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Mali- February 2018

High performance coagulant for drinking water

Kemira

Kemira: Where We are within Municipalities

Kemira: What We do for Municipalities

Corrosion prevention
Odour control

Suspended solids removal
Organic matter removal
Colour control
Disinfection
Filter aids
Metals removal
Odour control
pH-control
Sludge treatment

Suspended solids removal
Organic matter removal
Nutrients removal
Colour control
Disinfection
Filter aids
Metals removal
Odour control
pH-control
Sludge treatment

Kemira: Product Positions

- Coagulants number 1 in the world
  - Iron- and aluminium salts for drinking water and wastewater
  - Customized for maximum efficiency
- Polymers number 2 in the world
  - Poly-Electrolytes for water treatment, sludge management and industrial application

Unique capabilities in water treatment chemicals

PRODUCTS

Polymers
(EPAM, DPAM,
Polyamines,
PolyDADMACs,
Resin Amines)
Al Coagulants
Fe Coagulants
–
Antiscalants
Defoamers

APPLICATIONS

Raw water treatment

Waste water treatment

Sludge treatment
–
Membrane care

Biogas yield enhancement

CUSTOMER INDUSTRIES

Municipalities
–
Private operators
–
Industrial customers

Coagulant Chemistry and Flocculation

Kemira

What is an Inorganic Coagulant?

- Inorganic Coagulants is the common name for Aluminum or Iron Salts that are used in water treatment.

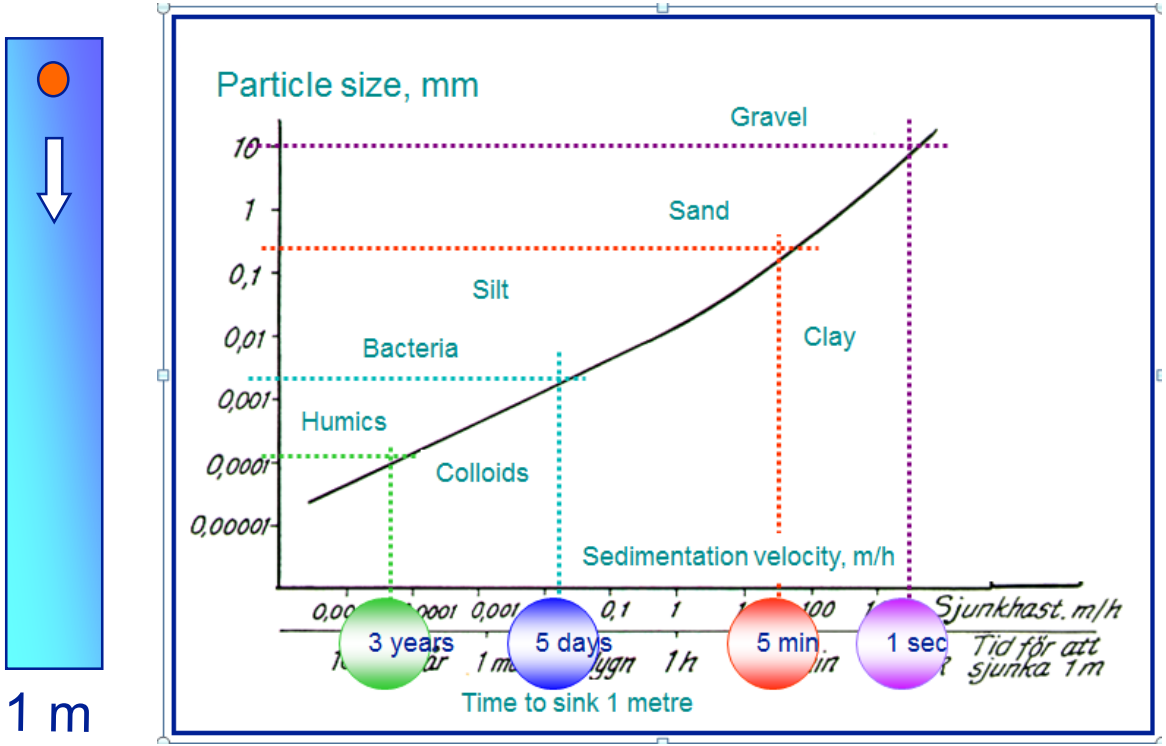
- Form flocs by reacting with water.

- These flocs incorporate suspended solids and colloidal material. This property helps to remove undesirable contents from water. Separation is done by sedimentation or flotation and/or filtration.

- This process is called coagulation or flocculation and is used as a first and important step in purifying water.

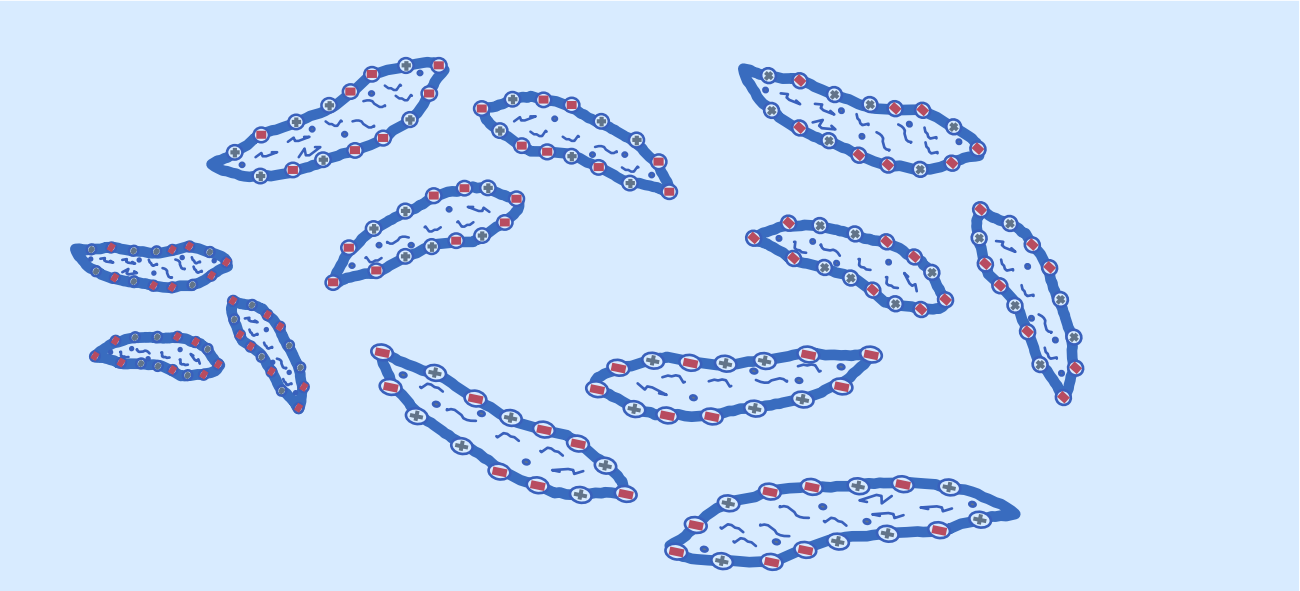
Chemistry of the water

Sedimentation velocity for particles in water



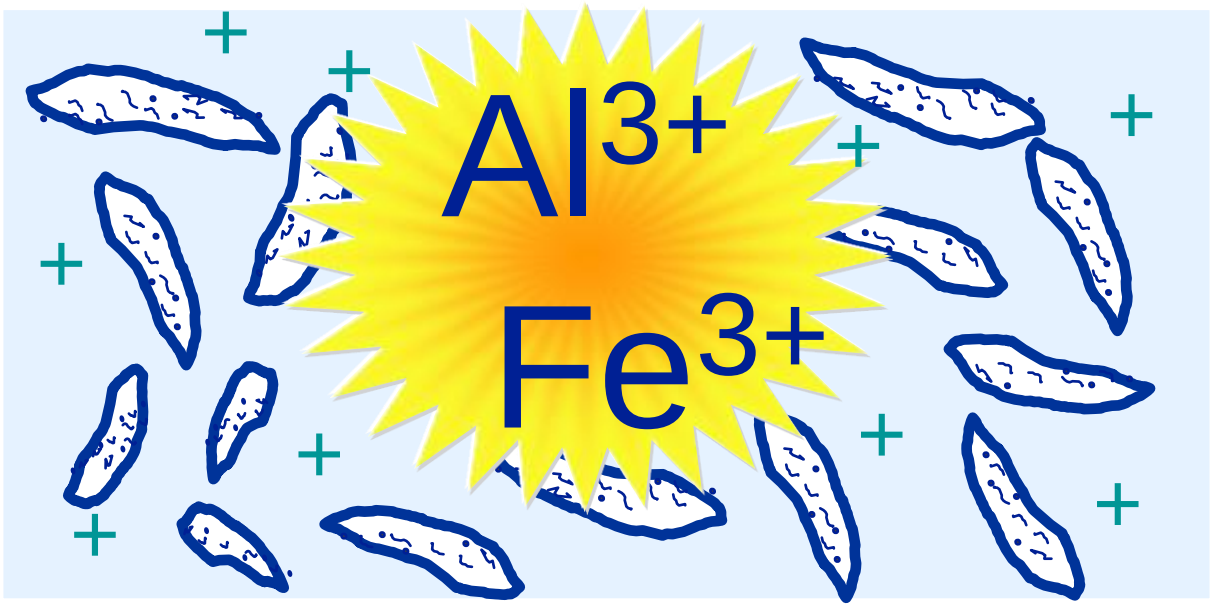
What happens when the coagulant is dosed to the water

Particles have negative net charge and repel each other



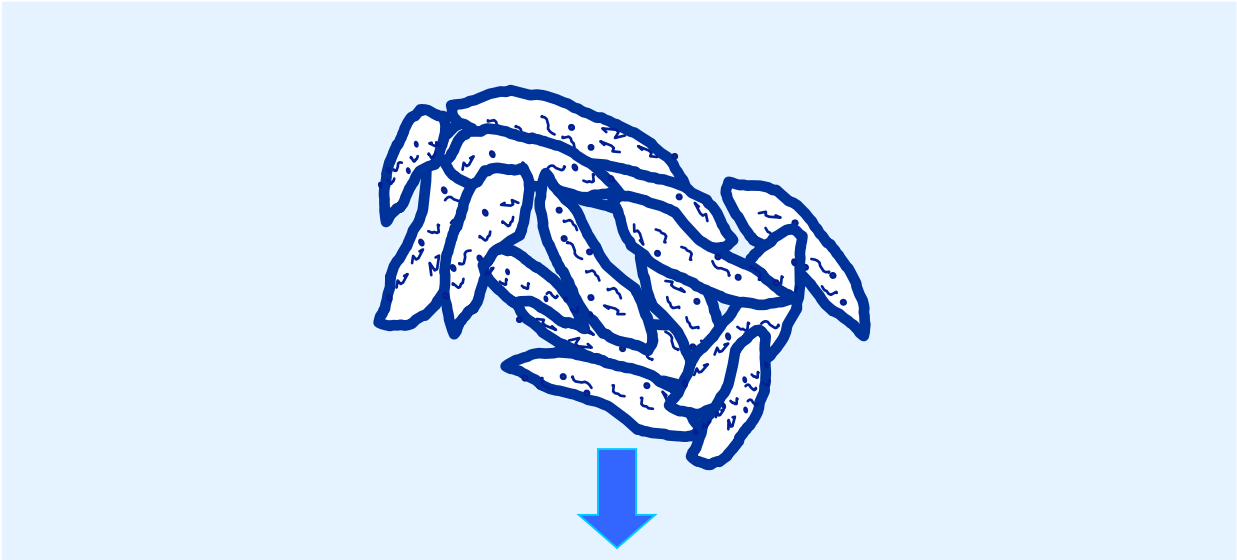
What happens when the coagulant is dosed to the water

Charge neutralisation - Addition of positive ions (metal salt)…

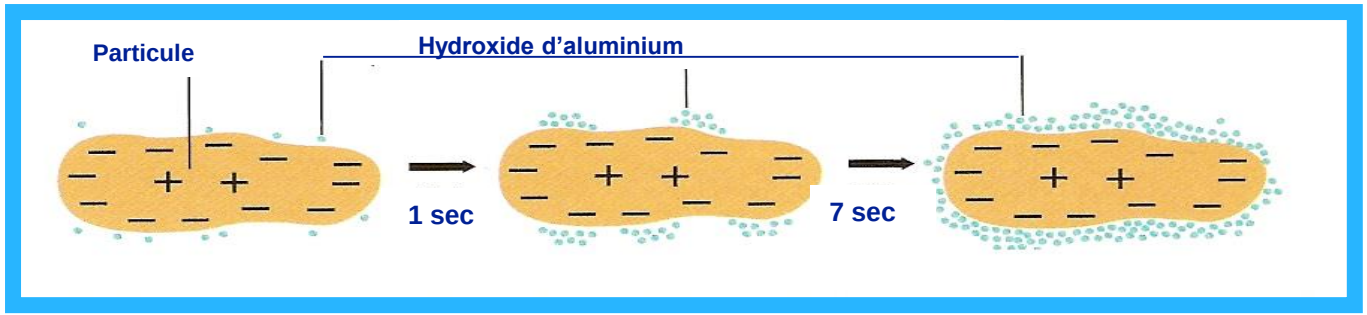


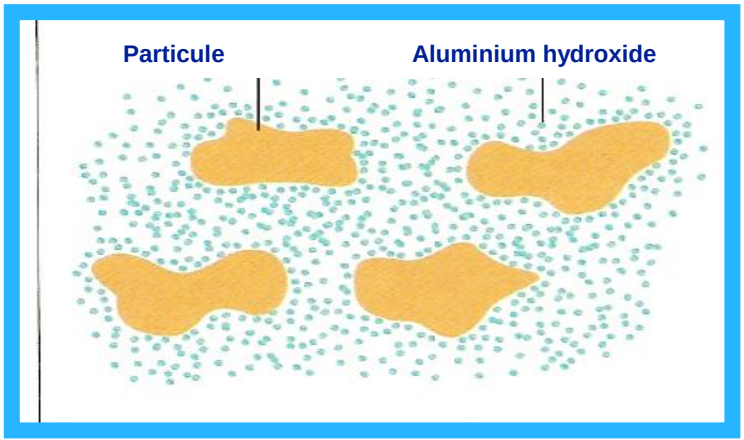
What happens when the coagulant is dosed to the water

Neutralization of charges …and flocs which can be removed!



« Sweep » coagulation





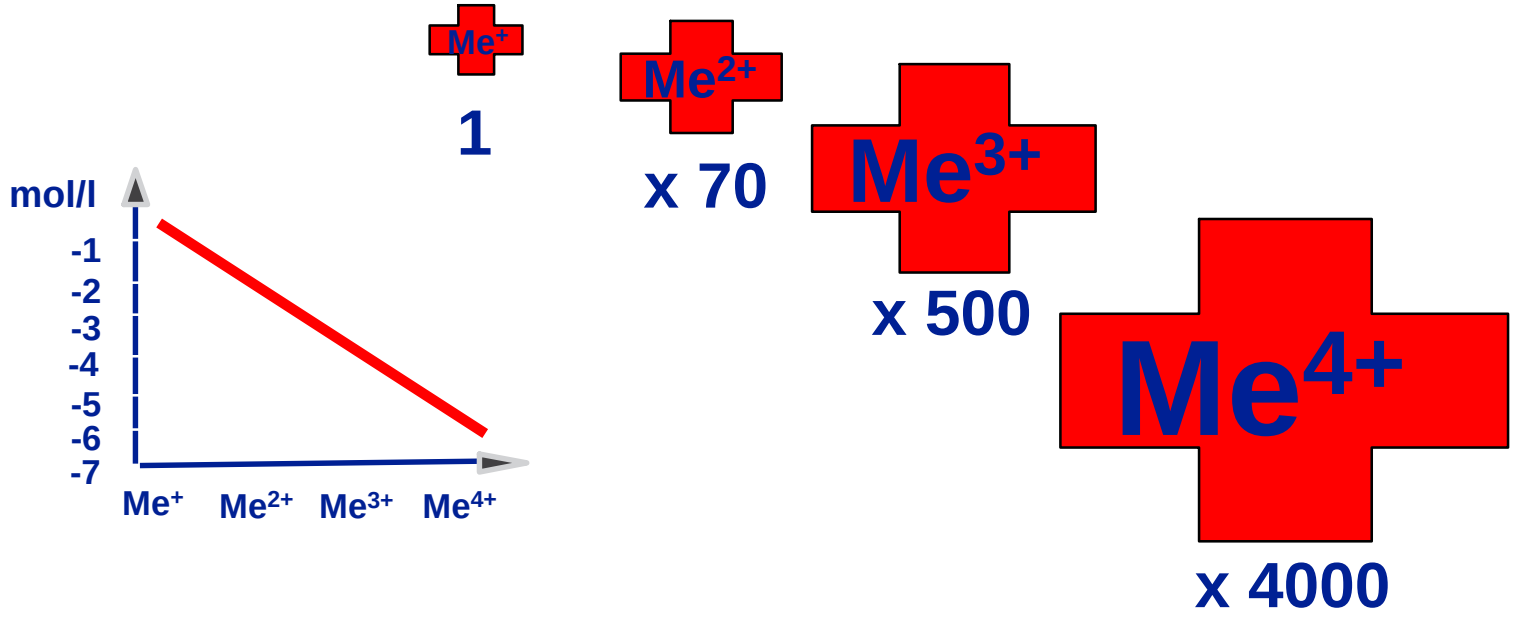
The formation of hydroxyde metals catch the particules into the flocs. Fast reaction from 1 to 7 secondes

$Al^{3+} + 3H_2O \rightarrow Al(OH)_3 + 3H^+$

$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$

Insoluble flocs

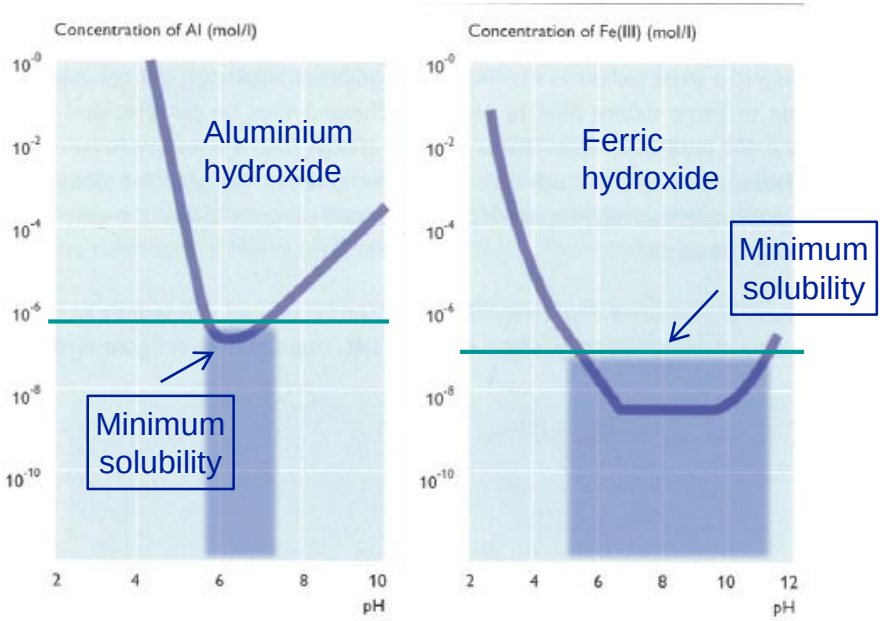
Destabilization power



What happens when the coagulant is dosed to the water

The influence of pH on the solubility of Al- and Fe-hydroxides

- The pH range expands by increased basicity in the coagulant
- PAXXL has a wider range compare to ALS



$Al^{3+} + 3H_2O \rightarrow Al(OH)_3 + 3H^+$

$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$

What happens when the coagulant is dosed to the water

Poor mixing – high dose – ineffective!

Ineffective Mixing!

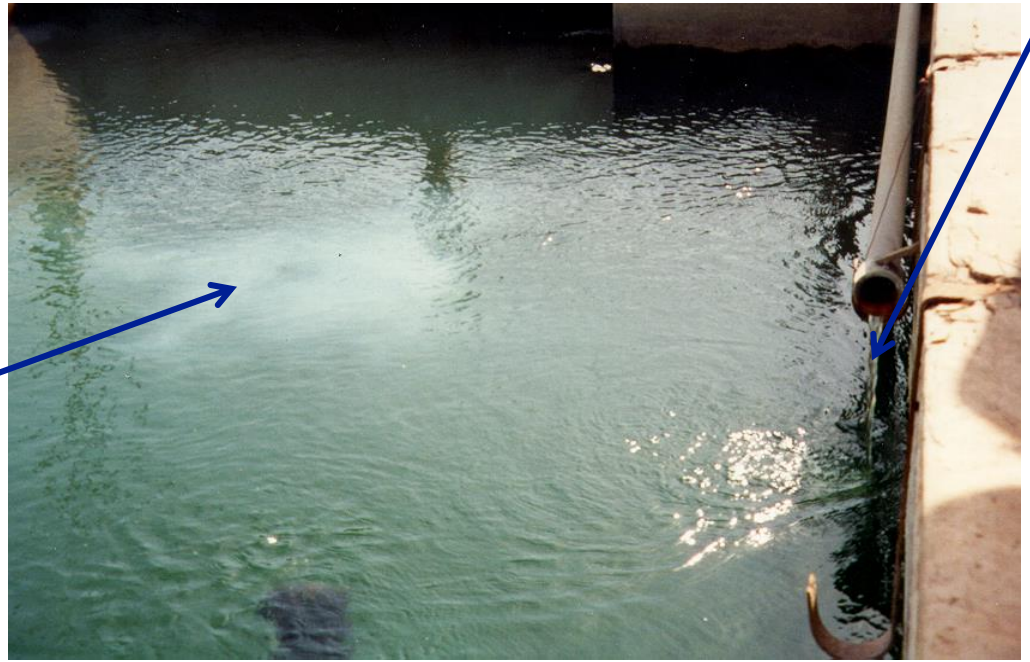
Higher dose of coagulant needed

More sludge is produced

Increased treatment cost!

Aluminium sulphate

Hydroxide flocs



Good mixing

Fantastic mixing!

Benefits of Different Coagulants

Kemira ALG & ALK
Aluminum Sulfate

- Universal Product!
- Dry product, easy to transport, even at distances
- Easy to dissolve & handle
- Forgiving and ”difficult” to overdose
- Wide working pH 6-8
- Excellent on particle, color & TOC removal
- Excellent on P removal

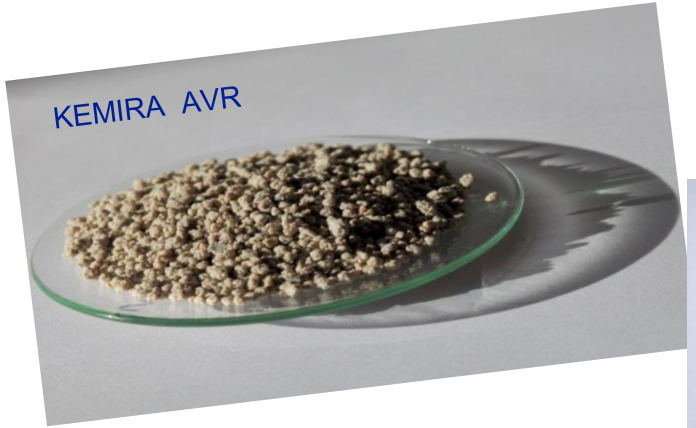
Kemira Ferix-3
Ferric Sulfate

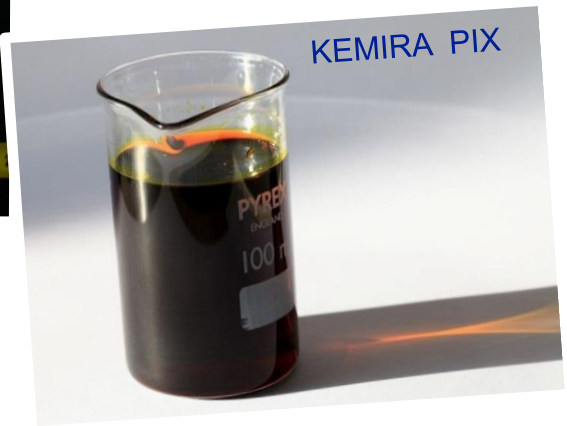
- Dry product, easy to transport even at distances
- Forgiving and ”difficult” to overdose
- Wide working pH 4-9
- Excellent on particle, color & TOC removal, heavy metals removal etc
- Excellent on P removal
- Odor Control product

Kemira PAX-18, XL31, XL19, XL39 & ACH
PACl & Aluminum Chlorohydrate

- Liquid products, no need for dissolving and easy to handle!
- Very high performance/high level of turbidity removal due to high charge on Al.
- Wide working pH 6-8,5 & consumes less alkalinity
- Little effect on pH
- Excellent on color, particle removal
- Can be customized for enhanced performance

Inorganic Coagulants





Products Available for Export – Inorganic Coagulants

- Dry Products;
  - Aluminum Sulfate (ALG, ALK)
  - Ferric Sulfate (Ferix-3)
    - Bulk shipments > 4 000 mt per shipment
    - FCL Shipments of approx 20-24 mt per shipment
      - Big Bags 1000 kg, 1150 kg, 1200 kg depending on what product
      - Small bags 25 kg, 40kg, 50 kg depending on what product
- Liquid Products;
  - Polyaluminum Chloride (PAX-XL100/PAX-18, PAX-XL31xx)
  - Aluminum Chlorohydrate (PAX-XL19/ACH, **PAX-XL39xx)**
  - Ferric Chloride (PIX-111)
  - Ferric Sulfate (PIX-113)
    - FCL Shipments of approx 20-24 mt per shipment packed in IBC's of 1000L.

Drinking Water Production

Kemira

Regulations

- Why standards?
  - To ensure that citizens gets enough of healthy, safe and esthetic water
- Example of standards
  - Each country normally has its own standard
- Chemical standards
  - Different standard
  - EU use CEN for coagulants (Available on Stream)
  - NSF in USA
  - KIWA, a Dutch standard that some times is used internationally
  - Country base

Parameter	WHO	EU	Note
E-coli (no/ml)	nd	nd	nd = not detectable
Acrylamide (mg/l)		0,1	Comes from PAM
Aluminium (mg/l)	0,2	0,2	Sweden 0,05
Arsenic (mg/l)	0,01	0,01	Hot topic
Iron (mg/l)	0,3	0,2	Sweden 0,05
Selenium (mg/l)	0,01	0,01	
Turbidity (NTU)	5	Acceptable to consumers	Sweden 0,3
pH	Preferably<8		Sweden 7,5 – 9,0
Colour (TCU)	15	Acceptable to consumers	Sweden 5
THM (ug/l)	<1000	100	Sweden 20 more focus in USA

Selection of coagulant

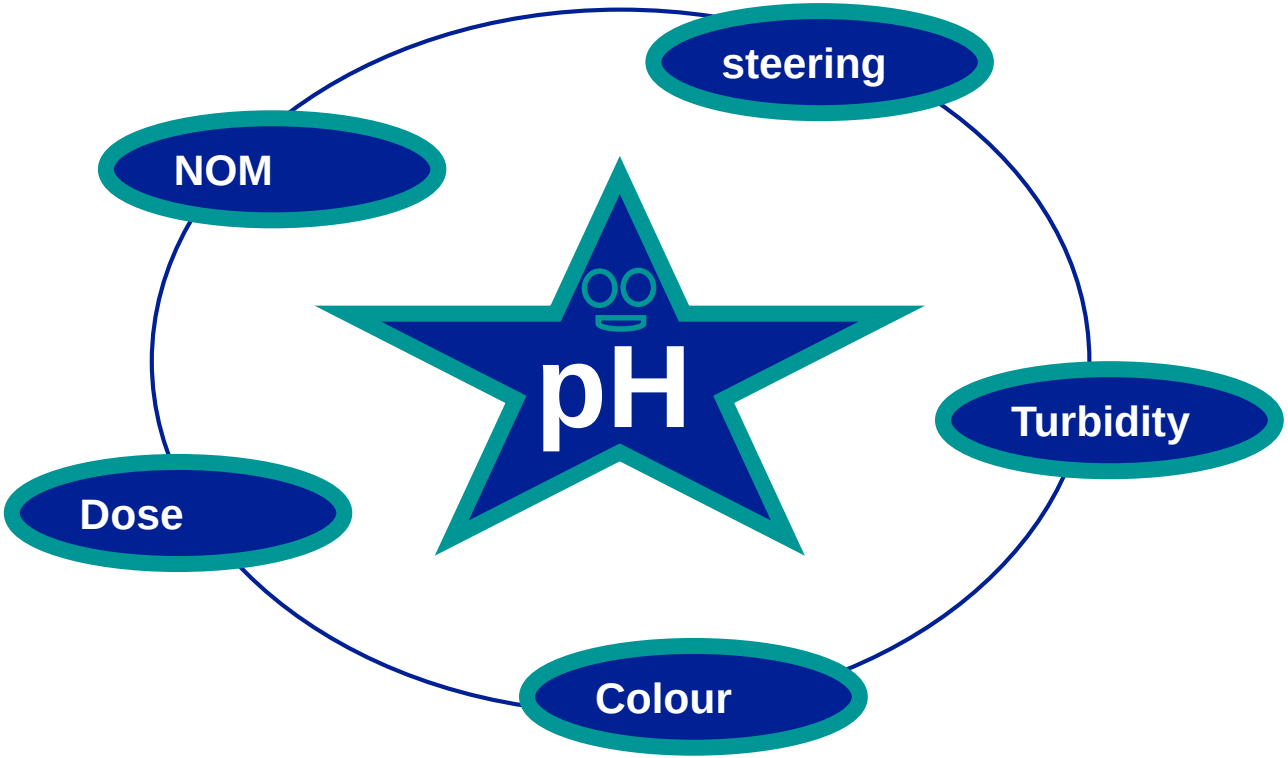
There are many reasons why a specific product is used. Water quality, water fluctuations, operation parameters, product availability, total cost, etc ...

Parameter affecting the selection of treatment process and chemical in use

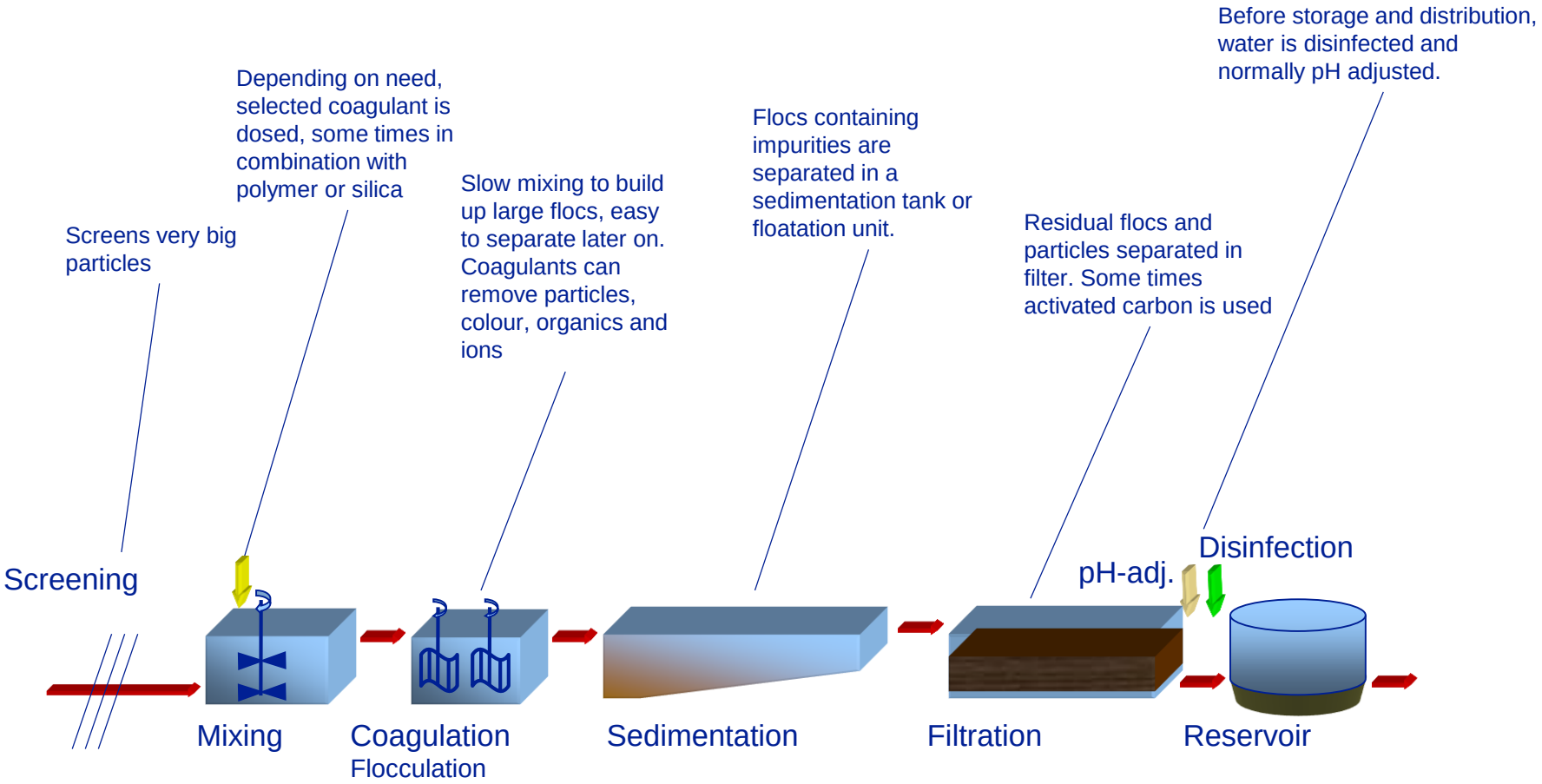
- Particles (turbidity)
- Color
  - Particles/Dissolved
  - Organic/metals
- Organic/TOC/COD
  - Particles/dissolved
  - Algae
- Taste/smell
- Bacteria/pathogens
- Metals
- Other
  - pH
  - Alkalinity
  - Hardness
  - Temperature

The drinking water production method depends on water source, demands, available resources and economy

pH – a key factor

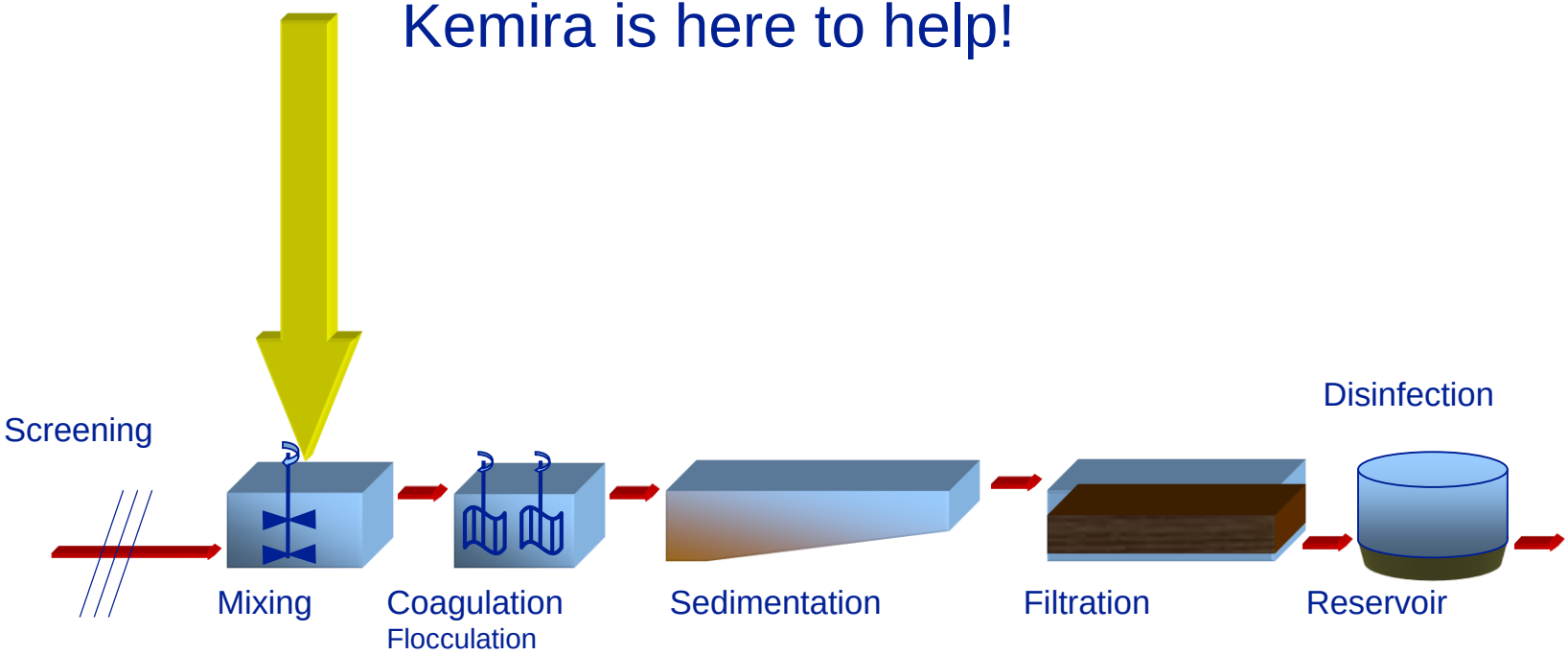


Typical drinking water plant



Typical drinking water plant

Key choice for your coagulants use.
Kemira is here to help!



High performance with PAXXL 3903 X

Case studies

Kemira

Coagulation et Floculation

Products developed for Africa

- PAX-XL3903 X Range : Blend between a polyaluminium chloride and a polyamine or polyDADMAC.
- PAX-XL 3903 X range is wide and NSF certified
- Kemira is supporting water company in delivering the best performance from our coagulants
- Kemira is supporting the water companies to get the lowest Total Cost :

Case 1

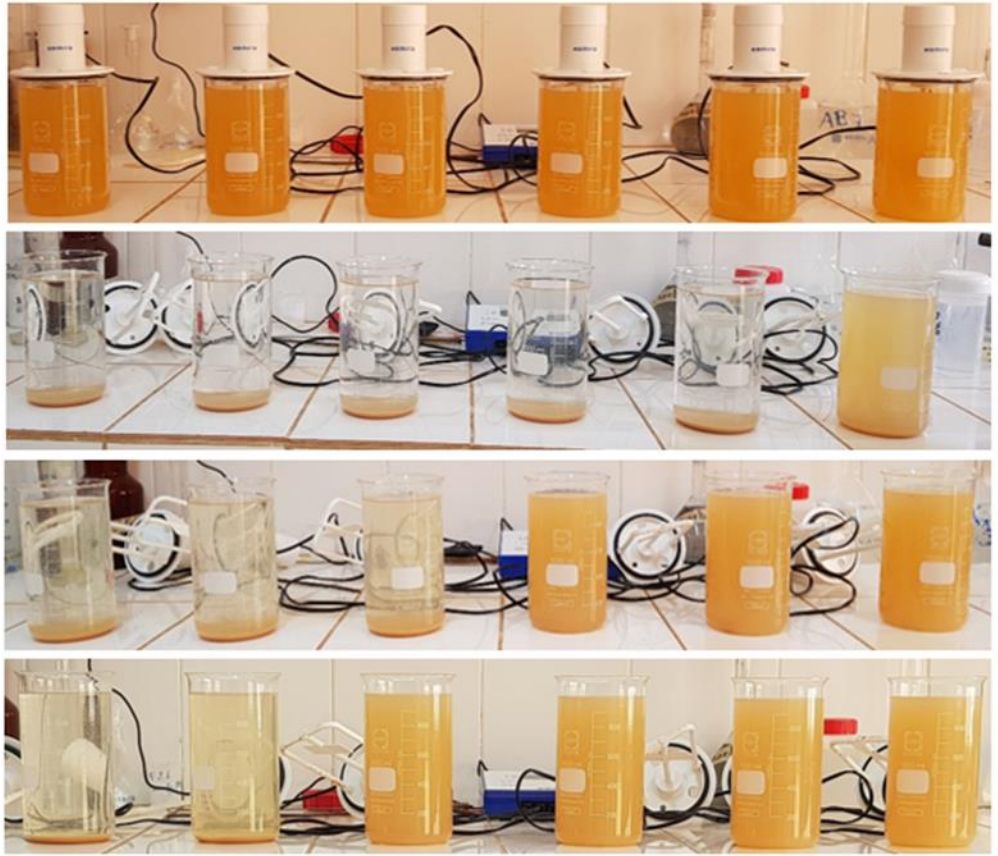
West Africa
Burkina Faso

Raw water data

- Turbidity 100 to 1000 NTU
- pH fluctuates between 6,5 to 7,5

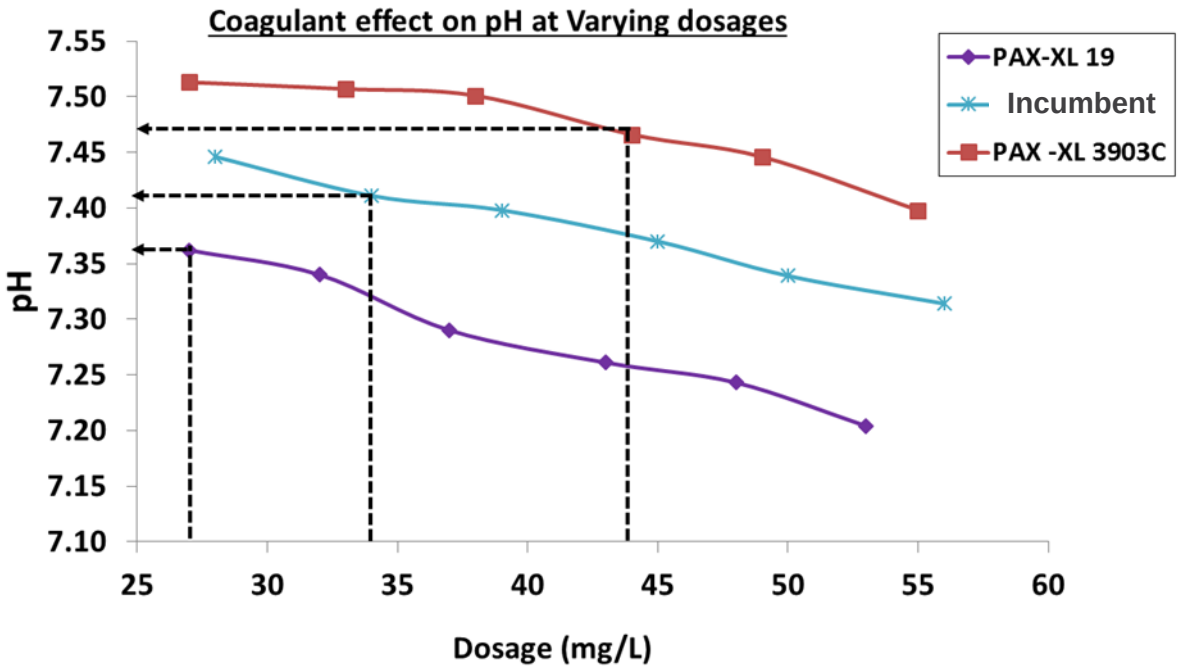
Inluence of over dosage

- Change in clarity as the dosage increases from left to right.
- Only Kemira PAX-XL 3903C is robust and performed better at wide range of dosage variation.
- Using such product will reduce the amount of lime required to buffer the pH.



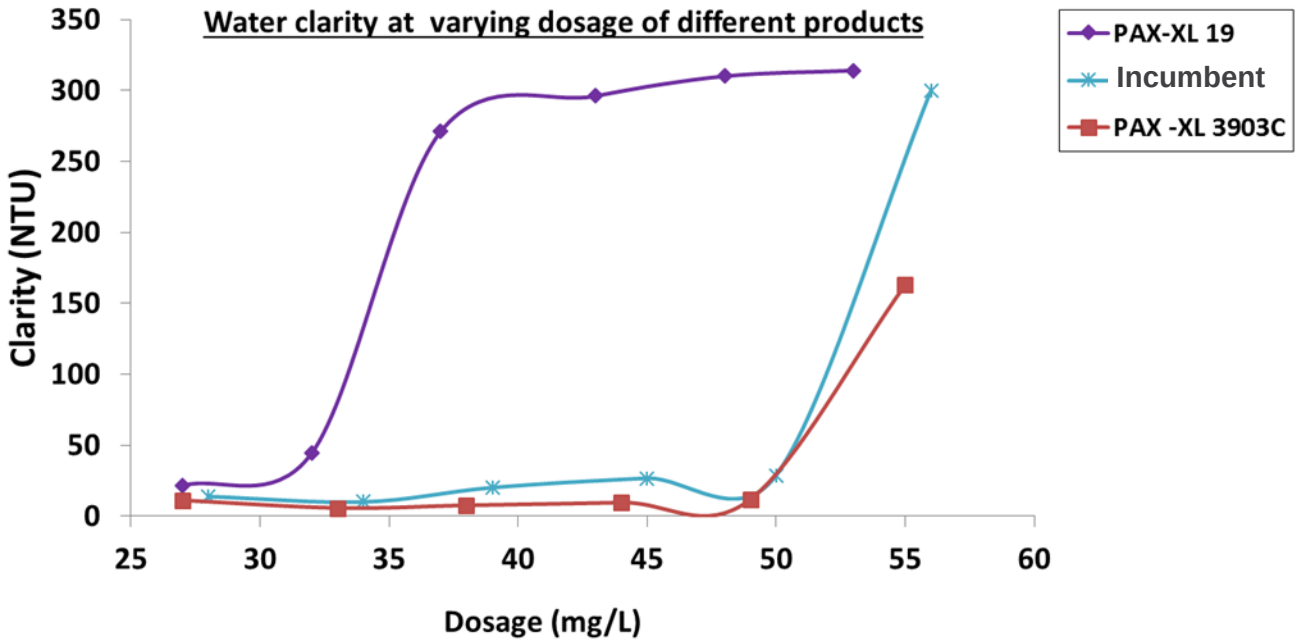
Inluence of over dosage

- PAX XL 3903 C is consuming much less alkalinity.
- The baseline pH of the raw water was 7.5. The results here shows that PAX-XL 3903C initial dosage of 27 mg/l did not affect the pH and further performed good up to the pH 7.46.
- 3 main benefits :
  - Lower lime consumption
  - Better performance because optimum pH
  - Low risk in case of over dosage



Inluence of over dosage

- The best performing product was Kemira PAX-XL 3903C, the clarity is affected after 44 mg/l dosage compared to other products.
- PAX-XL 19 is not capable of maintaining good SS removal in over dosage condition



Case 2

East Africa
Sudan

Kemira

Jar testing

A key tool to determine product & dose rate

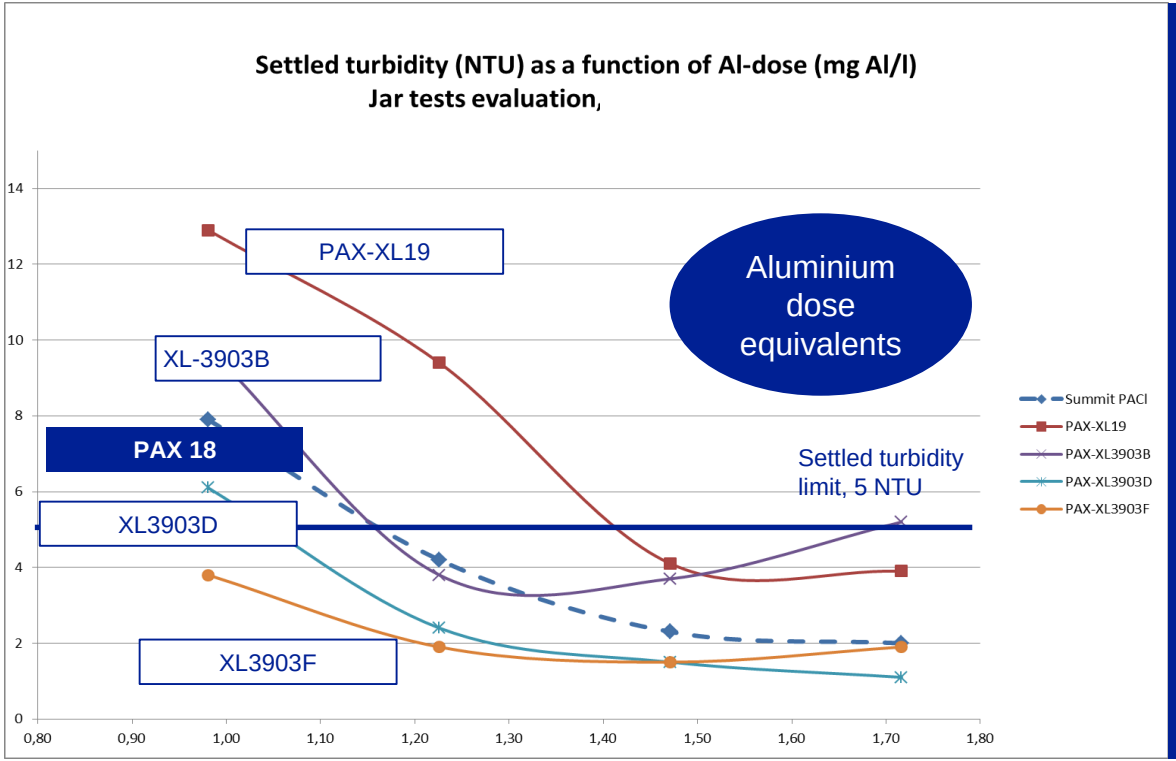
Raw water data

- Turbidity 4200 to 5300 NTU
- pH approx. 8

Products used in this evaluation

- PAX18
- PAX-XL 19
- **Kemira PAX-XL39XXX range : Ratio of Polyamine in the blend with Polyaluminium chloride**
  - PAX-XL3903B
  - PAX-XL3903D
  - PAX-XL3903F

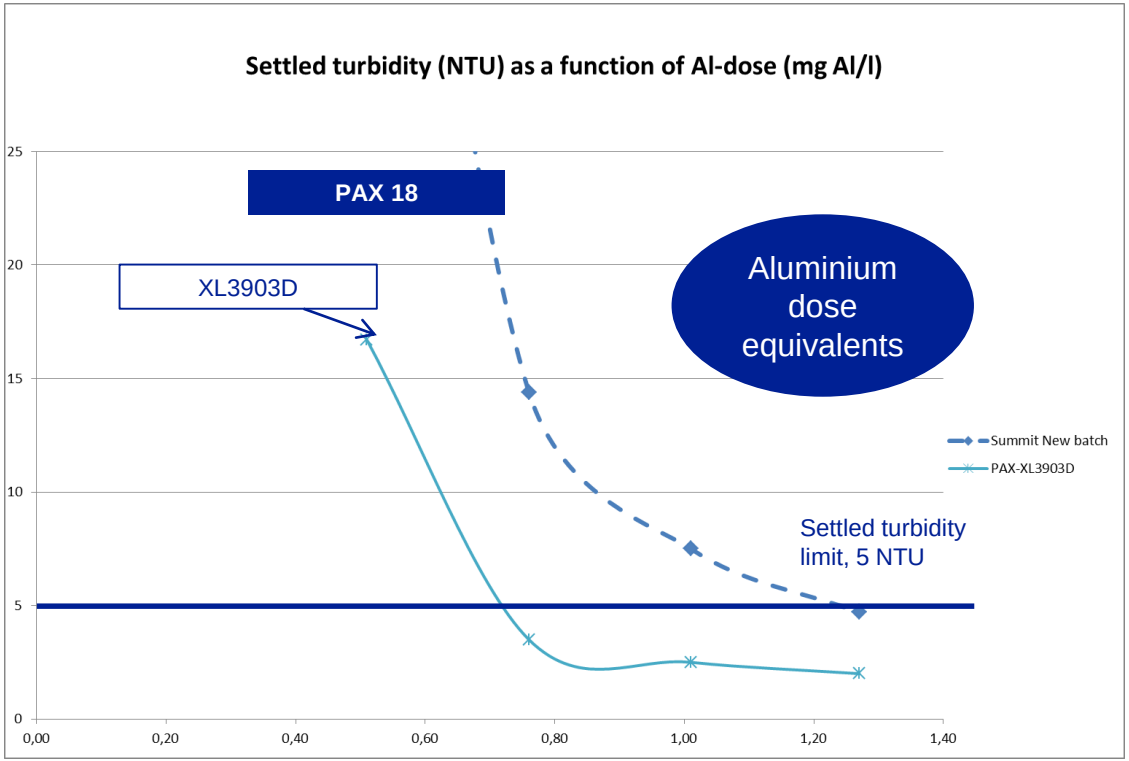
Tubidity performance



- Three products gives equal or better results compare to PACl
  - XL3903B
  - XL3903D
  - XL3903F
- pH on water, after coagulation:
  - Approx. 7,9

Raw water turbidity was between 5300 and 5500 NTU

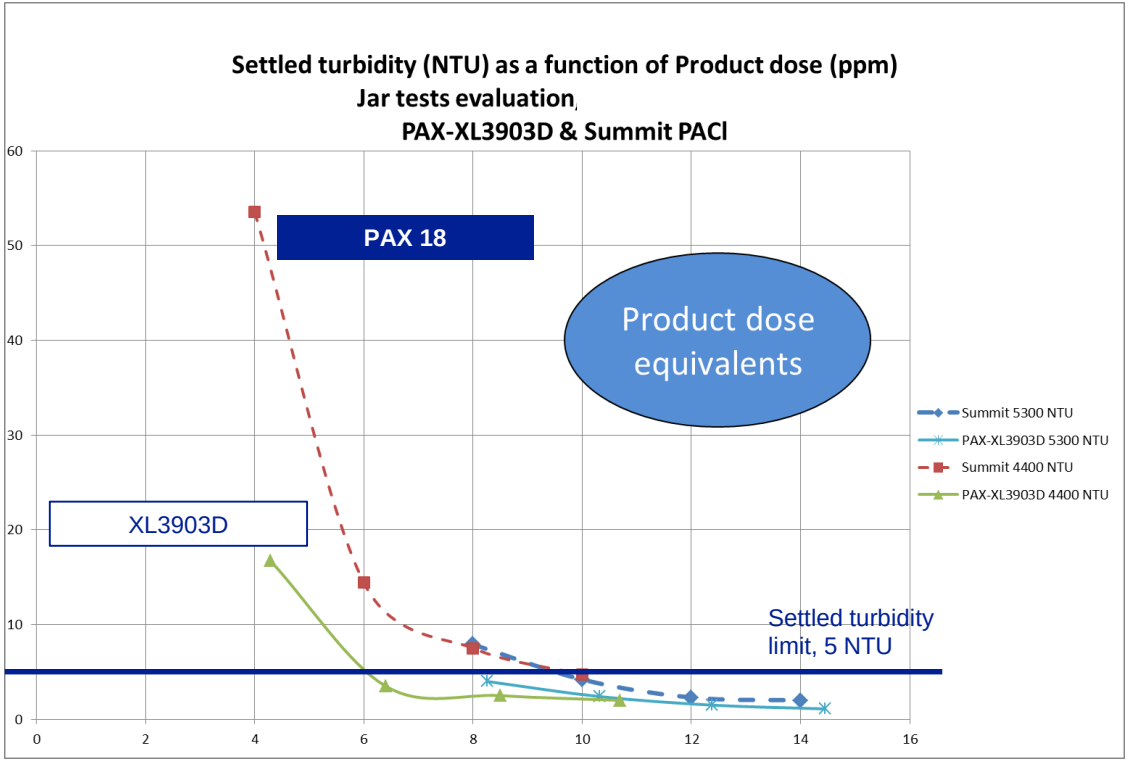
Turbidity performance



- At lower doses, PAX-XL3903D gives tremendous better turbidity reduction compared with Summit PACl
- pH on water, after coagulation:
  - Approx. 7,9-8,0

Raw water turbidity was between 4200 and 4400 NTU

Performance with 2 different raw water turbidity



Conclusions:

1. PAX-XL3903D shows excellent improvements in turbidity reduction .

2. It is particularly at the lowest Aluminium doses , where XL3903D show its superiority to PAX 18.

3. The performance of XL3903D is 35 to 40 % better in the settled turbidity range of 3 to 5 NTU, compared with PAX 18

This graph is reporting the findings from jar-test series using raw water with turbidity of 5300-5500 and 4200-4400 NTU

Improvements on turbidity reduction

Comparison between PAX-18 and Kemira PAX-XL3903 D

Settled Turbidity	Product dose needed (ppm)[1)]		Improvements
NTU	PAX 18	PAX-XL3903D	%
2	13	10,7	18
3	11,2	6,7	40
5	9,3	6	35
10	6,9	5,2	25

[1)] ppm is equal to ”gram product/m^3 water”

Thanks