TECHNICAL SESSION 2: WATER TREATMENT

5th Virtual Network Meeting of the Utility Platform, Tuesday November 29th, 2022

AGENDA

1. Welcome and introduction

2. Statements of WOP partners

3. Water treatment issues (proposal):
   - Process optimization
   - Chemical use
   - Water quality
   - Performance indicators
   - Trainings
   - Exchange of experience

4. Conclusions / Summary

PROCESS OPTIMIZATION

Example: Filtration process

- Filter material
- Filtration efficiency: runtime and filtrate quality
- Filter backwash

...

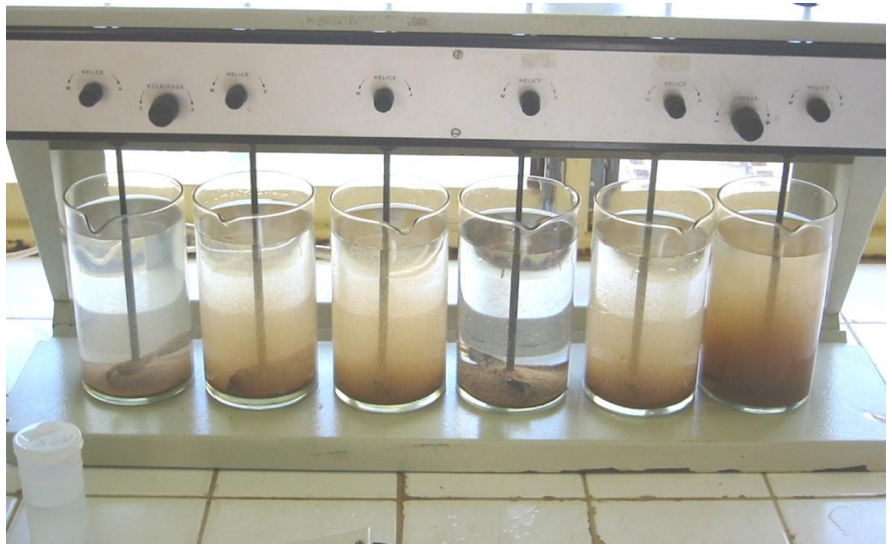
Filter sand samples from different top layer areas after first filter backwash after filter refilling: left – filter sand, right – smaller undergrain

Removing undergain manually

CHEMICAL USE

- Selection and application of chemicals

- Focus:
  - Flocculation
  - Disinfection



WATER QUALITY

Water quality aspects

- Problems and challenges regarding water quality?
- Possibilities for treatment process adaptation / optimization?

PERFORMANCE INDICATORS

Aspects

- Are PI used in your utility?
- Sets of PI? KPI/PPI?
- Application in short, mid term and long term planning?

	PI	unit
1	**Operation - Production**	
	BASIC PI	
1.1	raw water extraction	[m3]
1.2	amount of treated water	[m3]
1.3	amount of water supply	[m3]
1.4	amount of water used	[m3]
1.5	amount of backwashing water	[m3]
1.6	consumption of polymer cationic	[kg]
	consumption of sodium chlorite (liq)	[kg]
1.7	consumption of coagulant	[kg]
1.8	consumtion of chlorine	[kg]
1.9	consumption of chlorine dioxide	[kg]
1.10	filter run time	[h]
1.11	*height sand layer*	*[m]*
1.12	*height anthracite layer*	*[m]*
1.13	...	
	SPECIFIC PI	
1.30	plant availability	[%]
1.31	spezific internal water consumption	[%]
1.32	specific consumption of backwash water	[%]
1.33	specific consumption of chlorine	[g/m3]
1.34	specific consumption of chlorine dioxide	[g/m3]
1.35	specific consumption of coagulant	[g/m3]
1.36	specific consumption of coagulant incl. turbidity	[g/(m3*NTU)]
1.37	spec. chemical consumption of polymer	[g/m3]
1.38	spec. chemical consumption of polymer incl. Turbidity	[g/(m3*NTU)]
2	**Operation - Quality**	

TRAININGS

Aspects

- Training situation in the utility?
- Training for WTP staff?
- Development of water treatment trainings for the Utility Platform?

EXCHANGE OF EXPERIENCE

Aspects

- Exchange of experience in water treatment on the Utility Platform?
- Regular online meetings of treatment experts?
- On-the-job training

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PROCESS OPTIMIZATION

Example: Filtration process

Filter Material

- Check filter material installed and filter backwash
- Undergrain layer on top of sand must be removed manually, final backwash
- Production start
- Result: higher flow rate of water and very good filtrate quality, longer filter run time

Filter Backwash

- Short backwash with air
- Backwash with air and water or water alone with filter bed expansion
- Result: saving of backwash water, higher production

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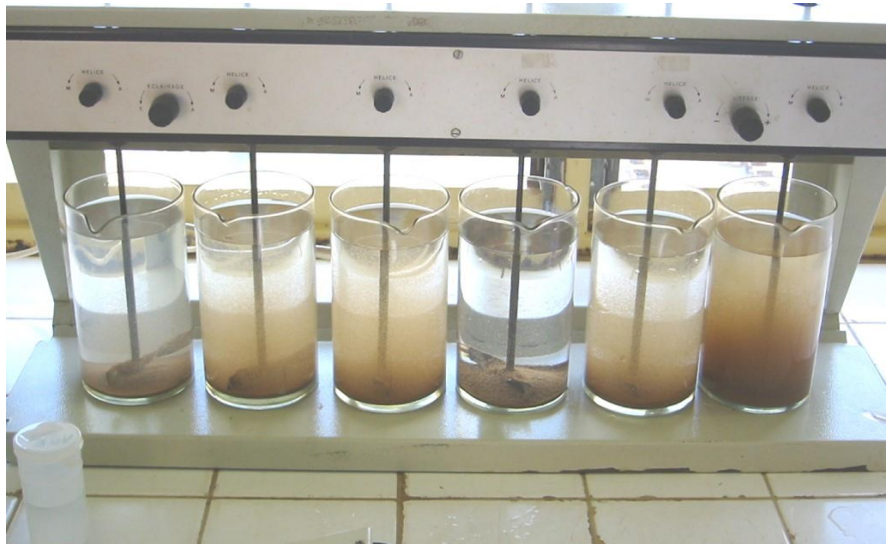


CHEMICAL USE

Chemicals in Surface Water Treatment:

Flocculation Chemicals

- Coagulants (aluminium or iron compounds)
- Flocculants (= flocculation aids; organic polymers)

Disinfection Chemicals

- Chlorine for prechlorination (chlorination of rawwater)
- Chlorine for postchlorination (final disinfection)
- Chlorine dioxide

CHEMICAL USE

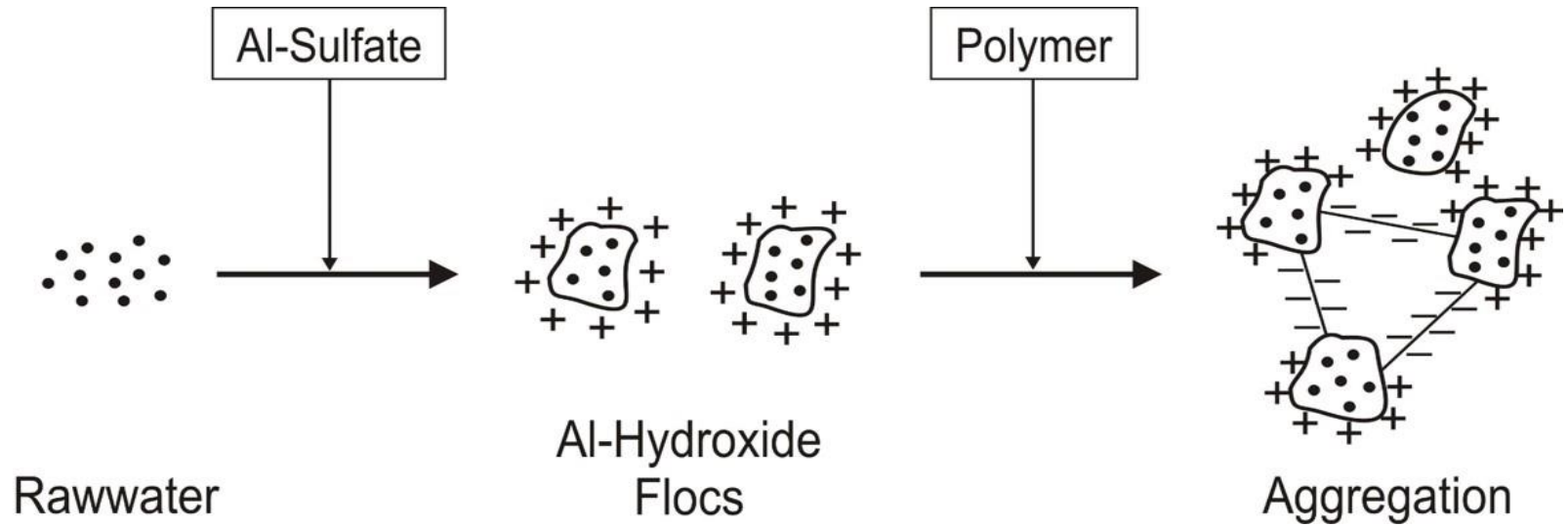
Flocculation chemicals

Group	Chemicals	Function
coagulant	aluminium salts iron (III)-salts	destabilisation, aggregation and precipitation, co-precipitation in metal hydroxides
flocculation aid (flocculant)	synthetic high-molecular polymers, polyelectrolytes	aggregation of small flocs to bigger agglomerates, stabilisation of flocs
other chemicals, if needed	milk of lime, lime water, caustic soda, acid	pH-adjustment

Source: Dr.-Ing. A. Nahrstedt, Dr.-Ing. S. Panglisch, DVGW-Kurs 6, Verfahrenstechnik der Wasseraufbereitung

CHEMICAL USE

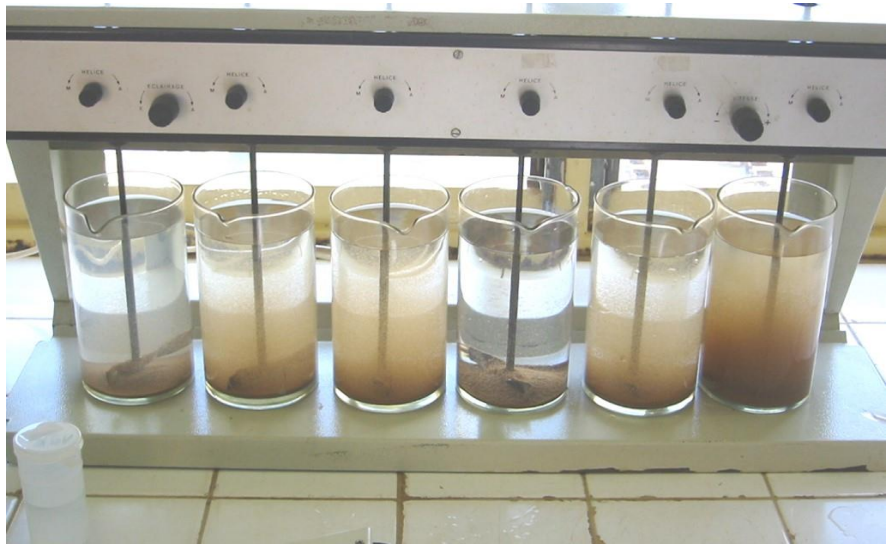
Function of coagulant and anionic polymer (flocculation aid)



CHEMICAL USE

Jar Test

- Laboratory tests are generally recommended to compare and select flocculation chemicals.
- Application of potable water grade (PWG) chemicals must be ensured!



CHEMICAL USE

Flocculation aid: dosing station

- Anionic polyacrylamide product in dry form
- Dissolving of polymer is slow (1 h)
- Dosing solution must be prepared on site
- Automomatic dosing and preparation stations widely used
- 2 or 3 chamber stations allow production of dosing solution to demand
- Normal dose: 0.1 -0.4 ppm

CHEMICAL USE

Recommendations for flocculation chemicals

- Avoid dosing of unnecessary chemicals.
- Compare and test flocculation products in laboratory and in full scale to achieve a technologically and economically efficient process.
- Ensure products applied have a proven PWG certificate (impurities may present health risks)

CHEMICAL USE

Ideas and recommendations for chlorination

- Avoid unnecessary dosing of chlorine.
- If prechlorination is applied investigate the need. Prechlorination may be useful in case of
  - high fecal contamination of the rawwater,
  - high numbers of algae in the rawwater,
  - need to reduce color.
- Dose chlorine according to demand to ensure safe drinking water quality. Overdosing increases costs and causes higher formation of unwanted disinfection byproducts.
- Idea: Produce chlorination solution from table salt by electrolysis

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PERFORMANCE INDICATORS

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PERFORMANCE INDICATORS

Operation - Quality

BASIC PI		
2.1	turbidity raw water	[NTU]
2.2	turbidity treated water	[NTU]
2.3	colour	
2.4	formation of disinfection by-products	
2.5	number of nematodes in raw water	[-]
2.6	number of nematodes in treated water	[-]
2.7	redox potential (Eh)	

Groundwater Use

BASIC PI		
3.1	groundwater abstraction	[m^3]
3.2	abstraction rate	[m^3/h]
3.3	well availability	[%]

PERFORMANCE INDICATORS

Energy

BASIC PI		
4.1	total power consumption	[kWh]
4.2	power consumption raw water extraction	[kWh]
4.3	power consumption water treatment	[kWh]
4.4	...	
SPECIFIC PI		
4.5	spec. power consumption raw water abstraction	[kWh/m^3]
4.6	spec. power consumption water treatment	[kWh/m^3]
4.7	...	

PERFORMANCE INDICATORS

Finance

	BASIC PI	
5.1	total costs	[JD.]
5.2	investments	[JD.]
5.3	maintenance	[JD.]
5.4	costs for polymer	[JD.]
5.5	costs for energy	[JD.]
5.6	...	
	SPECIFIC PI	
5.7	specific operating costs supplied water	[JD./m^3]
5.8	spec. maintenace expenditure	[JD./m^3]
5.9	portion energy expenditure	[%]
5.10	spec. energy expenditure	[JD./m^3]
5.11	...	

Human Resources

	BASIC PI	
6.1	Number of trained employees	[-]
6.2	Improved occuptation in health	[-]

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THANK YOU FOR YOUR PARTICIPATION

DEVELOPMENT OF CHEMICAL USE IN FLOCCULATION

20+ years ago:

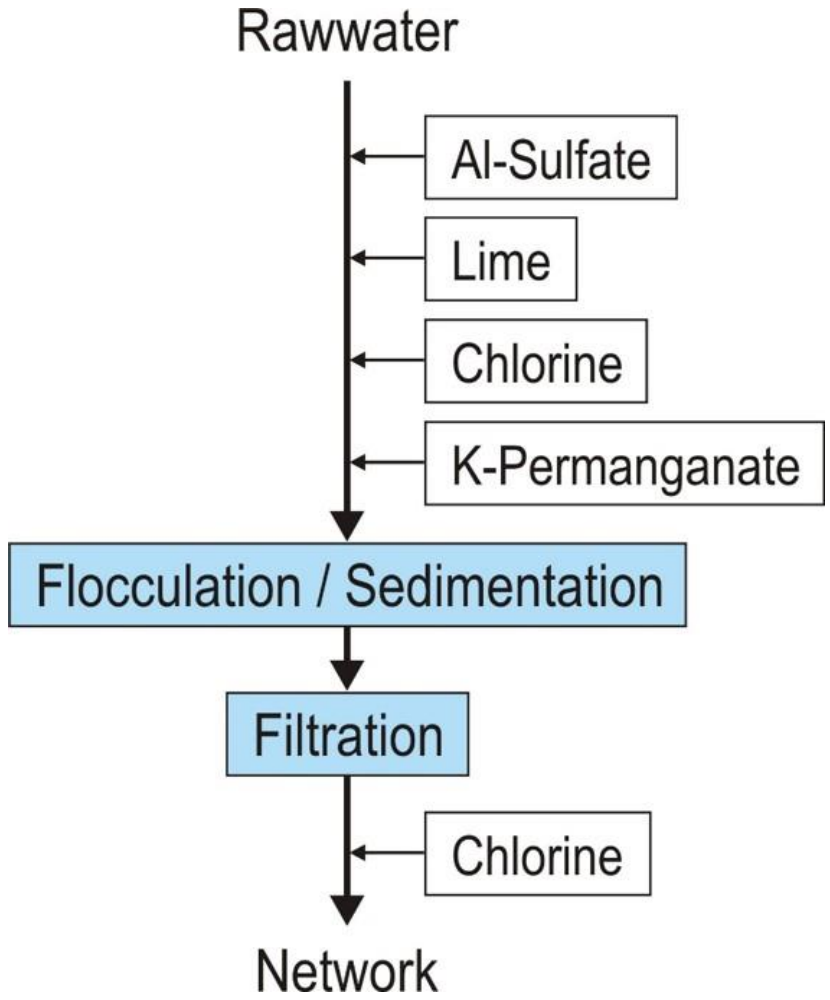
- aluminium sulfate (+ lime für stabilization of pH)
- disadvantages: - high chemical demand
  - AS highly acidic (pH correction)
  - dry products, dosing solutions prepared at WTP

Intermediate development:

- AS replaced by polyaluminiumchloride (PAC)
- advantages: - liquid product, ready to dose, no pH correction
- introduction of flocculation aid (organic polymers, dosed after coagulant)

Recent development:

- liquid blend products of PAC and cationic polymer (one product dosed)



CHEMICAL DEMAND FOR DIFFERENT CHEMICALS
(TYPICAL DOSE FROM PERSONAL EXPERIENCE)

Rawwater: (mid) turbidity 400 NTU

Chemical (combination)	Dose	Observation
PAC	60 ppm	Flocs not very stable, many small
PAC + anionic polymer		Big, dense flocs, well sedimenting
PAC	40 ppm	
Anionic polymer	0.2 ppm	
PAC + cationic polymer		Flocs dense and stable, often smaller than with anionic polymer
PAC	40 ppm	
Cationic polymer	1- 2 ppm	
Blend		Flocs better than PAC alone, not strong
PAC	40 ppm	
Cationic polymer	40 ppm	