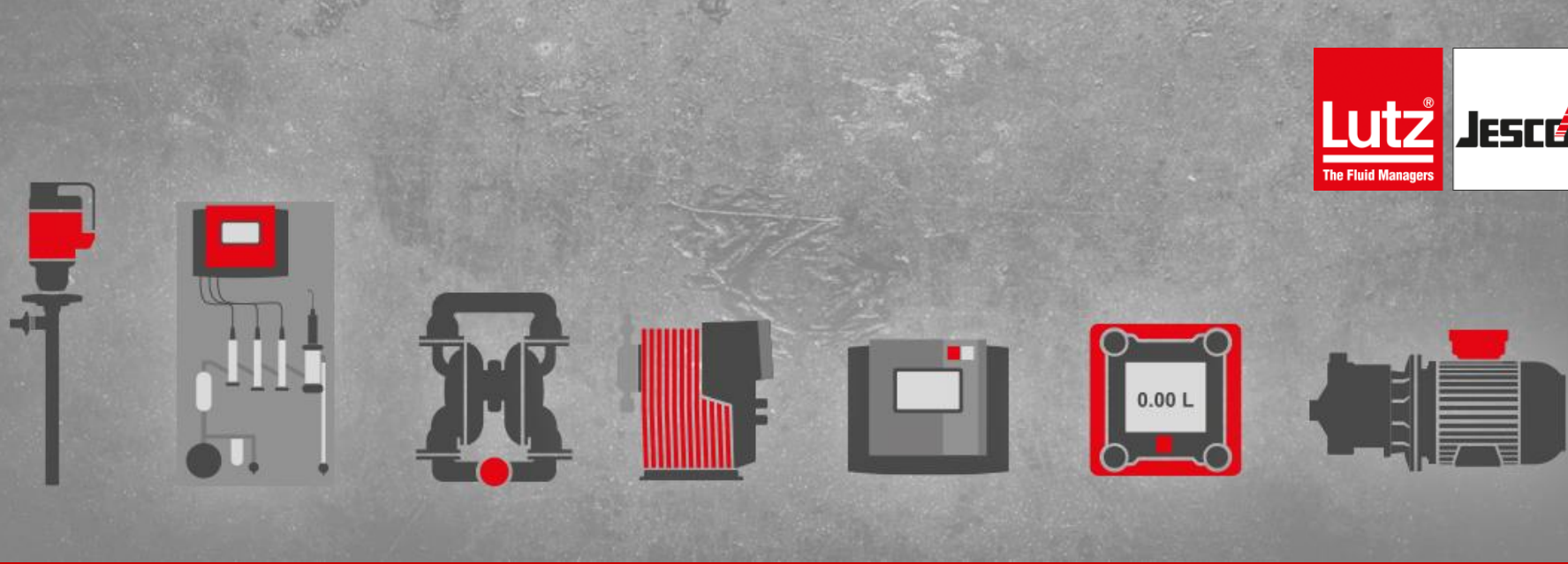
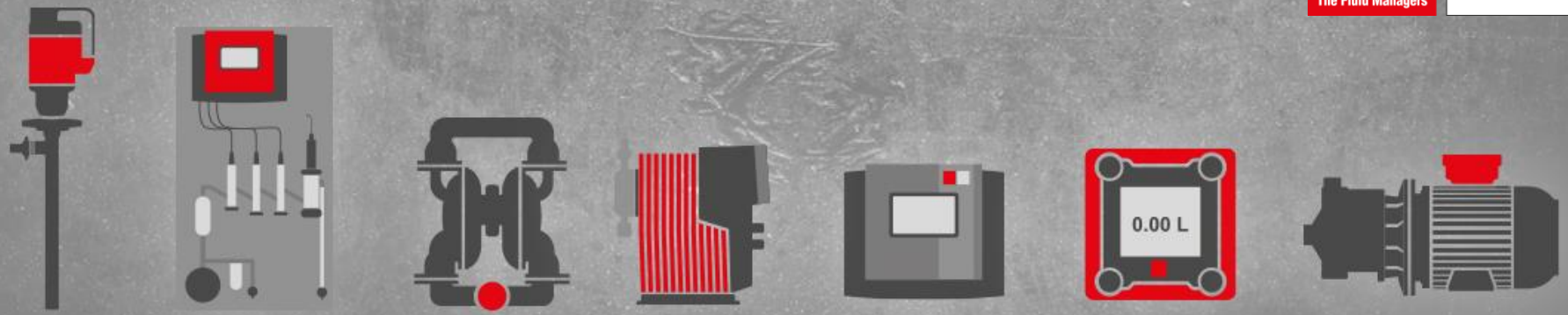


Legionella: principais aspetos a considerar na escolha de um sistema de desinfeção e monitorização da qualidade da água em redes de distribuição, prediais (todas) e AQS no específico

Albufeira, 05 de Junho de 2024

safety is our concern

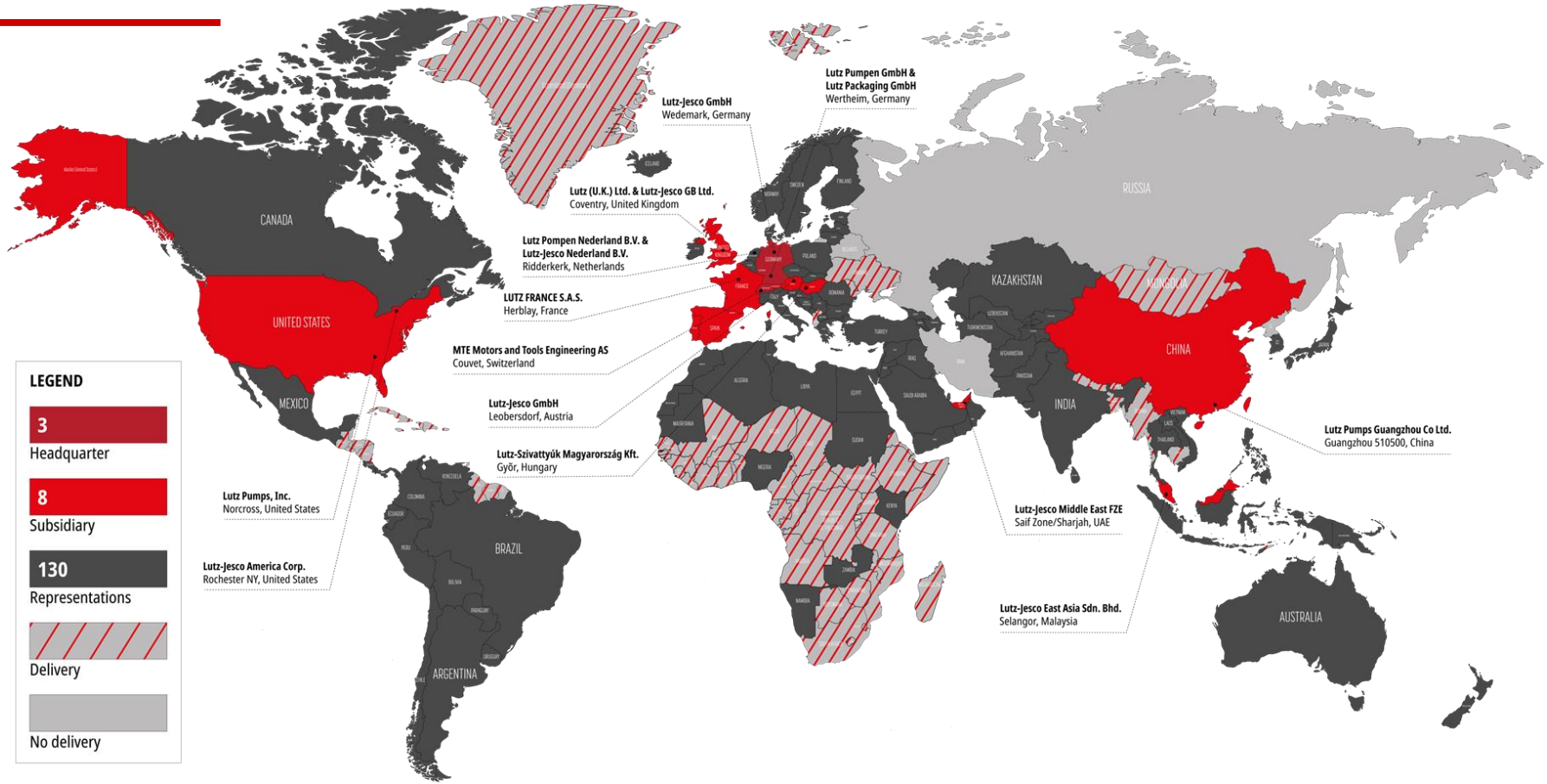


Lutz Group

Lutz Pumpen | Lutz-Jesco | MTE Motors

safety is our concern

Worlwide


Lutz-Jesco GmbH
Wedemark, Germany
Lutz Pumpen GmbH &
Lutz Packaging GmbH
Wertheim, Germany
Lutz (U.K.) Ltd. & Lutz-Jesco GB Ltd.
Coventry, United Kingdom
Lutz Pompen Nederland B.V. &
Lutz-Jesco Nederland B.V.
Ridderkerk, Netherlands
LUTZ FRANCE S.A.S.
Herblay, France
MTE Motors and Tools Engineering AS
Couvet, Switzerland
Lutz-Jesco GmbH
Leobersdorf, Austria
Lutz-Szivattyúk Magyarország Kft.
Győr, Hungary
Lutz Pumps, Inc.
Norcross, United States
Lutz-Jesco America Corp.
Rochester NY, United States
Lutz-Jesco Middle East FZE
Saif Zone/Sharjah, UAE
Lutz-Jesco East Asia Sdn. Bhd.
Selangor, Malaysia
Lutz Pumps Guangzhou Co Ltd.
Guangzhou 510500, China
CANADA
UNITED STATES
MEXICO
BRAZIL
ARGENTINA
RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
INDIA
AUSTRALIA
LEGEND
3
Headquarter
8
Subsidiary
130
Representations
Delivery
No delivery

Milestones

History

- **1954** the company **Karl Lutz** Maschinen- und Apparatebau was founded
- International expansion through the establishment of subsidiaries
- Patented solutions for more environmental protection and operational safety (complete drum emptying)
- Expansion of the business fields through the takeover of further companies

Lutz Pumpen GmbH

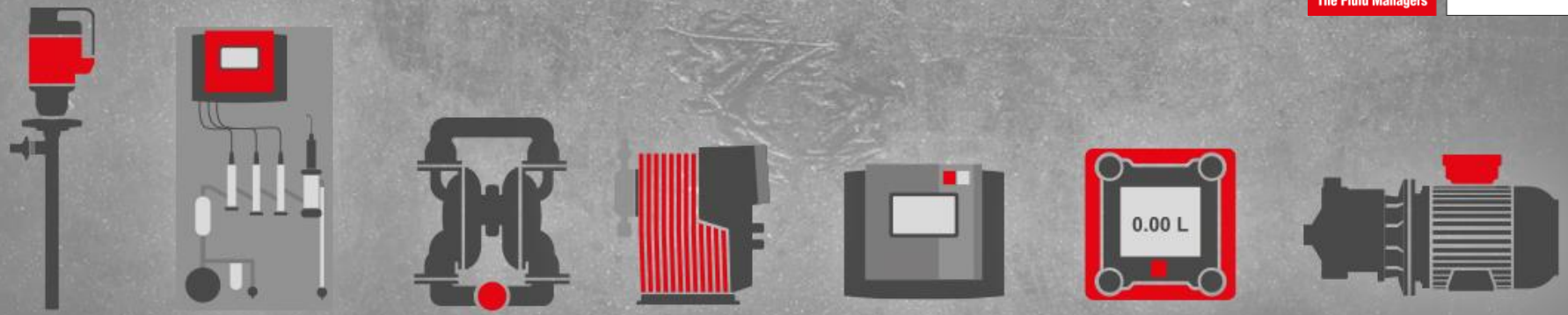
safety is our concern

MTE Motors and Tools Engineering SA

The constructive driving power

Lutz-Jesco GmbH

The right dose of progress

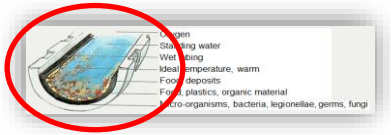


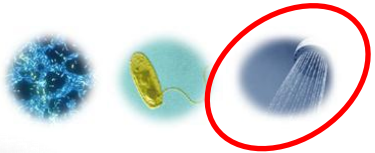
Legionella

safety is our concern

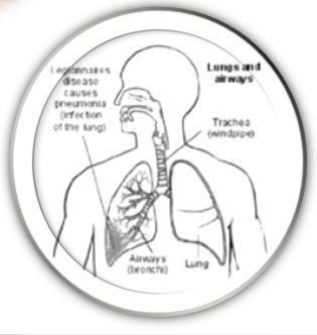
Legionella: what about?

- **Water flows into pipes**, pipes get older, biofilm born and grow into pipes, and Legionella grows into biofilm. Legionella:
  - OR it comes from municipalities;
  - OR it grows into infrastructure directly as: cooling tower, hot water and/or cold water in building, sprinklers, irrigation network, any similar.

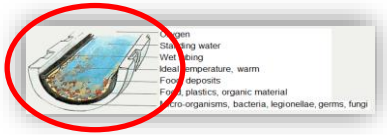


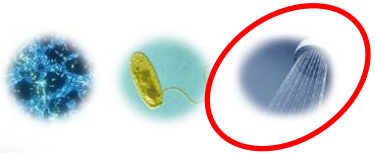


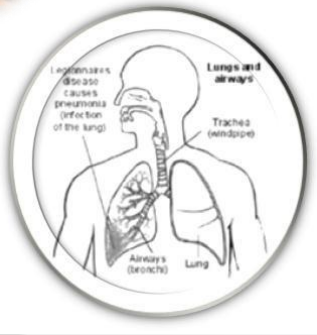
- Once water containing biofilm/legionella, the bacteria is not dangerous if drank, but if it is dangerous if it is in the **air** and we breathe it: legionella bacteria goes into our lungs, and that is what can cause pneumonia.



Legionella: what about?



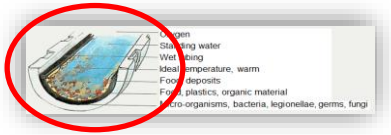




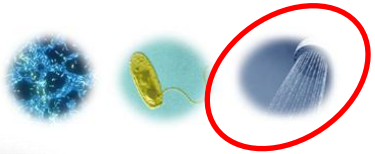
Biofilm in cooling tower - **Biofilm in pipes**

Legionella: what about?

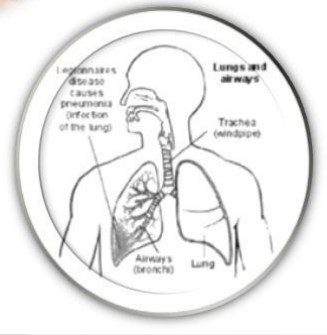
Solutions to fight Legionella are mainly:



- **Thermic treatment** (use of very high temperature in the water):
  - it kills bacteria (and damage piping and human skin), no effect on biofilm
  - it is expensive, and bacteria would grow and rise-up back again after temperature goes down again (because biofilm is still there)



- **Chemical treatment:**
  - ***Use of biocides as chlorine (Cl2) and chlorine dioxide (ClO2)***:
    - Prevent (and partially destroy the existing biofilm in case of ClO2);
    - Kill the bacteria;
    - It allow to save money by avoiding high temperatures.



Final target: to define actions (treatment and maintenance)

Swimming Pool & SPA

Cooling tower

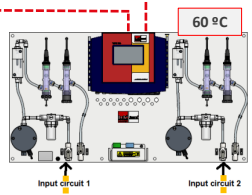
CLOUD, SCADA
Any other

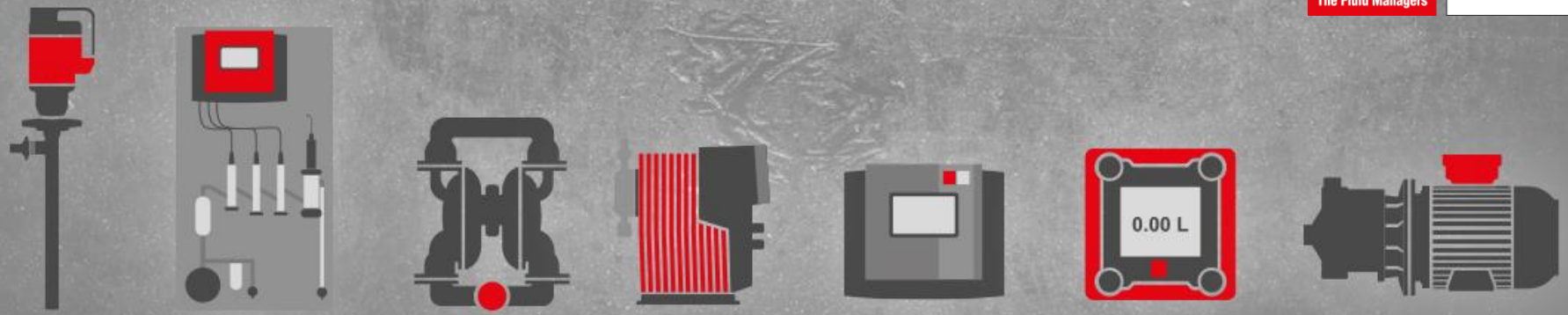
Irrigation

COLD WATER RESERVOIR

INLET

HOT WATER Reservoir

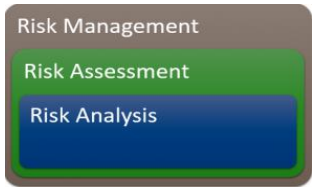




Key points to consider

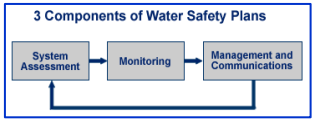
safety is our concern

Risk Management > Risk Assessment > Risk Analysis



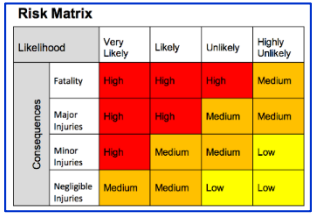
Risk Management.

is the **continuing process to identify, analyze, evaluate** and treat loss exposures and monitor risk control and financial resources to mitigate the adverse effects of loss, ***typically also described as*** the **Identification, Analysis (or Measurement), Treatment and Monitoring of risk**.



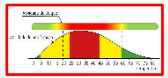
Risk Assessment.

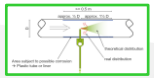
it is primarily concerned with the **Identification and Analysis phases, and includes processes and technologies** that identify, evaluate, and report on risk-related concerns. This process is a "key component" of the risk management process.



Risk Analysis.

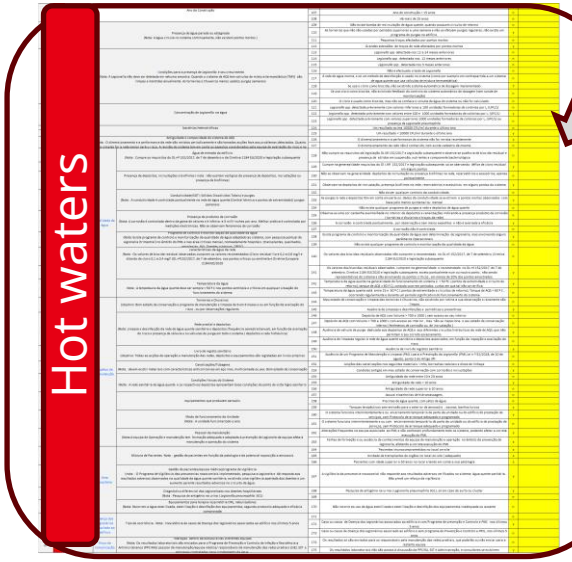
It can be considered the evaluation component of the broader risk assessment process, which determines the significance of the identified risk concerns: it is the actual **quantification of risk** (i.e. **calculating the probability and magnitude of loss**).



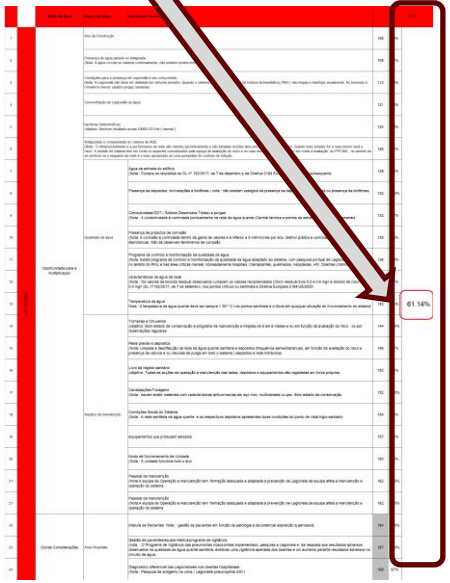


https://www.healthguardsecurity.com/difference-between-risk-management-and-risk-assessment/

Notes about *Risk Management* > *Risk Assessment* > *Risk Analysis*



Hot waters



Cold water

Cooling towers

...

...

Home Missão Equipa Contacto

Legionella Risk Assessment Form

Available soon

Form sample

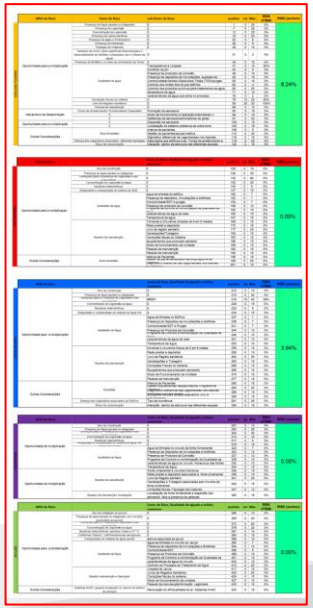
Risk analyses => actions (treatment and maintenance)

Know your own system first

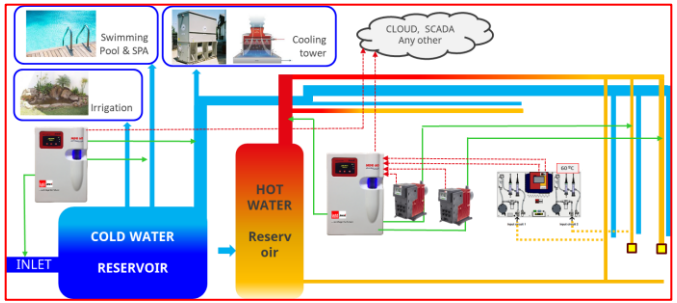
water quality status (pH, biocide in use and residual along piping, temperature)

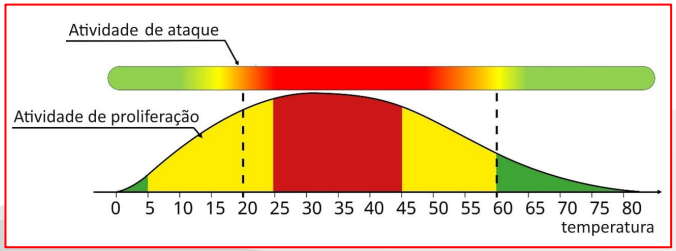
water flow, piping status, end points, etc..

Analyse and quantify risk's

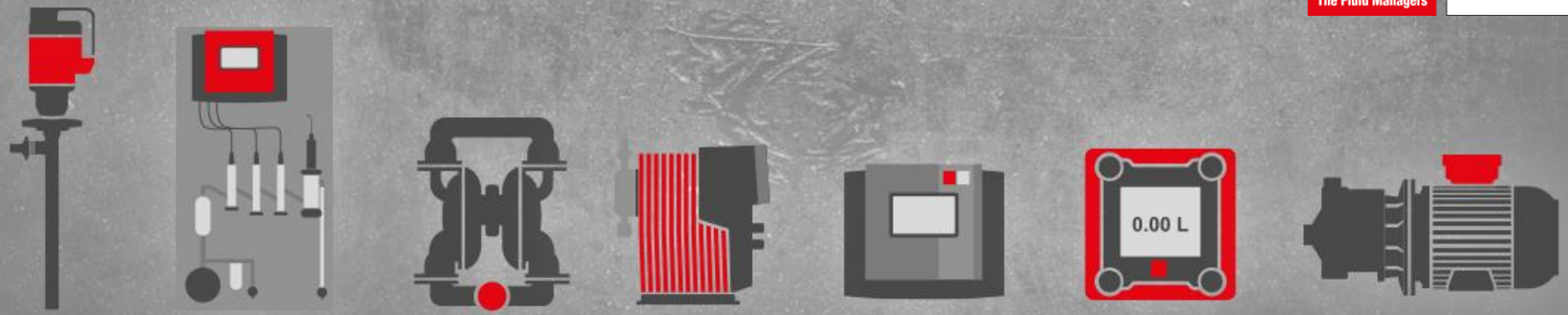


Look for solutions to be implemented vs thermic and/or chemical compatibility





Compare alternatives in the market and do it



Treatments:
Thermic, chemicals, others

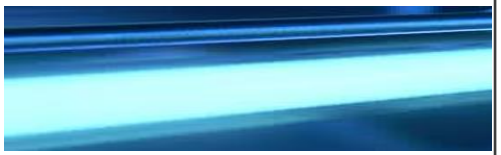
safety is our concern

Disinfection Methods Comparison:

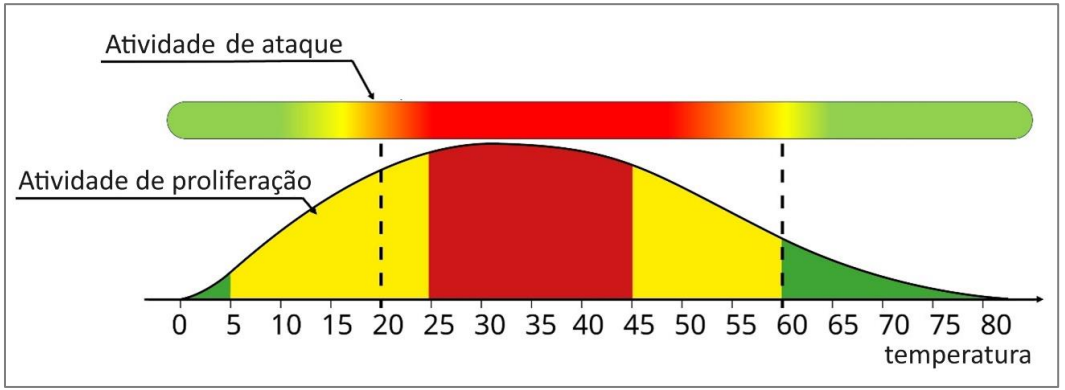
Non-chemical

Air bubble,
Filters,...

UV



temperature



Preliminary remarks about chemical treatment

re-chlorination in drinking water ⇔ water treatments against Legionella:

Very similar or different?
They demands similar skills and products:

- Need of **analytical instruments**, meaning:
  => biocides (and eventually: also same in-situ generators)
  => dosing
  => monitoring

- Need of **operators** that understand water treatment (or it may work, but it won't work effectively)

- Need to **avoid biocide degrades to bio-products**:
  => municipalities: mainly because of new EU Drinking directive
  => buildings: mainly because the more it the degrades, the less it is effective against Legionella
  => Both have same issues: **water consumption might be seasonal and/or changes during week-end..**

Disinfection Methods Comparison:

chemicals	organhalogenic disinfection byproducts	inorganic disinfection byproducts	non-halogenic disinfection byproducts
chlorine (Cl_2)/ hydrochloric acid (HOCl)	trihalomethanes, halogenic acetic acids, haloacetonnitrils, chlorine hydrates, chloropicrin, chlorophenols, N-chloramines, halofuranones, bromohydrins,	chlorate (particularly the application of hypochlorite)	aldehydes, alkanic acids, benzene, carboxylic acids
Chlorine dioxide (ClO_2)		Chlorite Chlorate	unknown
chloramines (NH_3Cl etc.)	haloacetonnitrils, cyano chlorine, organic chloramines, chloramino acids, chlorohydrates, haloketons,	nitrite, nitrate, chlorate, hydrazine	aldehydes, ketons
ozone (O_3)	bromoform, monobromine acetic acid, dibromine acetic acid, dibromine aceton, cyano bromine	chlorate, iodate, bromate, hydrogen peroxide, underbromic acid, epoxy, ozonates	aldehydes, ketons, ketoacids, carboxylic acids

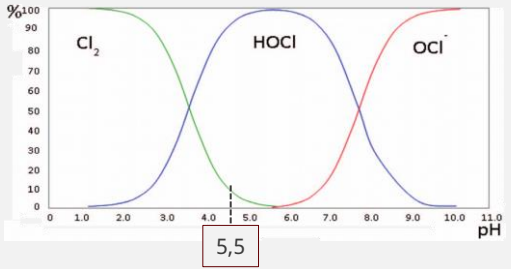
Disinfection Methods Comparison:

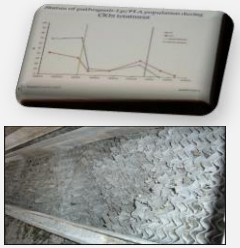
	Liquid/gaseous chlorine in bottles	Commercial Sodium hypochlorite 12-15%	On-site Electro-chlorination	On-site ClO2
Advantage	- 100% pure disinfectant - Recommended by the World Health Organization (WHO) - Limitless stability of the product - At hard water (>15°dH) no additional dosing of PH-regulating chemicals required - Easy to operate due to the matured vacuum dosing technology - Exact dosing possible by automatic control valves	- Low system investment costs - Simple and safe in the application at prescribed handling - Exact dosing possible due to automatic control	- High safety due to handling only salt. - Eliminate delivery & handling of hazardous chemical - Eliminate injection point scaling and pump air-locking associated with commercial sodium and calcium hypochlorite - High stability and less chlorate building in the product due to the low chlorine concentration (<10 g/l) - Lower operational costs and material consumption compared to commercial sodium hypochlorite and calcium granulate	- Up to 2 times better disinfection efficiency compared to chlorine - Mostly no dependence to PH-value - High Depot efficiency, long time stable in the distribution lines, great for destroying biofilm - Neutral in taste and smell - No disinfection by products like THM or Chloramines - No formation of organic compounds because as oxidant, it exchanges "*e-*" and destroy the molecule, it does not change the formula of the molecule..
Disadvantage	- High System investment costs - Intermediate piping system and installation required - Relative high spare requirement and handling/transport/storage issue of the bottles or drum. - High safety issue. Expensive safety equipment and well trained staff required.	- Product costs almost 300% higher than chlorine gas due to only 12-15% chlorine content - Strong PH-reducing chemicals like hydrochloric acid required. - Scaling issues at middle hard waters. High blocking rate at injection point, piping and pump valves. - Low conductivity; average chlorine loss of 1 g/liter/day; after 6 months only alkine without chlorine available. The chlorine loss is accelerated by UV and temperature. - High accident danger due to mixing with acid solutions.	- Fresh water feed required due to the increased salinity in the product. - High System investment costs - High replacement costs of the electrolyzing cells after max 5 years (up to 30% of the initial system costs) - Lifetime of the cells and the quality of the product is strongly depending on the salt specification and the water quality	- High system investment costs - ClO2 is much instable, sensitive to UV and temperature - ClO2 tends to degassing - High system security and staff training required. - Accident danger due to mixing of the reagents.

Disinfection Methods Comparison:

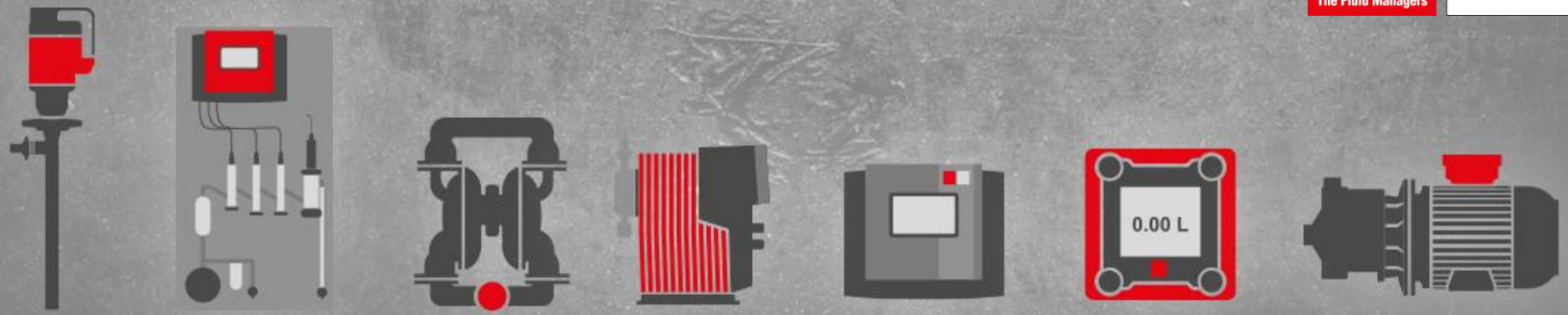
Disinfectant	Drinking water limits			
	guideline	Europe	USA	WHO: World Health Organization
Chlorine	Min. 0.1 ppm Max. 0.3 ppm	0,3 ppm	1,5 ppm	4 ppm
Chlorine dioxide	Min. 0.05 ppm Max. 0.4 ppm	0,2 ppm	0,8 ppm	0.8 ppm
Ozone	Max. 0.05 ppm	0 (zero)	0 (zero)	0 (zero)

Legionella





☆	Chlorine		
☆☆	Chlorine dioxide		
☆☆	Monochloramine		
?	Ozone		



Chemical treatment (in detail)

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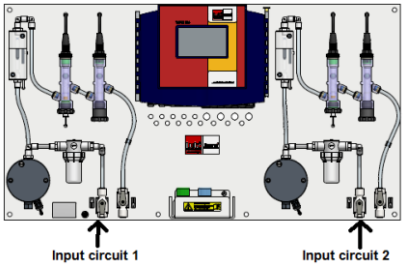
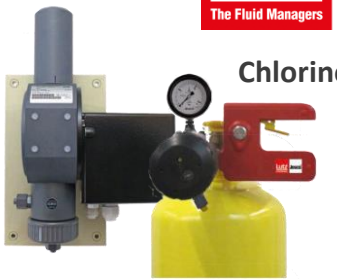
Dosing pumps & accessories



Measuring and control water sample system



Chlorine gas

Cl2, ClO2 Gas Warning Units

Chemical Dosing / Boiler feed tanksets

Sodium Hypochlorite Generator (MiniChlorGen)

Chlorine Dioxide Generator

Biocide degradation to bioproducts means it is not any more effective as biocide…

Sodium hypochlorite (NaOCl) and chlorates (ClO3-)

Chlorine can be sourced in multiples ways:

- **OR by concentrated sodium hypochlorite.** In this case, production is from an **industrial process** using specific membrane that in the best case produce sodium hypochlorite in **between 17% and 14%** concentration and without ClO3-, but product quickly and fast ***degraded to ClO3-***, continuing degradation until final injection into drinking water..

- **OR by sodium hypochlorite produced in-situ via electrolyses** Since Hypo concentration is very low **(0,6% concentration), it can be stored even weeks or months without any significant degradation**.

- **OR chlorine gas, in that case no ClO3- exists.** Remark, cost of production is cheaper than other biocides, it is typically used in industrial process (Egypt), as groundwater to bigger Drinking Water Treatment Plant (pre-oxidation and final disinfection).

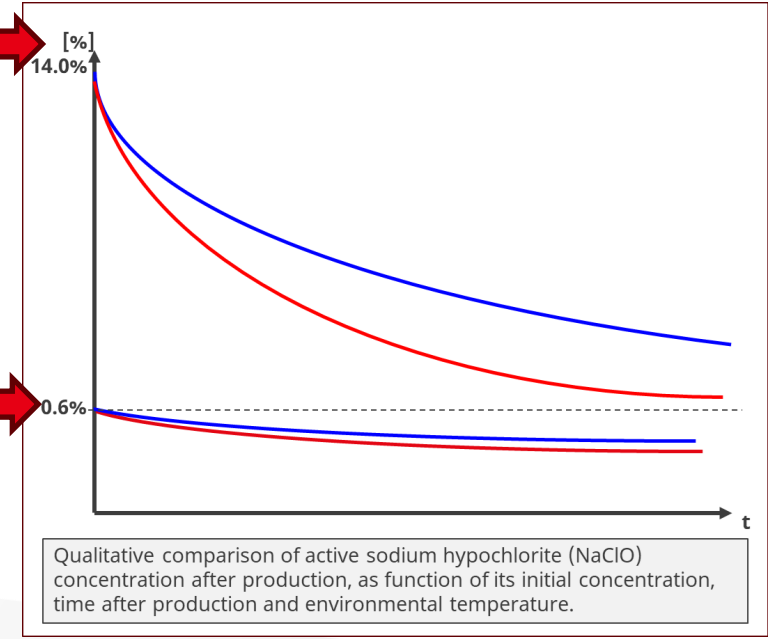
Chlorine dioxide (ClO2) and chlorites (ClO2-)

Against Legionella, chlorine dioxide can be provided**:**

- **OR as ready to be used:** powder/tablets to be mixed with water, or as stabilized ClO2 in liquid solution.

- **OR in-situ production:**
  - the most common in use is by reaction of diluted precursors as
    - HCl (Hydrochloric Acid) 9%
    - $NaClO_2$ (Sodium Chlorite) 7,5%, and in any case:
  - Reaction can take place as batch or in-line, and
    - **The more the final concentration is, 0,05% (0,5gr/l) to 0,2% (2gr/l), the more bio-products are.**
    - Wrong dimensioning of the generator, or no capability of the generator to lower final concentration and adapt to ClO2 demand along seasons (summertime vs wintertime).
    - also depending on the manufacture's know-how..

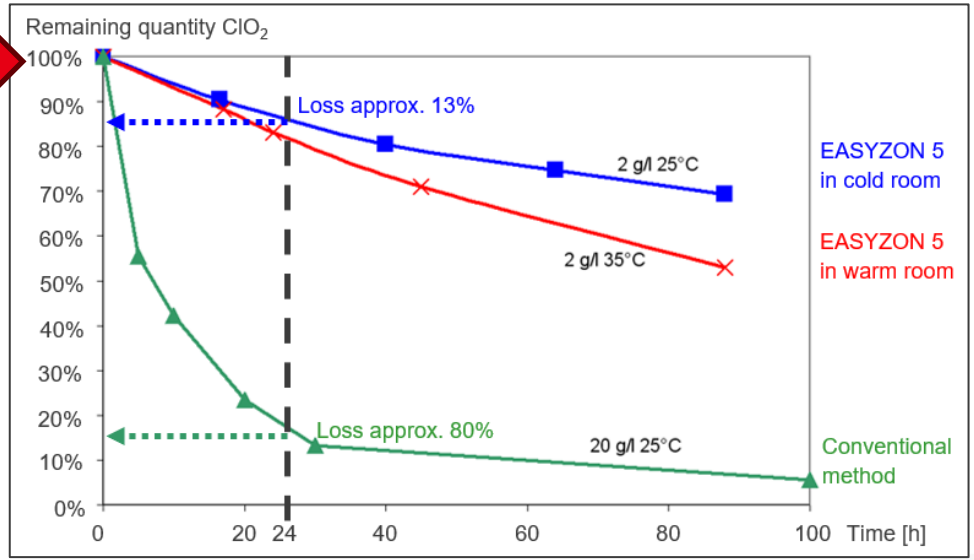
Sodium hypochlorite (NaOCl) and chlorates (ClO3-)



Qualitative comparison of active sodium hypochlorite (NaClO) concentration after production, as function of its initial concentration, time after production and environmental temperature.

Key words:
elsevier sciencedirect bleach decomposition

chlorine dioxide (ClO2) and chlorites (ClO2-)

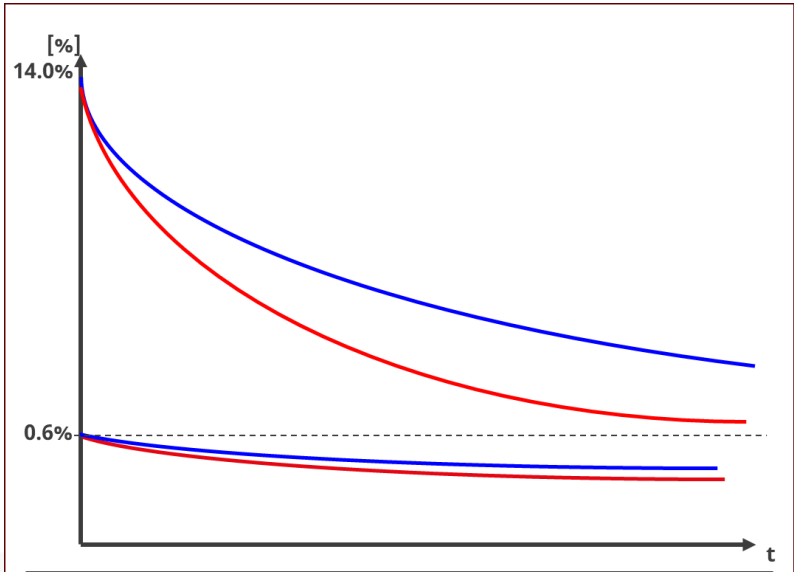


Qualitative examples of how to get low ClO2 degradation: high use of acid OR low final ClO2 concentration

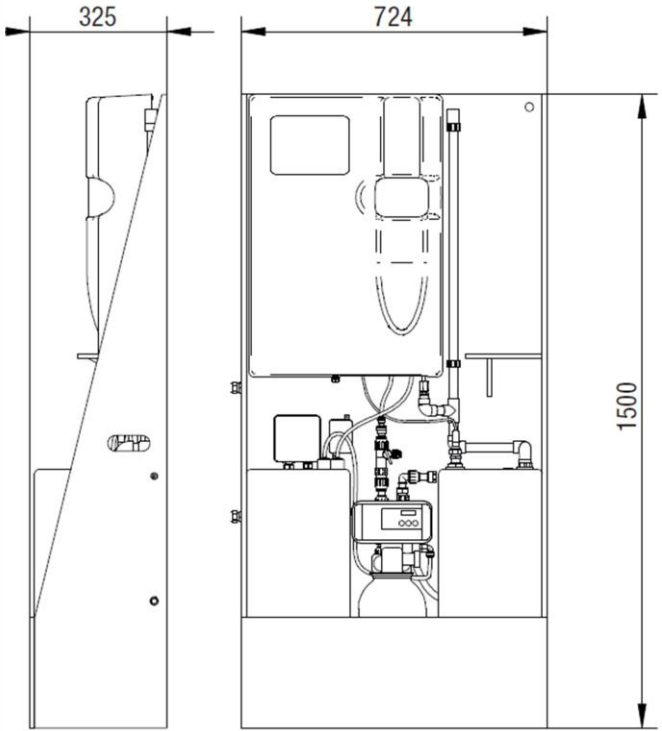
Key words: elsevier sciencedirect chlorine dioxide decomposition, decay

Sodium hypochlorite (NaOCl) generators:

MiniChlorGen, 30 g/h to 8500 g/h standard at 0,6% concentration

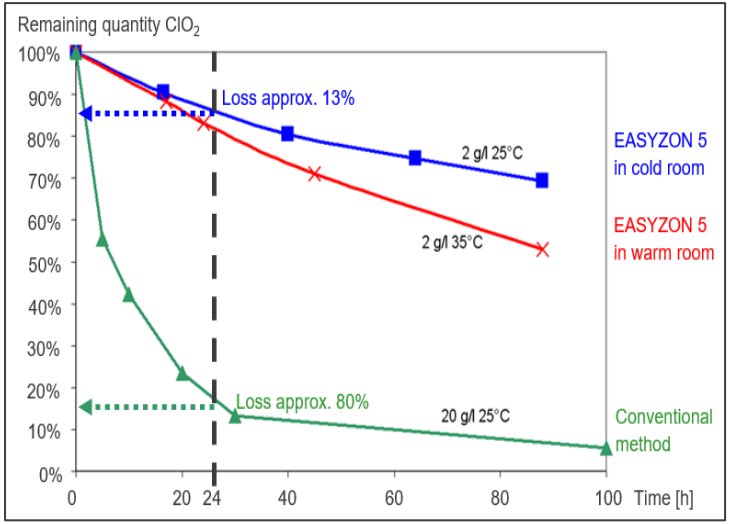


Qualitative comparison of active sodium hypochlorite (NaClO) concentration after production, as function of its initial concentration, time after production and environmental temperature.

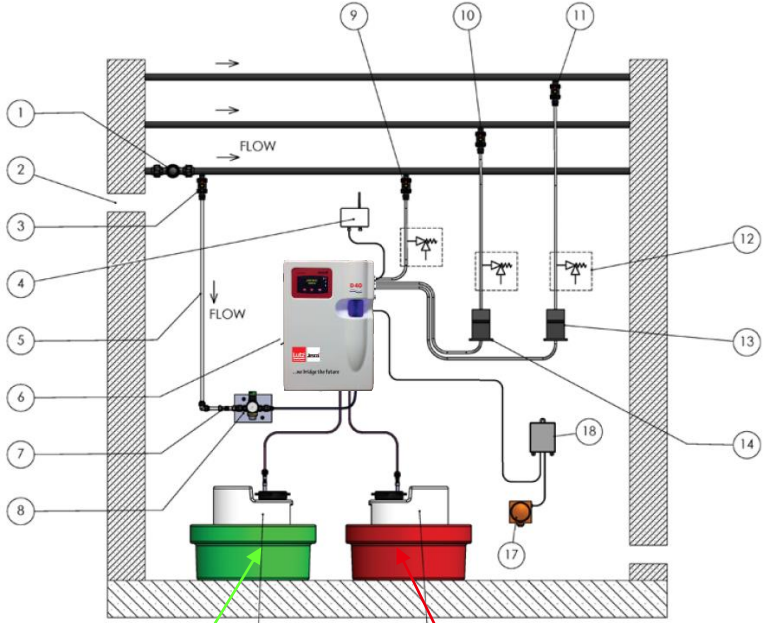


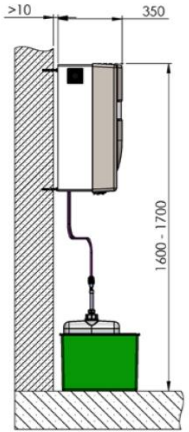
Chlorine Dioxide (ClO2) generators:

Easyzon, 5gr/h to 40g/h **down to 0,05% concentration**!!
And standard units up to 2Kg/h



Qualitative examples of how to get low ClO2 degradation:
high use of acid OR low final ClO2 concentration

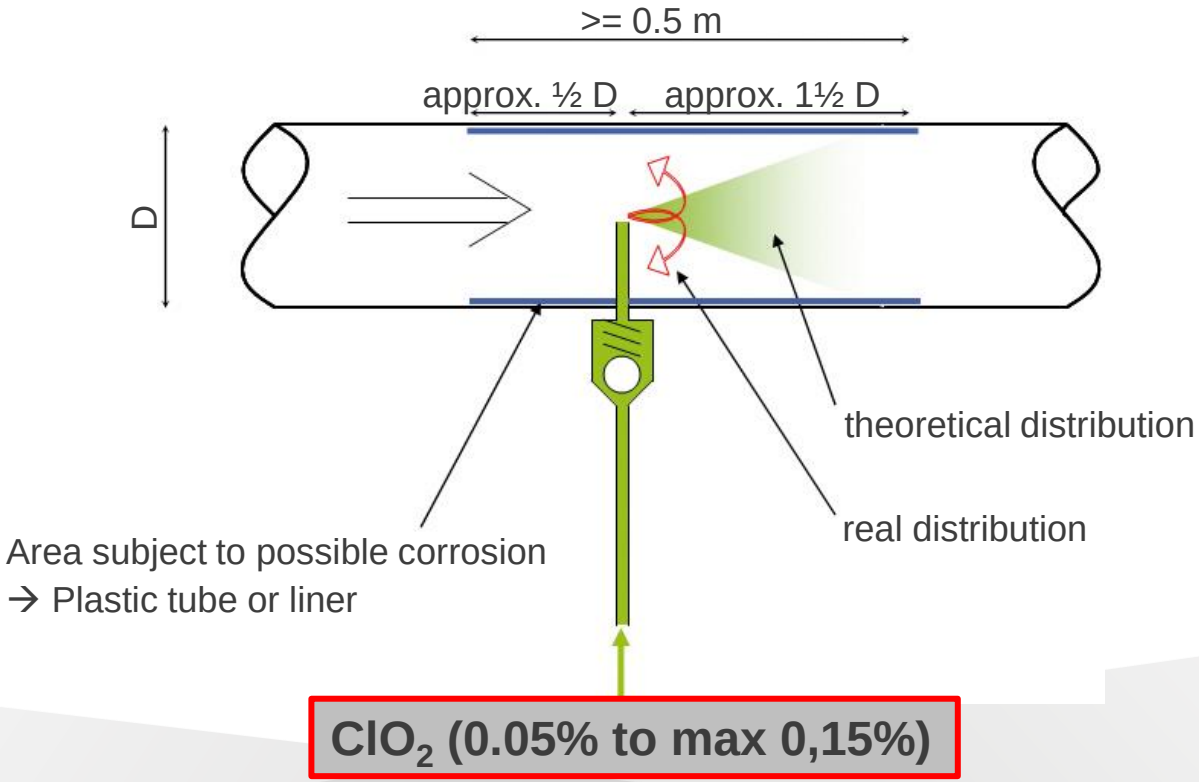




Hydrochloric Acid
HCl [9%]

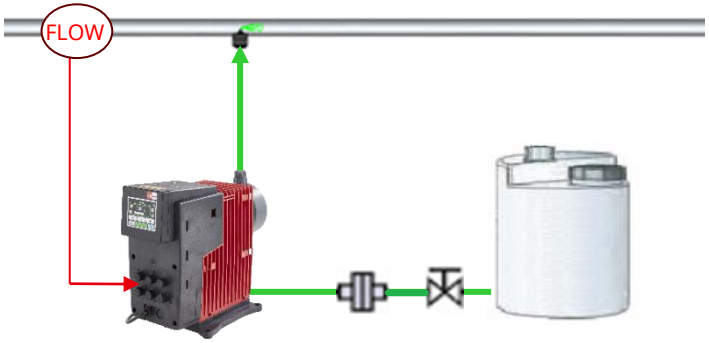
Sodium Chlorite
$NaClO_2$ [7,5%]

Measurement & Control: injection point (details)



Measurement & Control: general example

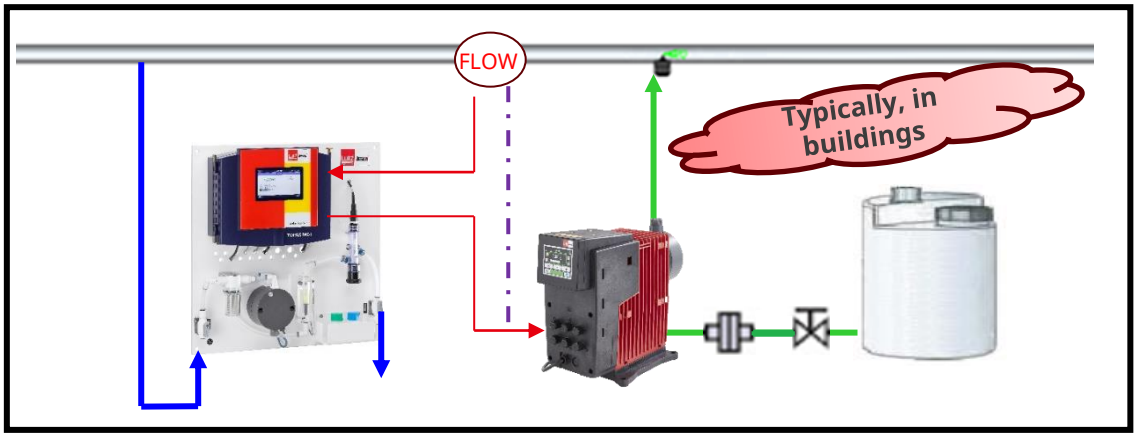
Flow signal to a dosing pump, dosing pump injecting a biocide

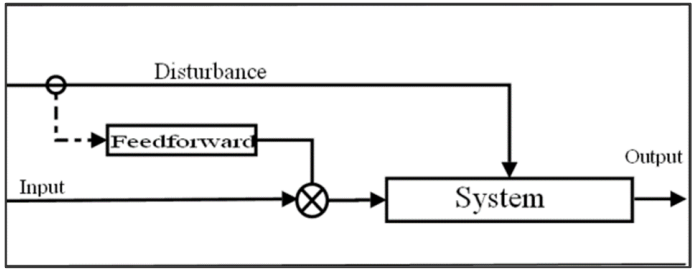


What Biocide?

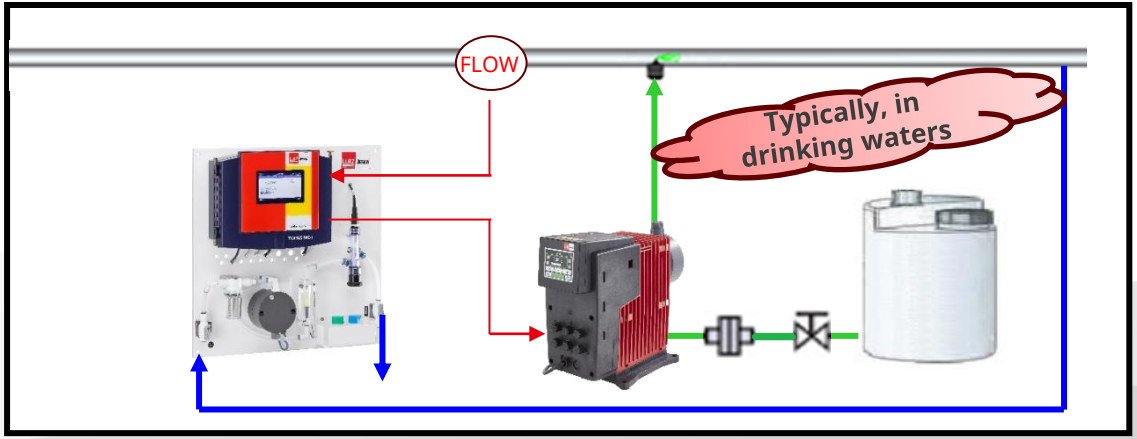
What concentration?

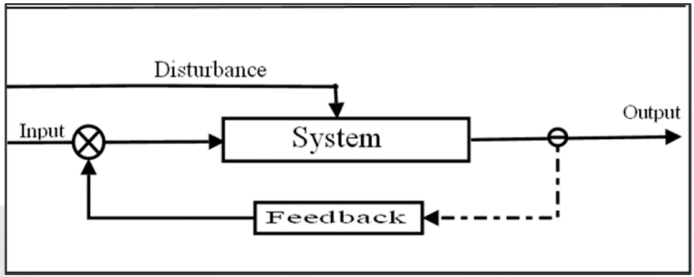
Measurement & Control: general example





feedforward >>>





<<< feedback

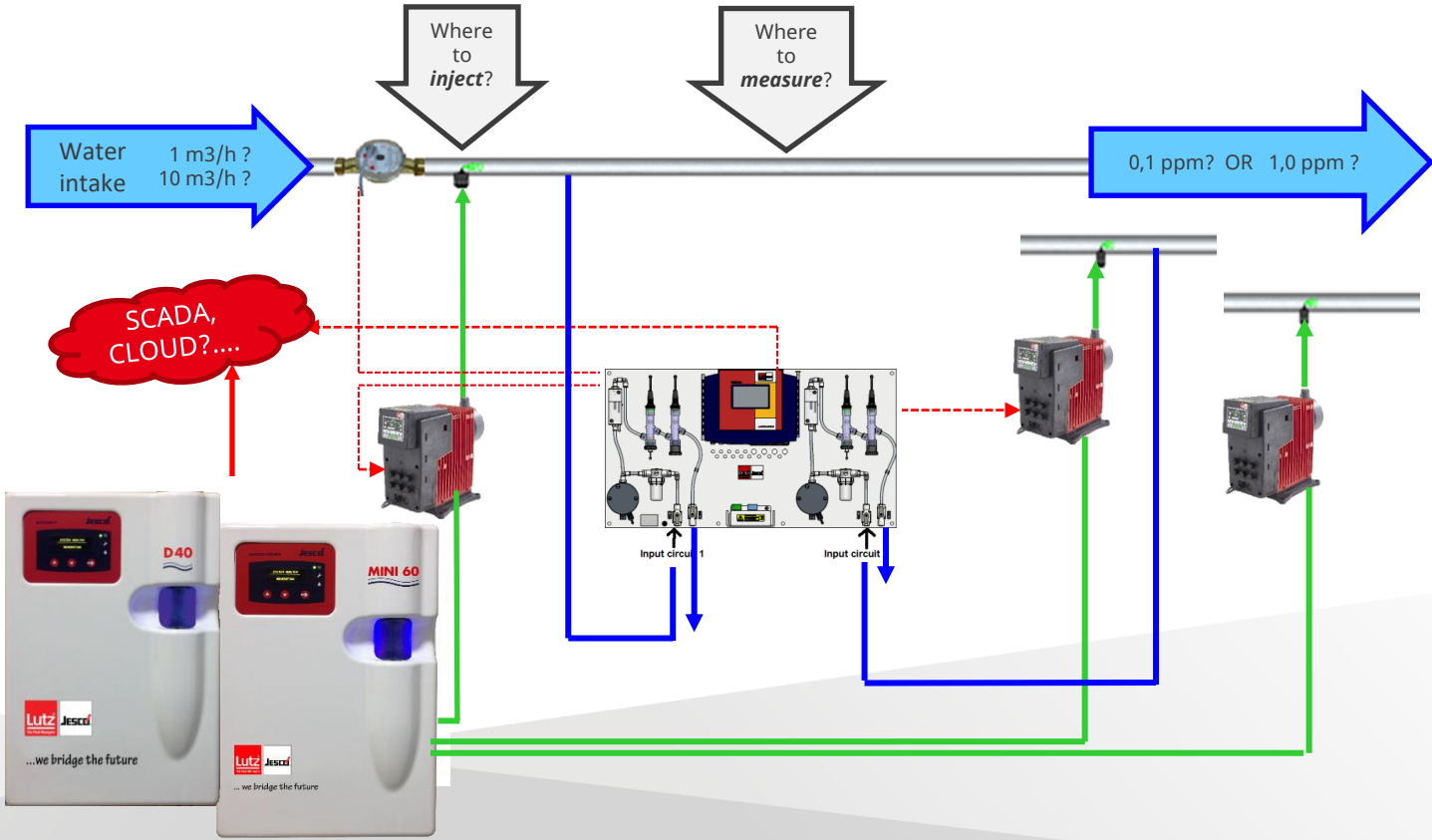
Measurement & Control: general example

do it well

do it right

do something

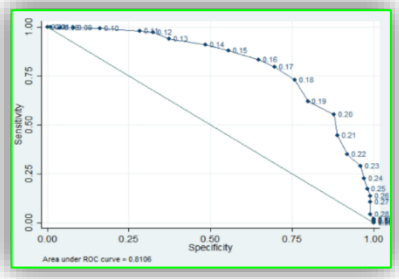
do nothing



Chlorine (Cl2) vs. chlorine dioxide (ClO2)

Chlorine:
Standard residual of 0,5 ppm it generally ok, BUT it doesn't means it is a safe water: cases of legionella still alive are registered even with shock treatment of even more than 50 ppm.
Why??

Chlorine dioxide:
In general, always better than chlorine, with ideally injection rate to get a residual vale in between 0,23-0,25 ppm (depends on several factors, including piping condition and material).
Lower concentrations are always better than chlorine.
Higher concentrations might generate corrosion (phosphate inhibitor might be necessary).



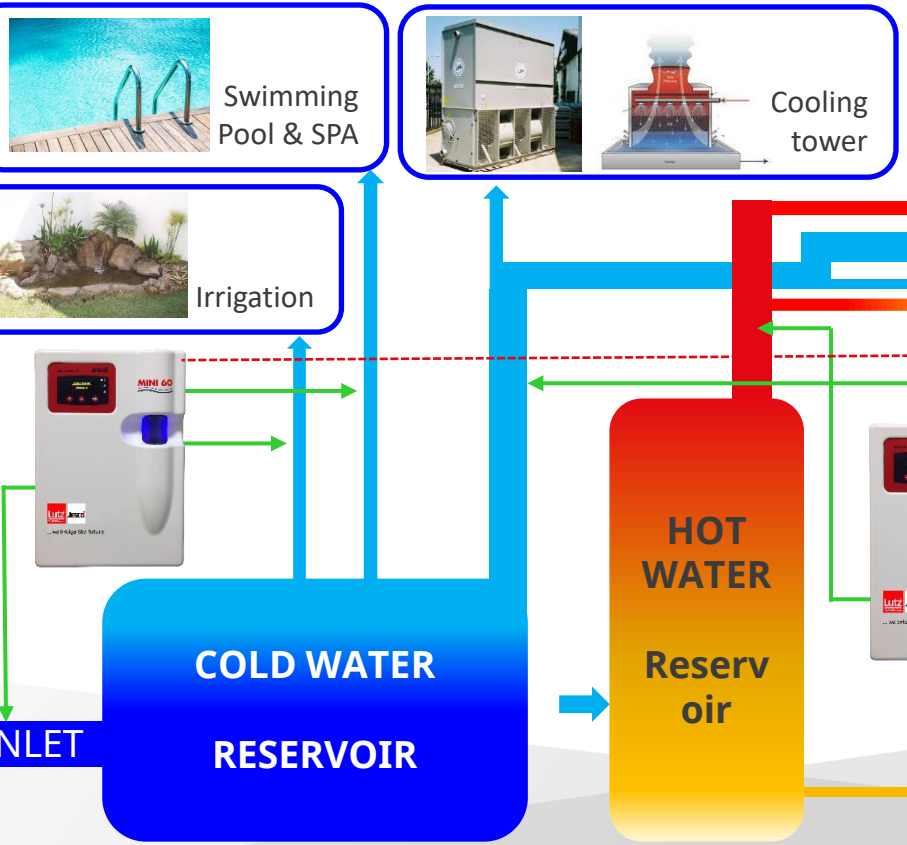
Pipe corrosion:

Material	temperature	Biocide
Plastic (the standard PP in use)	generally, not allowed more than 50 °C by manufactures	Some manufacture would not allow any biocide (unsense). Lower concentrations are required
Stainless steel	Ok with thermic treatment	Generally ok with biocide, except for higher concentration in any case

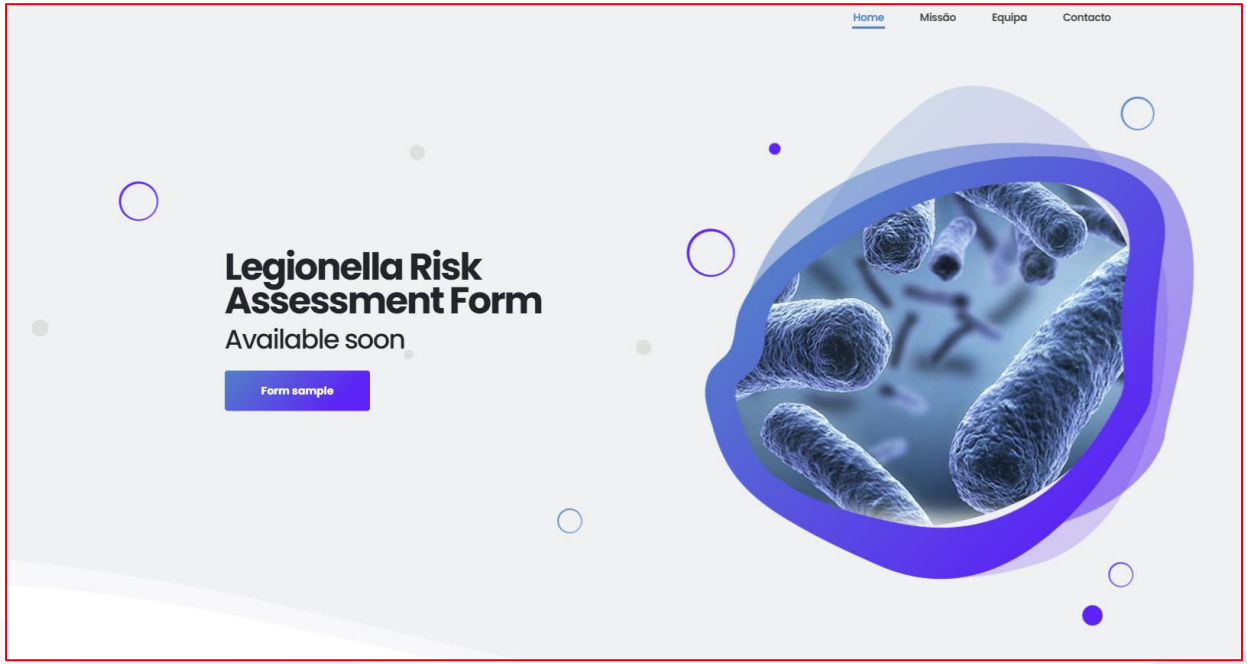
Right combination:

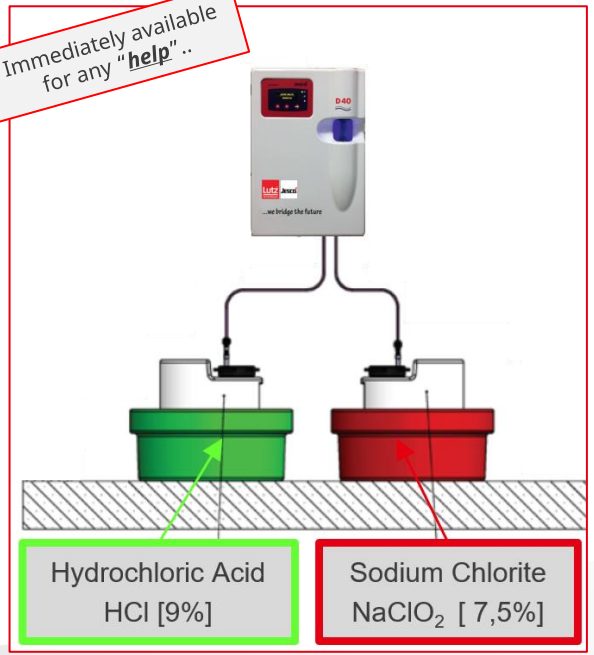
Reliable **generators** and reliable **monitoring and control system** (sensors and dosing pumps) to make sure biocide is *in real and correct dosage* and in the appropriate injection point

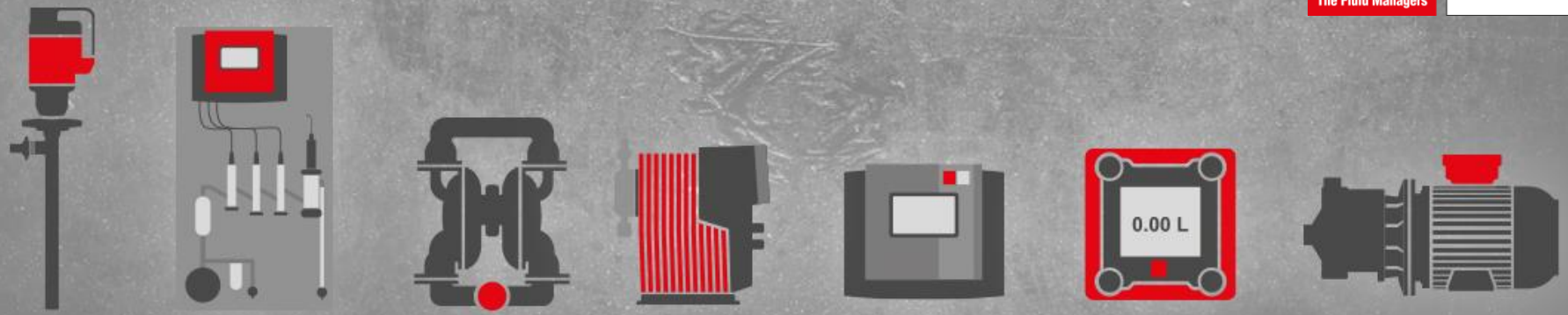
Final target: water treatment concept



Final remarks







Many thanks for listening – Any Q’s?

safety is our concern

Vincenzo Rocca
Area Sales Manager

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