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Cross-flow microsand filtration for membrane pre-treatment

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ABSTRACT

VORTISAND microsand filters were introduced in the mid-1980s as a means to remove very fine particles (less than 2 microns) in cooling tower circuits. Computational fluid dynamics, lab-scale, and full-scale studies were used to determine the optimal design parameters of the *VORTISAND* filters. Filtration rates of 50–60 m^3/m^2 h (20–25 gpm/sq. ft.) are typical. About 90% removal of particles greater than 2 microns and SDI reduction of 42–68% are demonstrated.

Keywords: Cross-flow; Microsand; Filtration; Membrane; Pretreatment

1. Introduction

The primary objective of pretreatment to any membrane system is to make the feed water compatible with the membrane. Inadequate membrane pretreatment results in high-chemical cleaning costs, increased downtime, permanent loss of performance, and reduced membrane life [1].

VORTISAND microsand filters (Fig. 1) were introduced in the mid-1980s in the HVAC market as a means to remove very fine particles (less than 2 microns) in cooling tower circuits. More than 2,500 systems were installed worldwide.

In 2013, as *VORTISAND* was introduced in new markets and applications (wastewater reuse, RO pretreatment, process water), extensive R&D efforts began to understand the cross-flow effect (Fig. 2), to improve the performance and to increase the filtration capacity. In the *VORTISAND* filter, the filtrate flow is always equal to the feed flow (no retentate).

The results of this work are summarized herein.

2. Material and methods

Computational fluid dynamics (CFD), lab-scale, and full-scale studies were used to determine the optimal design parameters of the *VORTISAND* filters.

Laser particle counts (LPC) were used to measure the efficiency of the *VORTISAND* filters (Fig. 3).

3. Results

CFD modeling of the *VORTISAND* filter shows:

(1) The cross-flow effect occurs across the entire media surface.
(2) The media remains undisturbed (the surface stays flat).

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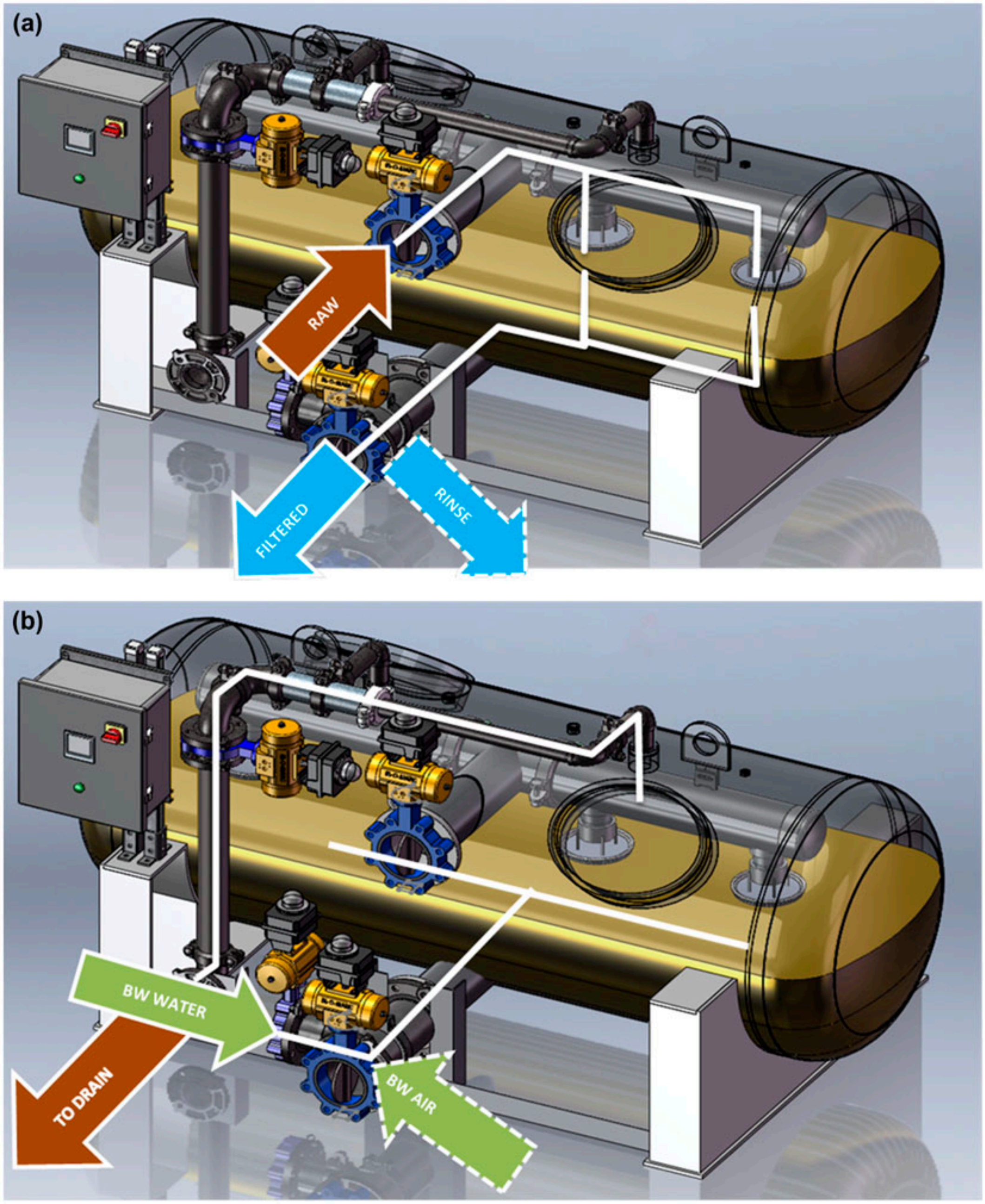

Fig. 1. (a) Filtration mode and (b) backwash mode.

(3) There is no migration of fine media (top layer) into the coarse media (bottom layers).
(4) Backwash flow is evenly distributed.

LPC (Fig. 3) show:

(1) About 90% removal of particles greater than 2 microns that are far better than multimedia filters (MMF).

Lab-scale and full-scale studies show:

(1) Filtration rates of 50–60 m^3/m^2 h (20–25 gpm/sq. ft.) are typical.
(2) Coagulation is not required to aggregate very fine particles.
(3) SDI reduction of 42–68% is demonstrated.

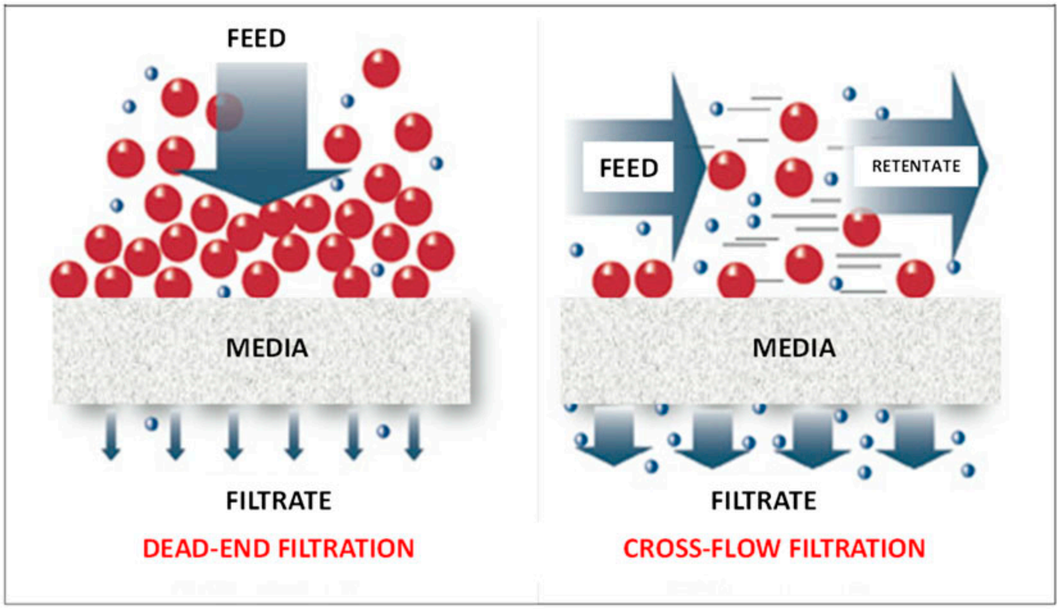

Fig. 2. Type of filtration.

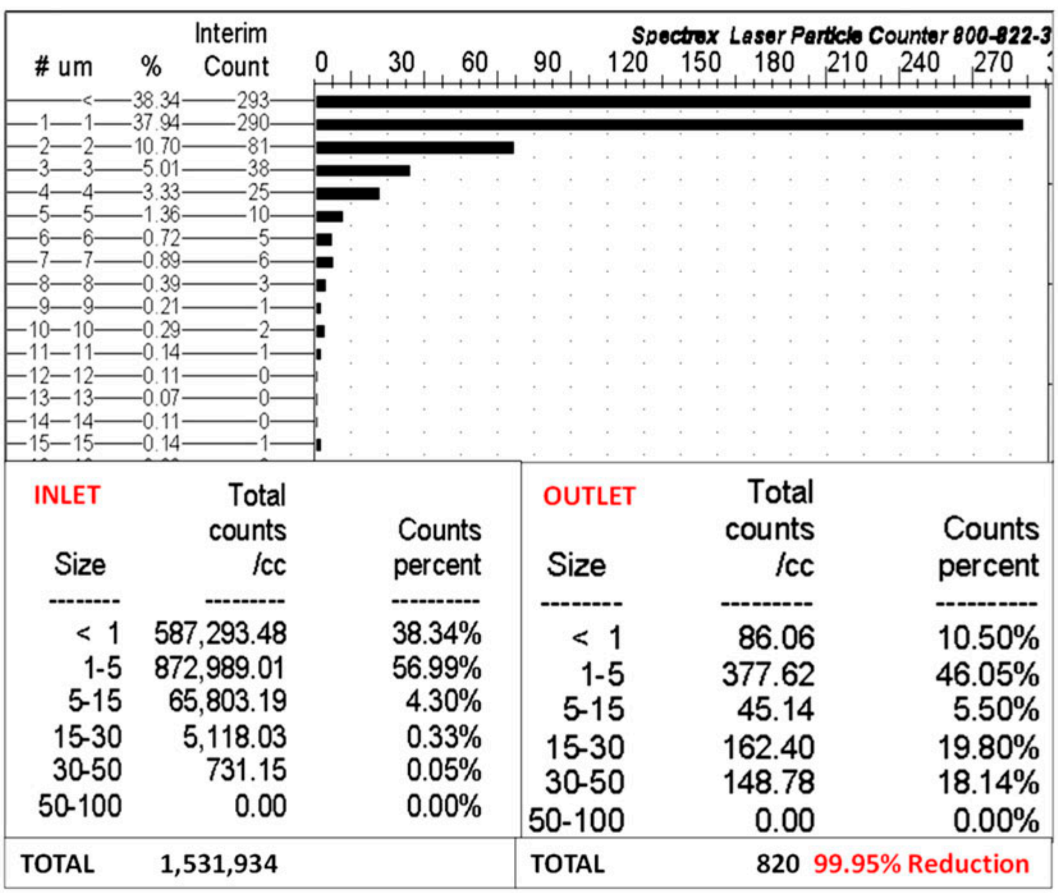

Fig. 3. Particle counts.

(4) Cost is very competitive compared to other pretreatment processes (micro and ultrafiltration (MF/UF).

4. Conclusions

VORTISAND cross-flow microsand filtration provides an efficient and cost-effective way to protect membranes and fills the technological gap that currently exists in water filtration, providing the efficiency of microfiltration at the cost of MMF.

Reference

[1] B. Mohaved, Proper Pretreatment for Brackish Water Reverse Osmosis Systems, in Pretreatment Solutions, American Membrane Technology Association, Stuart, FL, 2013.