said underwater testing device being placed underwater at a depth of at least 500 meters.

Furthermore, the underwater testing device including:

- at least one filter;
- a water inlet which is suitable for introducing a flow of water sampled from the environment of the device into the underwater device;
- a pipe connecting said water inlet and said filter;
- a discharge pipe downstream of said filter that is suitable for discharging the filtrate into the environment of the device;
- at least one pump which is suitable for filtering of the flow of water across said filter;
- a means for supplying the device with power,

is also an object of the present disclosure.

The disclosure further concerns the use of said underwater testing device in order to follow the evolution of the fouling of a filter placed in an aquatic environment in real conditions.

In one aspect of the disclosure, there is provided a method for following the evolution in real conditions of the fouling of an underwater filtration system including one or several filters that is placed in an aquatic environment, said method including the steps consisting in: introducing a flow of water taken from said aquatic environment into an underwater testing device via a water inlet, said underwater testing device including said filter(s); bringing said flow in the underwater testing device up to said filter(s); obtaining a filtrate downstream of said filter(s) and discharging said filtrate into the environment via a discharge pipe; the method being characterized in that it further includes a step of measuring in a repetitive manner the difference in pressure between the upstream side and the downstream side of said filter(s) to assess fouling of said filter(s), and said underwater testing device being placed underwater at a depth of at least 500 meters.

In another aspect, there is provided an underwater device including: at least one filter; a water inlet which is suitable for introducing a flow of water sampled from an aquatic environment of the device into the underwater device; a pipe connecting said water inlet and said filter; a discharge pipe downstream of said filter;

at least one pump which is suitable for filtering of the flow of water across said filter; a means for supplying the device with power; the underwater device being characterized in that it further includes a means for measuring the difference in pressure between the upstream side and the downstream side of said filter to assess the fouling of said filter.

In still another aspect, there is provided an under-water device including in order with respect to the normal flowing of the water flow in the system: a water inlet; a pipe connecting said water inlet and a pre-filter; said pre-filter; a pipe connecting said pre-filter and desulfation membrane; said nanofiltration membrane for desulfation; then on the one hand, a discharge pipe downstream of said desulfation membrane; on the other hand, a discharge pipe for the retentate of the desulfation membrane; the underwater device being characterized in that it further includes a means for measuring the difference in pressure between the upstream side and the downstream side of said filter to assess the fouling of said filter.

DESCRIPTION OF THE FIGURES

Figure 1 is a schematic representation of an embodiment of an underwater testing device according to the invention.

Figure 2 is a schematic representation of another embodiment of an underwater testing device according to the invention.

Figure 3 is a schematic representation of an underwater testing device within the context of its use.

DETAILED DESCRIPTION OF THE INVENTION

In the present application, the expression “between … and … inclusive” must be understood as including the limit values.

The method for testing an underwater filtration system according to the invention first of all includes a step consisting in introducing a flow of water into an underwater testing device via a water inlet. The underwater testing device, which is also an object of the invention, is characterized among other things by the fact that

CLAIMS

1. A method for following the evolution in real conditions of the fouling of an underwater filtration system including one or several filters that is placed in an aquatic environment, said method including the steps consisting in:

- introducing a flow of water taken from said aquatic environment into an underwater testing device via a water inlet, said underwater testing device including said filter(s);

- bringing said flow in the underwater testing device up to said filter(s);

- obtaining a filtrate downstream of said filter(s) and discharging said filtrate into the environment via a discharge pipe;

the method being characterized in that it further includes a step of measuring in a repetitive manner the difference in pressure between the upstream side and the downstream side of said filter(s) to assess fouling of said filter(s), and

said underwater testing device being placed underwater at a depth of at least 500 meters.

2. The method according to claim 1, wherein the underwater testing device is brought to the surface and an operator assesses the state of fouling of the filter(s).

3. The method as claimed in claim 1 or 2, characterized in that said method further includes a step consisting in:

- recording said measurement of the difference in pressure in a storage means situated in the underwater testing device or transmitting said measurement of the difference in pressure to a receiving means situated outside the underwater testing device.

4. The method as claimed in claim 3, characterized by the fact that the measurement of the difference in pressure is taken at a frequency of between once a second and once an hour inclusive, each measurement obtained being recorded in the storage means situated in the underwater testing device or being transmitted to the receiving means situated outside the underwater testing device.

5. The method as claimed in any one of claims 1 to 4, further including the steps consisting in sampling at least one flow chosen from among:

- the flow upstream of the filter(s); and

- the flow downstream of the filter(s);

and in storing said sample in a storage means situated in the underwater testing device or in sending said sample to a receiving means situated outside the underwater testing device.

6. The method as claimed in any one of claims 1 to 5, characterized in that said method further includes a recycling step consisting in bringing at least part of the filtrate obtained at the outlet of the filter up to the flow of water which is intended to cross said filter.

7. The method as claimed in any one of claims 1 to 6, characterized in that said method further includes a step for backwashing the filter.

8. The method as claimed in any one of claims 1 to 7, characterized in that said method further includes a step consisting in injecting a biocide into a pipe which connects the water inlet and the filter, in a preferred manner close to the water inlet.

9. The method for testing as claimed in any one of claims 1 to 8, further including a preliminary step consisting in submerging the underwater testing device into an aquatic environment at a depth of at least 500 meters, then leaving the device underwater for a duration of between 1 and 12 months inclusive, then bringing the device to the surface.

10. An underwater device including:

- at least one filter;
- a water inlet which is suitable for introducing a flow of water sampled from an aquatic environment of the device into the underwater device;
- a pipe connecting said water inlet and said filter;
- a discharge pipe downstream of said filter;

- at least one pump which is suitable for filtering of the flow of water across said filter;

- a means for supplying the device with power;

- the underwater device being characterized in that it further includes a means for measuring the difference in pressure between the upstream side and the downstream side of said filter to assess the fouling of said filter.

11. The underwater device as claimed in claim 10, characterized in that the filter is a membrane for desulfation.

12. The underwater device as claimed in claim 10 or 11, characterized in that the filter is a nanofiltration membrane for desulfation, and in that the device further includes a pre-filter, said pre-filter being situated upstream of said nanofiltration membrane for desulfation.

13. The underwater device as claimed in any one of claims 10 to 12, characterized in that the device further includes a recycling circuit which connects the discharge pipe downstream of the filter to the pipe upstream of the filter.

14. The underwater device as claimed in any one of claims 10 to 13, characterized in that the device includes a backwash circuit.

15. The underwater device as claimed in any one of claims 10 to 14, characterized in that the filtration unit further includes one or several biocide tanks, at least one of said tanks being suitable for the injection of biocide into the pipe which connects the water inlet and the filter, in a preferred manner close to the water inlet.

16. The underwater device as claimed in any one of claims 10 to 15, characterized in that said device includes at least one sampling pipe for one or several flows chosen from among:

- the flow upstream of the filter(s); and
- the flow downstream of the filter(s);

and in that said device further includes a means for storing said samples situated in the underwater testing device and/or a means for sending said samples to a receiving means situated outside the underwater testing device.

17. An under-water device including in order with respect to the normal flowing of the water flow in the system:

- a water inlet;
- a pipe connecting said water inlet and a pre-filter;
- said pre-filter;
- a pipe connecting said pre-filter and desulfation membrane;
- said nanofiltration membrane for desulfation; then
- on the one hand, a discharge pipe downstream of said desulfation membrane;
- on the other hand, a discharge pipe for the retentate of the desulfation membrane;

the underwater device being characterized in that it further includes a means for measuring the difference in pressure between the upstream side and the downstream side of said filter to assess the fouling of said filter.