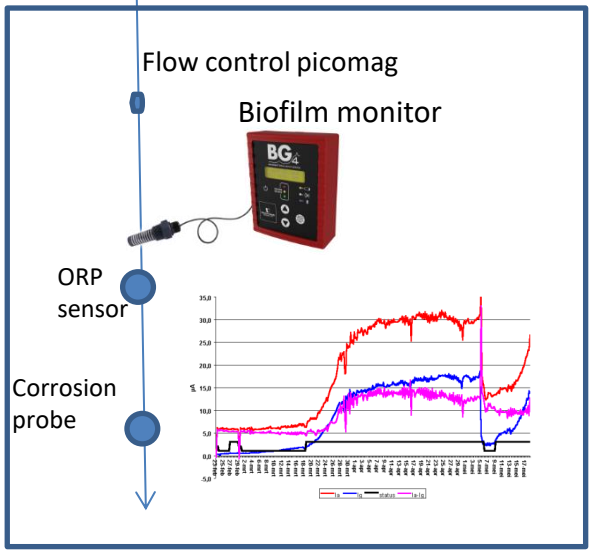
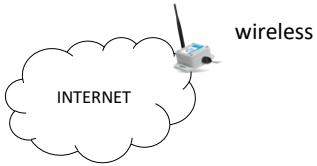
ENWANEX audit measuring set-up

Critical exchanger
Design specs





Critical Exchanger Pinch algoritme based on specs and water/energy nexus value

Mobile easy to install Plug & measure IMCHLO's ENWANEX audit equipment

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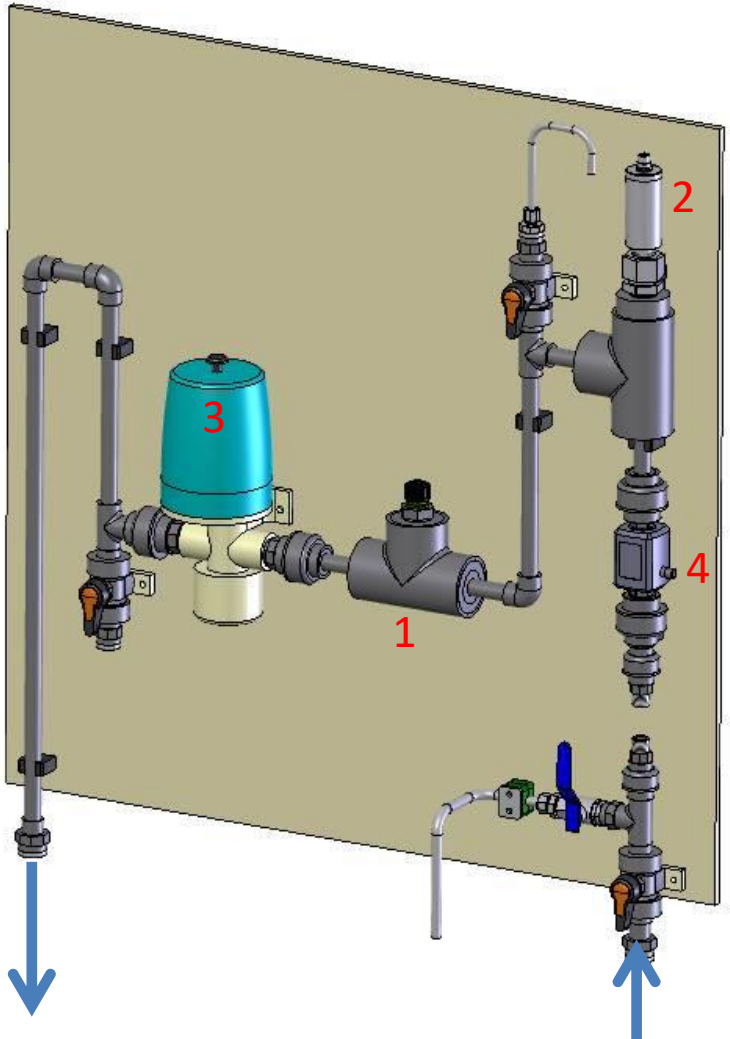

1) BioGeorge (biofilm)probe
2) Corrosion probe
3) ORP probe
4) Flow regulator

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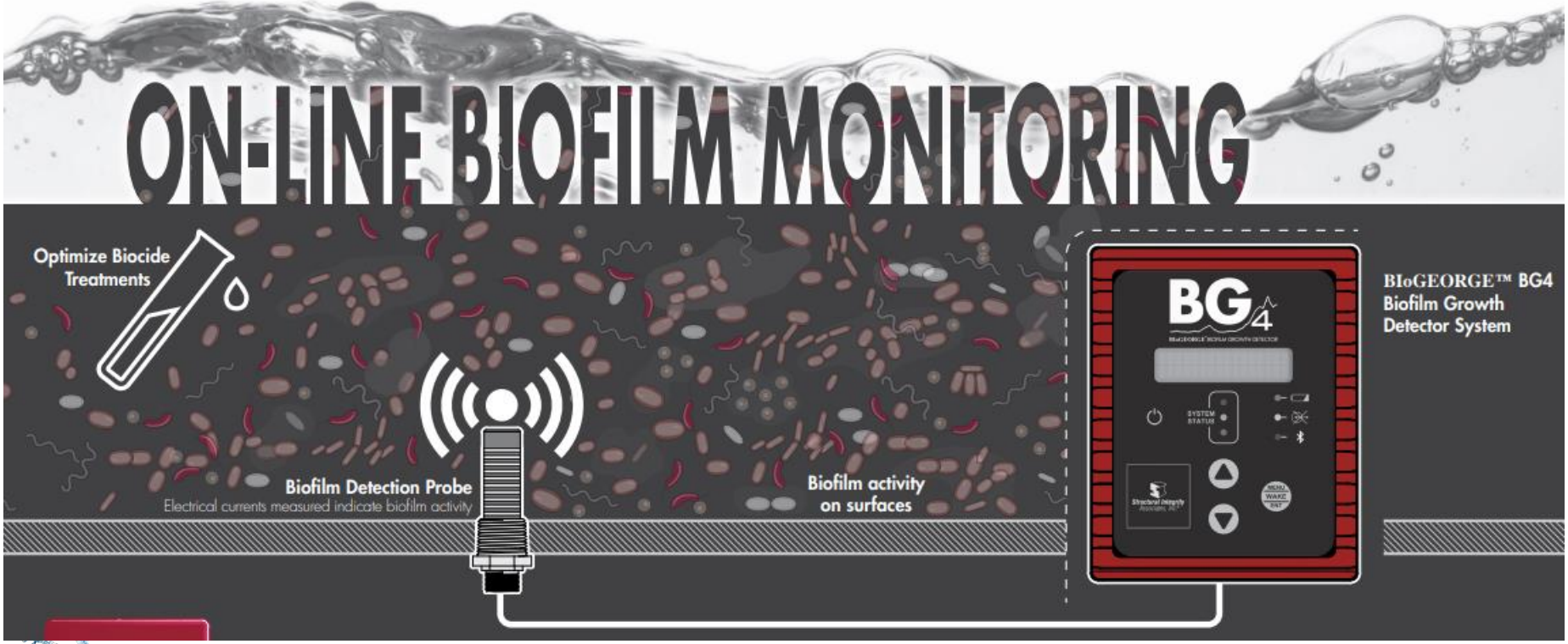
On-line methods for monitoring biofilm activity on metallic surfaces provide the system operator with the necessary information to control biofilms effectively and economically by initiating mitigating actions before significant damage is incurred. Of equal importance, an on-line monitor allows optimization of the concentrations and addition frequencies of water treatment chemicals and adjustment of maintenance schedules, thus avoiding over-treatment of the water and reducing operating costs. The **BIoGEORGE™ BG4 Biofilm Growth Detector System** utilizes electrochemical methods to provide these on-line functions. A probe electrode stack, comprised of a series of stainless steel or titanium discs, is subjected to intermittent polarization to a pre-set DC potential. Biofilm activity on surfaces is detected by an increase in the **applied electrical current** required to achieve that potential. As a biofilm becomes established, the biofilm may also generate a current during times when the applied potential is off. The measured applied and generated **electrical currents** are proportional to **biofilm activity**.

ON-LINE BIOFILM MONITORING



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ENWANEX audit equipment

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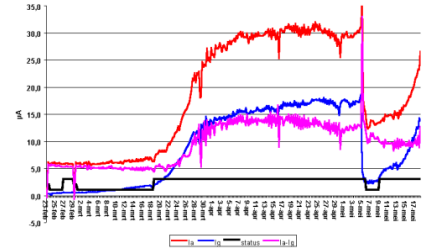
ENWANEX outcome

Biofilm dashboard



Energy/CO2 dashboard

Exchanger Performance

Energy/pinch calculations

Comparison between actual situation and design situation detects and finacially quantifies improvement possibilities.

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Possible value paths based on ENWANEX audit:

Advantage / value claim	Benefit	Financial
1. Reduced corrosion	Asset protection	Lower replacement costs →
2. Clean heat exchanger surfaces	Improved heat transfer	Lower energy related costs and or higher output → €
3. Better bio-film control/removal	- Lower Legionella risk - Less bio dispersant needed	-good company citizenship / protect employees - Lower cost of bio dispersant →
4. Reduced Disinfection by -product formation (AOX/ THM/ chlorates/ …)	Avoid discharge fines / strengthen comply with company targets and policy	- good company citizenship / improve environmental profile
5. Cleaner packaging (high efficiency packaging)	Lower approach temperature	Lower energy related cost and or higher output →
6. Less destruction of organic water treatment chemicals (including Cu & Fe corrosion inhibitor and dispersants)	Lower water treatment cost	Lower treatment cost →
7. No/less biodispersant needed	Lower total water treatment cost	Lower treatment cost
8. Higher bleach efficiency/effectiveness	Lower bleach consumption/ cost	Lower bleach cost →

"Hard financials" → possible to quantity, put agreed money value → IMCHLO to help

"Soft financials" → difficult to quantify, agreement on value

= quantifiable

*: as compared to none DMH use

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