

ENVIRONMENTAL TECHNOLOGY VERIFICATION



ETV Verification Statement

TECHNOLOGY TYPE:	Coagulation and direct filtration	
APPLICATION:	Production of drinking water from surface water	
PRODUCT NAME:	Rosfilter	
COMPANY:	Ingenjörfirma Ros AB	
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Verification and test of a process combination of coagulation and direct filtration for treatment of surface water was conducted by the Danish Center for Verification of Climate and Environmental Technologies (DANETV).

DANETV was established by four independent Danish research and technology organizations and supported by the Danish Agency for Science, Technology and Innovation under the Danish Ministry of Science, Technology and Innovation to provide environmental technology verification for vendors of innovative water technologies. Information and DANETV documents are available at www.etv-denmark.com.

The verification and tests were performed by DHI, as DANETV Water Center, and were designed to satisfy the requirements of the ETV scheme currently being established by the European Union (EU ETV).

VERIFICATION AND TEST DESCRIPTION

The testing of a Rosfilter pilot plant for production of drinking water took place at Lilla Edet water works, Sweden, with water from river Göta älv. Ingenjörfirma Ros provided the product, a printed description of the product, and operation instructions for the tests. The product was operated by a technician of Lilla Edet water works, together with and supervised by DHI staff. DHI produced the plan, and report documents with input from an external technical expert. DHI also prepared this verification statement.

Test plan and test conditions

The testing followed the instructions laid out in the test plan. The testing included parameters that describe the filtrate water quality produced by the product, as well as operational parameters that important for the user. The operational conditions during verification were decided by the vendor and are summarized in table 1.

Table 1 Range of operational conditions of the Rosfilter during verification testing.

Parameter	Unit	Value
Filtration rate, measured	m/h	Average 4.7, range 4.6-4.9
Coagulant	type	Polyaluminiumchloride
Coagulant dose, measured	mg Al /l	Average 2.7, range 2.2-3.0 ¹
Maximum head loss	cm	145
Back wash rate	m/h	55
Back wash time	minutes	7

¹ The dosage was set constant, but varied somewhat. Stated is the maximum range, assuming minimum dosage during maximum flow, and maximum dosage during minimum flow.

The feed water conditions depended on the river water quality at the test site, which is subject to variation. Raw water conditions during the two-week verification testing are summarised in table 2.

Table 2 Feed water quality observed during verification testing.

Parameter	Unit	Average	Range
Water temperature	°C	---	1.5-4.5
Turbidity	NTU	2.5	1.7-3.7
Colour	mg Pt/l	21	20-25
TOC	mg/l	4.9	4.7-5.1
COD _{Mn}	mg/l	4	4-4
UV ₂₅₄	1/m	12.2	11.0-14.3
Aluminium	mg/l Al	0.14	0.06-0.25
pH	-	7.4	7.4-7.5
HPC _{3-d, 22°C}	no./ ml	250	100-500
Coliform bacteria	no./100 ml	230	120-340
Enterococci	no./100 ml	27	12-54

Quality Assurance

DHI provided internal review of documents and audit of the test system. An external technical expert reviewed the plan and report documents. This statement reflects the verification results after performing quality assurance.

TECHNOLOGY AND PRODUCT DESCRIPTION

The following description of the Rosfilter is based on information provided by the vendor and does not represent verified information.

Rosfilter

Rosfilter is a product combining coagulation and direct filtration (figure 1). After addition of the coagulant, the water passes through an upflow filter loaded with a multi-media bed. The filter bed consists of 1 m of coarse fractions in the bottom, and of 2.5 m fine sand. The filter is cleaned when a headloss set point is reached, alternatively after a fixed number of hours in operation. Rosfilter applies upflow filtration. The “backwash” is done by forward washing at a rate high enough to expand (fluidize) the bed of fine sand.

The filters normally consist of stainless steel columns in diameters from 1.0 to 2.5 m. For large filtrate flows, multiple filters are installed, and the feed water flow divided by a weir box.

Rosfilters use polyaluminium coagulants of different brands. The adaptation of the coagulant dosage is not automated, but decided by the operator when changes in flow or in raw water quality occur.

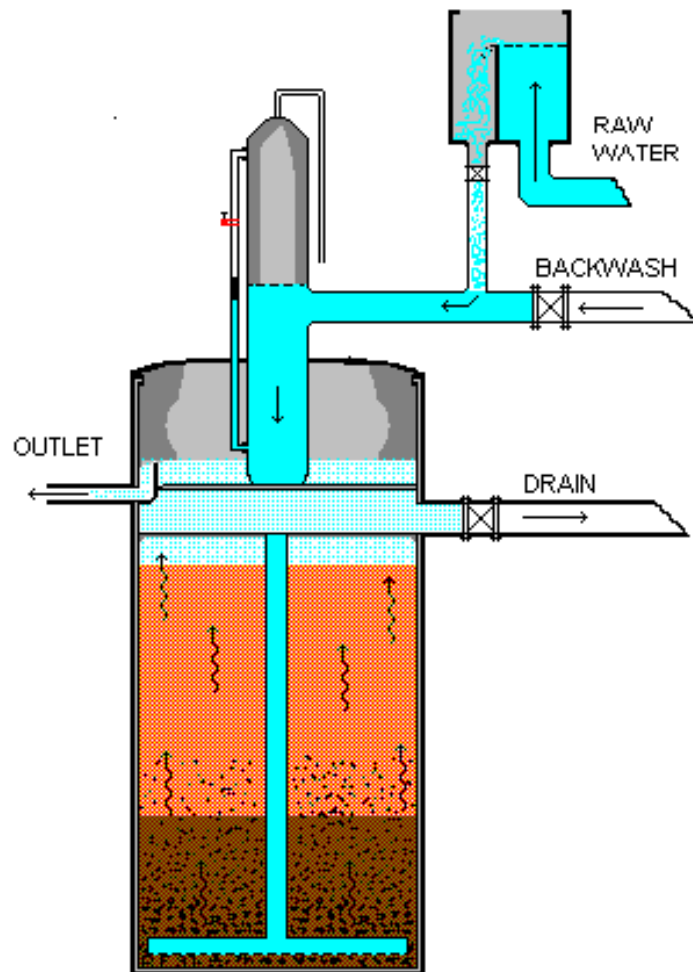


Figure 1 Schematic drawing of a Rosfilter (information from vendor).

VERIFICATION RESULTS

Filtrate quality was evaluated from the mature filter, *i.e.* after the initial improvement period (ripening) that occurs after each backwash. During verification testing, filtrate from the mature filter consistently fulfilled the criteria of the Swedish drinking water regulations for the parameters included in this verification.

The test conditions and results are described and discussed in more detail in the test report and verification report prepared this verification, available from www.etv-denmark.com.

Performance Parameters

The performance of the Rosfilter plant is summarized in table 3 as average and range.

Table 3 Results of verification testing. *n.d.* = no data; no breakthrough detected in any of the filter cycles.

Parameter	Definition	Average	Range
<i>Particles</i>			
Turbidity from matured filter (NTU)	0.10 NTU or lower	94.4	77.7-100
Percentage of values in turbidity range.	0.11-0.2 NTU	5.6	0-22.3
	>0.2 NTU	0	0-0
Initial turbidity	Filtrate turbidity 20 min into run (NTU)	1.7	1.1-2.7
Length of initial improvement period	Time to reach 0.5 NTU (minutes)	39	33-46
	Time to reach 0.2 NTU (minutes)	52	47-64
	Time to reach 0.1 NTU (minutes)	72	55-85
<i>Natural Organic Matter (NOM)</i>			
Colour	Colour in filtrate (mg Pt /l)	<5	<5-<5
	Removal (%)	>76	>75->80
TOC	TOC in filtrate (mg/l)	2.8	2.6-3.0
	Removal (%)	44	41-46
COD _{Mn}	COD _{Mn} in filtrate (mg/l)	1.3	1-2
	Removal (%)	69	50-75
UV ₂₅₄	UV ₂₅₄ in filtrate (1/m)	3.6	2.6-4.7
	Removal (%)	71	67-76
<i>Chemical parameters</i>			
Aluminium	Al in filtrate (mg/l)	0.016	0.014-0.020
<i>Microbial parameters</i>			
HPC 3-d, 22°C	HPC in filtrate (no./ ml)	<1	<1-2
	Log ₁₀ removal	>2.3	>2.0-2.4
Removal of coliform bacteria	Coliforms in filtrate (no./100 ml)	<1	<1-<1
	Log ₁₀ removal	>2.4	>2.1->2.5
Removal of enterococci	Enterococci in filtrate (no./100 ml)	<1	<1-<1
	Log ₁₀ removal	>1.4	>1.1->1.7
<i>Operational parameters</i>			
Backwash water loss	Ratio of feed water used for filter backwash (%)	8.1	6.6-8.5
First filtrate water loss	Ratio of feed water used until filtrate <0.2 NTU (%)	5.3	4.5-7.0
Time to reach turbidity breakthrough	Time to reach turbidity >0.50 NTU	n.d.	n.d.
Time to reach terminal head loss	hours	17	16-21

Original signed by Gerald Heinicke 31/05/2010
Test responsible, DHI

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Verification responsible,
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NOTICE: ETV verifications are based on an evaluation of technology performance under specific, predetermined operational conditions and parameters and the appropriate quality assurance procedures. DANETV or DHI make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable regulatory requirements. Mention of commercial product names does not imply endorsement.