Nitto
Innovation for Customers

HYDRANAUTICS



NANOFILTRATION FOR COLOUR REMOVAL FROM SURFACE WATER TO MEET DRINKING WATER STANDARDS

Case study

HYDRACoRe50 Delivers Effective Colour Removal from Surface Water at a Norwegian Drinking Water Plant Four Years On

Location	Norway
Feed water source	Grovelsjoen lake, gravity fed from 9–11 m depth
Application	Drinking water — colour and NOM removal
Plant capacity	500 m³/h across three membrane trains
Train under study	168 m³/h production
Start-up date	2012 (nanofiltration retrofit of an existing UF plant)
Pre-treatment	50 µm screen filter
NF design	HYDRACoRe50; 56 pressure vessels × 6 elements = 336 elements
Membrane area	37.2 m² per element
Post-treatment	UV disinfection + alkaline ($CaCO_3$) filter; NaOCl to distribution

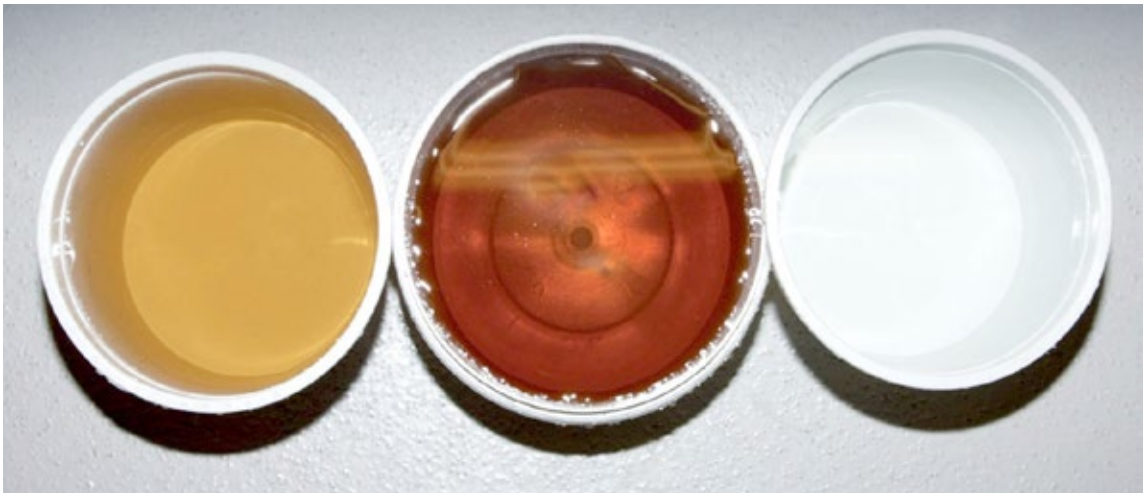
The PROBLEM

Norwegian surface waters carry high natural organic matter (NOM), mainly humic substances, giving undesirable color, smell and taste.

Such water is low in TDS (< 200 mg/l), alkalinity, hardness and turbidity, but high in TOC (3–10 mg/l) and color (30–170 mg Pt/l), with elevated iron, manganese and aluminum. NOM also forms chlorination by-products and feeds regrowth in distribution systems.

After ten years on cellulose acetate UF (8,000 Dalton), color episodes in the treated water showed source NOM rising beyond seasonal variation. A tighter barrier was needed without rebuilding the work.





Feed Color
157 mg Pt/l

Concentrate

Permeate Color
<2 mg Pt/l

The SOLUTION

Nanofiltration was selected for ease of operation, small footprint, low chemical demand and consistent color and TOC removal. HYDRACoRe50 rejects color and large organics while passing salts, preserving the waters natural minerals. The retrofit needed no plant modification.

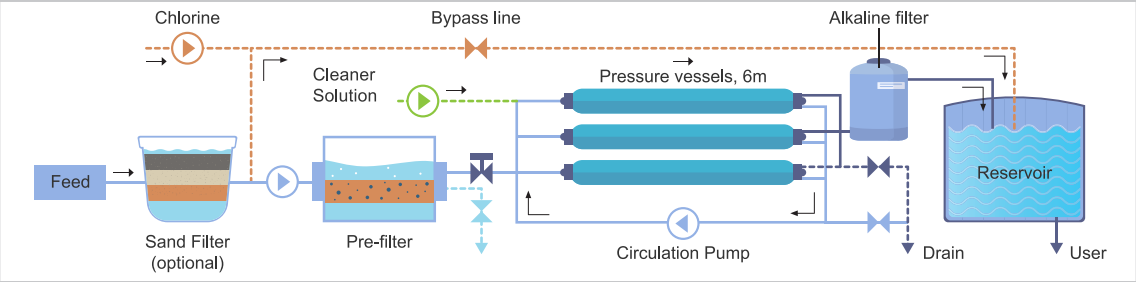
Why HYDRACoRe50

HYDRACoRe50 is a chemical- and oxidant-resistant composite NF element with a sulfonated polyether sulfone layer (~0.3 µm), rejecting organics above 1,000 Dalton at about 50 % NaCl rejection.

- Strong, constant, negative surface charges. Zeta potential is constant at − 85 mV from pH 3 to 11 (amphoteric polyamide RO: + 10 to − 20 mV), repelling anionic organics.
- Smooth surfaces. AFM and SEM show far lower roughness than polyamide, limiting colloid and microbial deposition.
- Chlorine tolerance. Rejection stable after 50 days in 1,000 ppm NaOCl (1,200,000 ppm-hours), allowing chlorine dosing against biofouling.

Treatment scheme

Raw water arrives by gravity via a pressure-trim valve and 50 µm screen filter to the NF rack, with concentrate recycle giving about 70 % recovery. Permeate is UV disinfected, remineralized through a CaCO3 filter to stabilize otherwise corrosive water and dosed with NaOCl before distribution.



Cleaning regime

Daily wash: NaOCl with organic salt at pH 7-8. Main clean, twice a year: NaOCl/NaOH at pH 12 and 35°C, then citric acid at pH 2. This is far more aggressive than cellulose acetate could withstand and removes the high-NOM fouling layer effectively.

Performance — water quality

Table 1. Average feed and permeate quality compared with Norwegian Drinking Water Regulations.

Parameter	Units	Raw water	Permeate, UF	Permeate, NF	Regulation
Turbidity	NTU	0.6	< 0.1	< 0.1	< 1
Colour	mg Pt/l	157	5 – 15	< 2	20
pH	—	6.5	6.5	6.5	6.5 – 9.5
Total organic carbon	mg/l	10	5.0	1.0	5.0
Iron	mg/l	3.5	0.17	< 0.01	0.2
Manganese	mg/l	0.4	0.05	< 0.01	0.05
Aluminium	mg/l	0.8	0.05	< 0.05	0.2
Coliform bacteria	per 100 ml	23	0	0	0
E. coli	per 100 ml	1	0	0	0
Plate count	per ml (22°C)	47	< 100	< 100	< 100

Operating data

Table 2. Operating performance before and after main cleans, 2012-2014.

Parameter	Flow before CIP, m³/h	Flow after CIP, m³/h	Flux after CIP, lmh	Feed pressure, bar	Recovery, %	Temp, °C
03.09.2012 (UF baseline)	—	168	14.0	3.7	71	9.5
12.03.2013	127	157	13.1	5.1	70	2.2
26.09.2013	123	158	13.1	4.3	66	11.6
24.06.2014	131	148	12.3	5.1	64	7.7
20.11.2014	112	144	12.0	5.6	74	7.7

Permeate quality over time

Table 3. Raw and permeate water analyses, 2012-2015. The first column is the cellulose acetate UF membrane it replaced.

Parameter	Units	15.08.2012 (UF)	24.10.2012	20.11.2013	10.09.2014	14.01.2015
Feed colour	mg Pt/l	145	199	156	109	163
Permeate colour	mg Pt/l	13	4	2	< 2	< 2
Feed turbidity	FNU	0.62	0.43	0.9	0.58	0.54
Permeate turbidity	FNU	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Permeate coliform	col/100 ml	< 1	< 1	< 1	< 1	< 1
Permeate plate count	col/ml	3	4	4	< 1	< 1

Membrane life and cleaning

About 90% of initial flux was recovered after every main cleaner over four years. Normalized flux declined some 7 % per year, and feed pressure rose from 3.7 to 5.6 bar; fouling stabilized after the first year.



Figure 2. HYDRACoRe50 elements installed into the existing pressure vessels with no plant modification.

The IMPACT

The retrofit met all Norwegian Drinking Water Regulations and beat the UF it replaced: color 157 to < 2 mg Pt/l (over 98 % removal, limit 20) against 5-15 with UF, and TOC 10 to 1.0 mg/l against a 5.0 limit. Iron and manganese fell below 0.01 mg/l and a full hygienic barrier was achieved. No membrane replacement was needed during the study or as of October 2016 four years on raw water up to 199 mg Pt/l behind only a 50 µm screen.

The NF retrofit also delivered environmental benefits by reducing treated-water color, organic matter and disinfection by-product precursors, helping improve drinking water quality while minimizing the need for chemical treatment. The longer membrane life and ability to withstand aggressive cleaning contributed to sustainable long-term operation and reduced membrane replacement frequency

For more information about Hydranautics case studies, contact us at **hy-marketing@nitto.com** or visit our website at **membranes.com**

About Hydranautics

Since our founding in 1963, Hydranautics has been committed to the highest standards of technology research, product excellence and customer fulfillment. Hydranautics entered the Reverse Osmosis (RO) water treatment field in 1970 and is now one of the global leaders in Integrated Membrane Solutions. Hydranautics became a part of the Nitto Group in 1987. Nitto is Japan's leading diversified materials manufacturer. The group offers over 13,000 high value specialty products worldwide including optical films for liquid crystal displays, automotive materials, reverse osmosis membranes for desalination and transversal drug delivery patches.

As leaders of high quality membrane solutions, we believe our commitments extend beyond manufacturing and selling our products. Our skilled staff of technicians, engineers and service professionals assist in designing, operating and maintaining a robust, reliable and efficient membrane system to meet your requirements and exceed your expectations.

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