Re-use of backwash water

Comparative study of 6 MF/ UF membranes

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Aachen Conference Water and Membranes
October 27, 2009

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Introduction

- Policy of Vitens: Re-use of backwash water → micro- or ultrafiltration and UV

- Experiences Vitens:
  - 1e generation pressure driven membranes
  - submerged membranes

- Standard at the moment:
  - submerged membranes

- Many membranes available
  - developments are going on

Goals

- Founded choice of membranes based on comparative research
- Selection of at least two membranes
- Establish the process design parameters

Criteria for membranes/ permeate

- Quality:

  - Turbidity < 0.1 FTU
  - Iron content < 0.03 mg/l
  - DEC ≥ 4

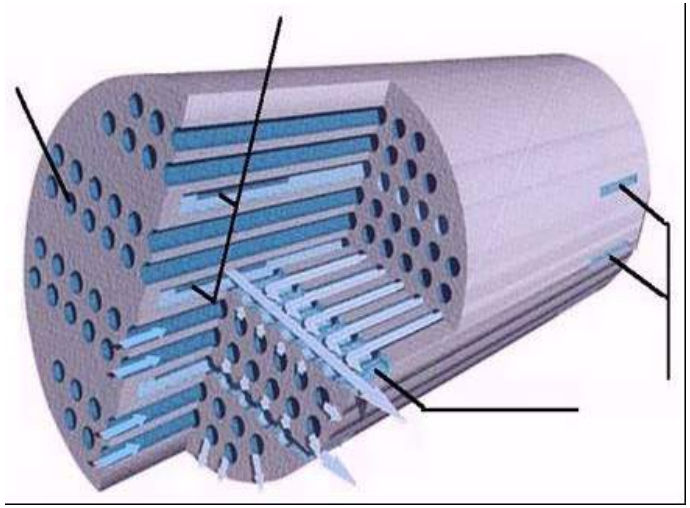
- Process:
  -Stable conditions

Selection of membranes

Membranes -->	*A*	*B*	*C*	*D*	*E*	*F*
Polymer		x	x	x	x	
Ceramic	x					x
Submerged	x	x			x	
Pressurised			x	x		x
Inside - out				x		x
Outside - in	x	x	x		x	
Tubular	x	x	x	x		x
Spiral wound					x	
Micro filter	x					x
Ultra filter		x	x	x	x	

Photos of selected membranes

C



F

A

B

E

Pilot plant research

- Research period: 3 month’s

- Capacity installations : 0,3 – 2 m^3/hour
  Except membrane A : 25 L/hour

- Process conditions based on recommendations of suppliers and our own experiences

Pilot plant research

- Conservative process conditions ;

- Establish the iron dosage;
- Increase of flux and lengthen the runtime;
- Backwashing and cleaning according recommendations

- Quality measurements permeate:
  - turbidity (continuously)
  - particles
  - iron content
  - colony count 22 en 37°C

- Sludge:
  - dry solid content: concentrate
    after sedimentation
  - sedimentation rate

Photos pilot plants

Membrane C in container

Results (1)

- Turbidity of all membranes < 0.1 FTU;
- Fe-content < 0.03 mg/l;
- Manganese removal incomplete
  - no removal for membrane F;
- DEC was too much influenced by the pilot installation:
  - materials and design
  - exception installation F

Results (2)

- High fluxes (20-100 l/m^2.uur) en long running time positively influenced by online coagulation with iron (2 -4 mg/l);
- Membranes A, C and E didn't fulfil the criterion of stable process conditions;
- Iron dosage in feed MF/UF improves sludge behaviour (sedimentation and dewatering)

Results

Membranes -->	*A*	*B*	*C*	*D*	*E*	*F*
Turbidity	++	++	++	++	++	++
Variations in Q_{feed}	- -	+ +	+ +	+ +	0	-
Stability of process	-	+	-	+	- -	++
Recovery	0	-	0	+	- -	++
Sludge process	+	++	-	+	-	++
Chemical costs €/m³		0,022		0,010		0,006
Energy costs €/m³		0,012		0,003		0,003
Total costs €/m³		0,55		0,42		0,44

Conclusies

- Membranes B, D and F fulfil the Vitens criteria
- Iron dosage in the feed of MF/UF improves the stability of the filtration process and the sludge treatment
- The permeate of MF/UF has to be filtered to meet the drinking water standard (manganese)
- UV radiation stand by for membranes B and D and in operation for membrane F
- In full scale installations extra care for sanitary design
- Ceramic membranes can compete with polymer membranes!!

Vitens