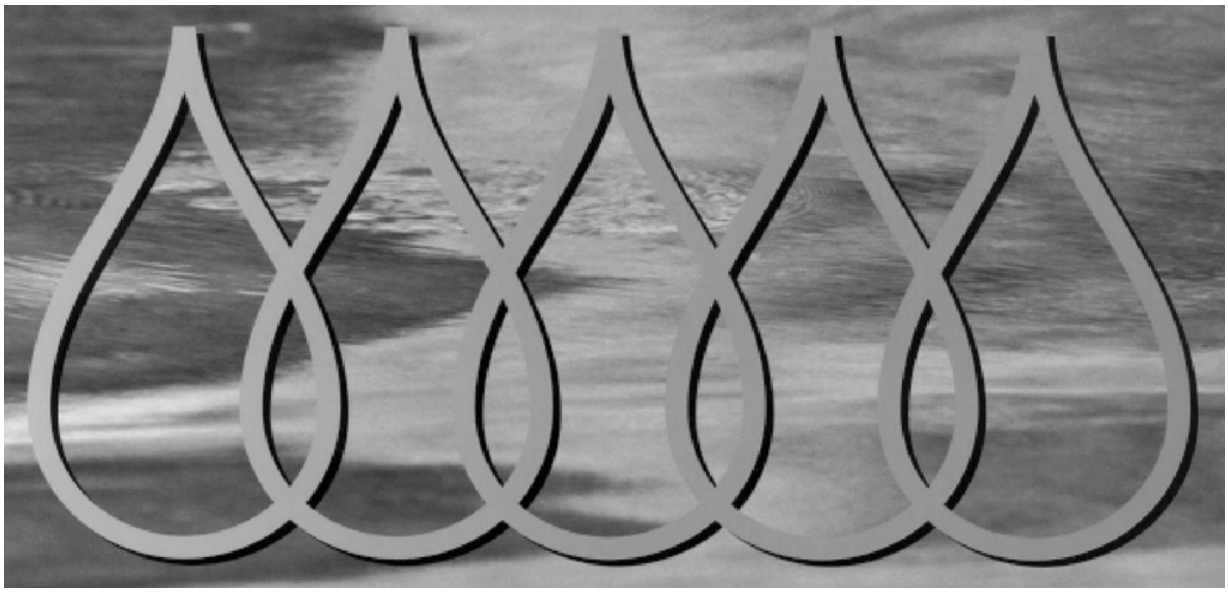
TECHNICAL DATA SHEET
COMMITTEE ON DRINKING WATER TREATMENT TECHNOLOGIES

DaguaFlo-IV

Development Stage:

REAL-SCALE VALIDATION

August 2009
(English translation by Dagua)



Québec

1. GENERAL INFORMATION

- **Name of technology**

  DaguaFlo-IV

- **Name and contact information of developer**

Dagua Inc.
1281, boul. Industriel
Granby, Québec J2J 2B8
Tel.: 450 378-2666
Fax: 450 378-1978
Internet: www.dagua.com
E-mail: sales@dagua.com
Contact: Pierre Lahaye

2. DESCRIPTION OF TECHNOLOGY

- **General**

The technology is designed for the treatment of surface water to eliminate turbidity, decrease colour levels and the concentration of natural organic matter, and reduce the demand for chlorine and its disinfection-related byproducts. It consists of a complete treatment chain that involves ozonation and membrane filtration without requiring the addition of chemicals. The question of parasite removal credits for the DaguaFlo-IV technology is addressed in a separate technical data sheet.

In the DaguaFlo-IV treatment chain, raw water is initially prefiltered and preozonated to an average residual ozone concentration of 1 mg/l. Ozonation is used to: 1) improve organoleptic properties (taste, odour, and color); 2) disinfect water according to the CT tables provided in the *Design Guidelines for Drinking Water Production Facilities;* and 3) lower the quantity of disinfection byproducts.

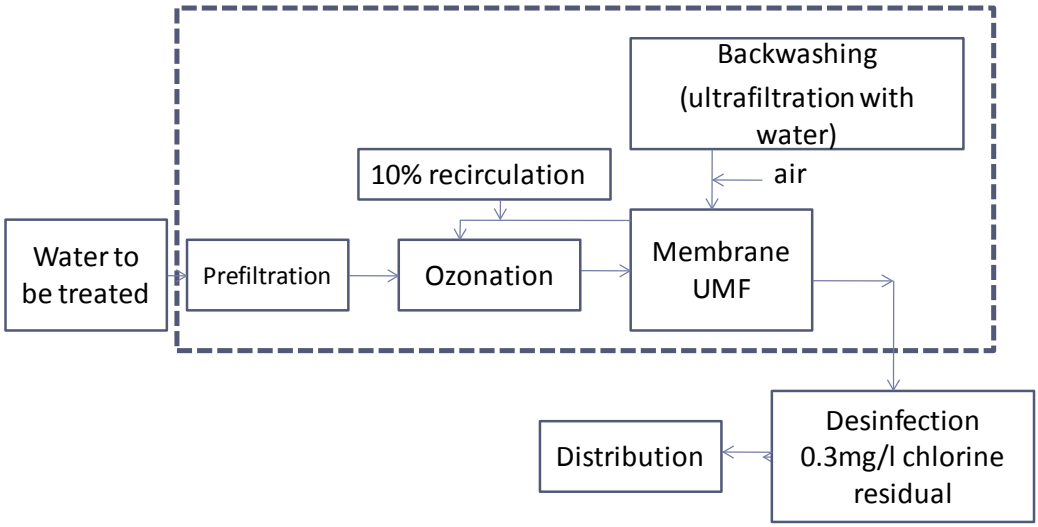
The preozonated water then passes through an ultra-microfiltration (UMF) membrane. This membrane filtration stage serves to reduce turbidity. Reverse flow cleaning of the membrane is carried out using ultra-filtered water, with no added chemicals. If necessary, an acid-alkaline backwash is performed when the trans-membrane pressure exceeds 240 kPa (once or twice annually).

Lastly, the treatment is completed by means of a chlorine disinfection to ensure a residual free chlorine content of 0.3 mg/l at the distribution network's inlet.

Note: The system designer is responsible for verifying compliance with all other parameters of the RQEP (Québec Regulation respecting the quality of drinking water).

- **Flow chart**

Treatment chain submitted to the Committee



- **Design criteria**

Pre-treatment:

- Type of pre-treatment used: self-cleaning, centrifugal separator with 74-µm mesh followed by a 400-µm manual-wash screen.
- Maintenance of pretreatment equipment:
  - Centrifugal separator: continuous purging ranging from 0.35 to 0.51 m³/h.
  - Screen: one manual backwash during the three-month test.
- Type of recommended pretreatment: manual or self cleaning filter (up to 400 µm mesh) preceded by an optional self-cleaning centrifugal separator (the system designer is responsible for specifying whether a centrifugal separator is required based on the quality of the raw water).

Preozonation:

- Ozone generation system: Dagua oxygen-based unit with a production capacity of 270 g/h (a redundancy of at least 10%, but at a minimum one ozone generator is required).
- Ozone reactor: pressurized with a theoretical contact time of 4.6 minutes and a T_{10}/T ratio of 0.92. An average ozone residual of 1.0 mg/l and minimum residual of 0.6 mg/l were maintained during tests at the outlet of the ozonation reaction tank.

Filtration by means of an ultra-microfiltration membrane:

1. **Membrane characteristics**
   - Type of module used: Microza USV-6203 made by Pall (the Microza UNA-620A module may also be used as an alternative since only the case and resin materials are different)
   - Filtration method: by gradient pressure with frontal flow
   - Membrane characteristics: hollow fibres with an outside-inside flow
   - Composition: membranes made of polyvinylidene fluoride (PVDF)
   - Module diameter: 16.5 cm
   - Module length: 200 cm
   - Nominal dimension of pores: 0.1 µm
   - Module's total filtration surface: 50 m² (approx. 6,000 fibres, each being 2 m long and having an outside diameter of 1.3 mm)

2. Module Characteristics

- Number of membranes in the module: 1
- Recommended filtration flux at 20ºC: 93 to 121 l/m²/h
- Tested filtration flux (temperature of raw water ≤ 1ºC): 590 to 72.6 l/m²/h
- Tested filtration flux (temperature of raw water ≥ 19ºC): 113.5 to 118.1 l/m²/h
- Tested capacity of module:
  - Max. inlet water flow: 5.9 m^3/h
  - Total inlet flow including recirculation (0.8 m^3/h or 13.5%): 6.7 m^3/h
  - Average daily ultrafiltrate production: 95.5 m³/d (based on 24-hour operation consisting of 16.2 hours of water production for distribution, 6 hours of backwashing, and 1.8 hours to fill the backwash tank)
- Trans-membrane operating pressure during the pilot test: 86.2 to 165.5 kPa
- Max. trans-membrane pressure to initiate acid-alkaline backwash: 240 kPa
- Max. permissible trans-membrane pressure: 345 kPa

3. Membrane backwashing procedure

Certain parameters (frequency, water flow rates, duration, etc.) of the different types of backwash depend on the quality of water to be treated and may be modified to optimize costs. The following table summarizes the characteristics of these procedures

Parameters	Typical range	Value used in the pilot test
A - Backwashing		
Frequency	12-30 min	12 min
Duration of air + water backwash	30-120 s	120 s
Air flow rate	85-110 l/min	110 l/min
Air and water flow rate	1.82 m³/h	1.82 m³/h
Duration of backwashing	30-120 s	30 s
Flow rate of backwash water	3.4 m³/h	3.4 m³/h
Forward flush duration	20-60 s	30 s
Forward flush flow rate	2.3-6.8 m³/h	3.0-5.9 m³/h
B – Acid-alkaline backwash		
Frequency	1-12 months	No acid-alkaline backwash was performed during the pilot test
Duration of first stage	120 min	
Flow rate of hot water (recirculated) with 0.5-1% NaOH	3.2 m³/h	
Backwashing	See A	
Duration of second stage	120 min	
Flow rate of hot water (recirculated) with 2.0-2.5% citric acid)	3.2 m³/h	
Backwashing	See A	
Rinse duration	75 s	
Rinse flow rate	2.95-5.91 m³/h	

4. Turbidity standards

- Standard to be achieved in this stage: 0.1 NTU, 95% of the time (according to the RQEP)
  - Performance achieved in the pilot tests: Turbidity < 0.07 NTU, 95% of the time

5. THM Standards

- Results of the SDS-THM tests performed according to the *Drinking Water Treatment Technologies Assessment Procedure* established by the Committee must comply with a value of 80 µg/l as set out in the RQEP.
- The average SDS-THM value obtained with chlorine in the pilot test was 63.5 µg/l (54.2 to 78.7 µg/l).

6. Residual Wastewater

Characteristics and daily volumes of wastewater

Type of wastewater	Suspended solids (mg/l)	Discharged into the watercourse	Volume (l/day)
Centrifugal separator	< 3	yes	9,062
UMF membrane with air/water backwash	14	yes	16,353*
Acid-alkaline backwash	N/D	N/D	380 l/wash**

N/D: Not determined (these waters must be characterized to verify whether they can be discharged into the watercourse).

* The volume obtained is based on a frequency of one backwash every 12 minutes (136.3 litres per backwash).

** The acid-alkaline backwash refers to an alkaline backwash followed by an acid backwash of the module.

In regard to the process-related waters that cannot be discharged directly into a watercourse, treatment will have to be provided consistent with the recommendations of the *Design Guidelines for Drinking Water Production Facilities.*

7. Process Recovery Rates

- With a centrifugal separator and a 400-µm screen filter: 77.7 to 87.4%
- Without a centrifugal separator but with a 400-µm screen: 84.3 to 94.8%

The low-range recovery rate values pertain to a day with a back wash every 12 minutes, an integrity test, and a chemical wash; the high-range recovery rate values pertain to a day with a washing every 30 minutes, but without an integrity test and without a chemical wash.

3. LEVEL OF DEVELOPMENT OF DRINKING WATER TECHNOLOGIES

The Committee evaluated the technology's level of development based on the Drinking Water Treatment Technologies Assessment Procedure. **It determined that the data obtained from the pilot test performed in Farnham on water from the Yamaska River is sufficient to meet the criteria permitting implementation of a real-scale validation project.** However, implementing a validation project remains restricted to all raw water whose properties correspond to the following critical parameters:

Critical parameters	Raw water	Other parameters measured at Farnham	Raw water
Turbidity (NTU) (*based on 95% of the samples)*	**< 37**	Turbidity (NTU) (*maximum*)	**130**
Total organic carbon (TOC) (mg/l) (*based on 90% of the samples)*	**< 5.6***	Total organic carbon (TOC) (mg/l) (*maximum)*	**7.2**
Bromide (µg/l) (*maximum*)	**100**	Colour (TCU) (*based on 90% of the samples)*	**29**
		Fecal coliforms (CFU/100 ml) (*maximum*)	**20,000**
		Temperature (ºC)	**0.7-20.1**
		pH	**6.9-8.2**
		Total alkalinity (mg/l $CaCO_3$)	**32-57**
		SUVA (l/mg-cm)	**3.0-5.1**

* All projects having a total organic carbon value greater than the value indicated require confirmation of the treatment chain's performance in relation to the formation of byproducts associated with chlorine-based disinfection and compliance with the RQEP's THM standards for 80-µg/l networks. Tests specified in the Committee's Recommendation Sheet 1 are required.

For values greater than the critical parameters mentioned in the table above, the Committee would be willing to accept data from a new test. It would have to be performed over a period of at least two weeks with design criteria identical to those contained in the form.

The number of installations under real-scale validation is limited to five.

Note: The level of development may be subject to revision after additional results are obtained.