Experimental Study of the microfiltration for the production of the drinking water

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Abstract:
Our study is related to the introduction of microfiltration into the conventional process of producing drinking water. A microfiltration rig was mounted at the Laboratory of the Engineering of the Processes of the Environment (LIPE) of the university Constantine 3. Raw water from Ain Tine (Mila) was used in all the experiments. The experimental works focused on the determination of permeate flow rate (filtered) for pure and raw water, depending on the transmembrane pressure (TMP). This part also considered the variation of mass transfer resistances and included different physicochemical tests, namely turbidity, matter in suspension (MES) and the dry residues (RS), for both for pure and raw water, filtered water and on the level of recycled water.
The results show that membrane of microfiltration can retain the various matters contained in raw water, by major elimination of MES and a better clarification of filtered water
Key words: *Membrane, microfiltration, flux, Suspended matter, drinking water.*

Résumé:
Notre étude porte sur l'introduction de la microfiltration dans le processus conventionnel de production d'eau potable ; un montage de microfiltration a été réalisé au Laboratoire de l'Ingénierie des Procédés de l'Environnement (LIPE) de l'université Constantine 3 ; l'eau brute utilisée dans toutes nos expériences est celle de Ain Tinn (Mila), Notre travail expérimental est consacré sur la détermination du flux de perméat (filtrât) en fonction de la pression transmembranaire (PTM), et cela pour l'eau pure et l'eau brute cette partie comporte aussi le suivi des résistances de transfert de matière et se concentre englobe sur les différents testes physico-chimiques, à savoir le suivi de la turbidité, la détermination des Matières en suspension (MES) et les résidus secs (RS), et cela pour l'eau brute, eau filtrée et au niveau de l'eau recyclée (concentrât) ; l'ensemble des résultats montre que la membrane de microfiltration peut retenir les différentes matières contenues dans l'eau brute, par une élimination importante des MES et une meilleure clarification de l'eau filtrée.
Mots clés: Membrane, microfiltration, flux, matières en suspension, Eau potable.

1. Introduction:

The choice of the microfiltration (MF) is to treat a drinking water, removing organic pollutants, namely organic matter (OM), suspended matter (MES), pathogenic microorganisms, etc. [1- 2]. This has numerous technical advantages such as avoiding the addition of chemicals, its moderate cost [3-4], etc., whereas, it is significant to note that there is a problem of clogging of the membrane which depend the water quality of the feed and the operating requirements of the process [5- 6].

2. Material and methods:

The tangential microfiltration system was mounted in our laboratory LIPE University of Constantine3.

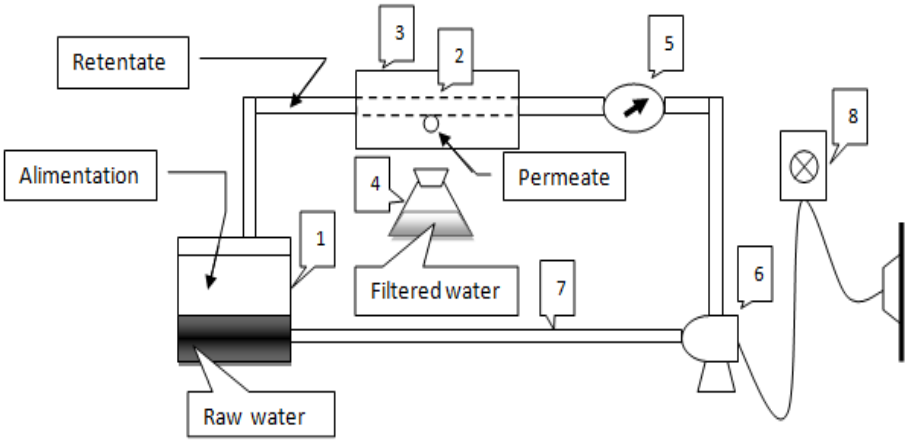

Figure1. Plan of the microfiltration system

The operating principle is as follows: the solution to be filtered (the raw water) was stored in the tank (feed tank (1)). It was pumped by (6) through the tubular micro filters (membrane (2)) held by the module (3). The flow (flow) of the pump could be adjusted by the switch (8) whereas the manometer (5) allowed the reading off the pressure at the entrance of the micro filter. The retentate was sent back into the feed tank (supply) and the permeate (filtered water) was collected in a conical flask (4) for analysis. The filtrate volume was followed according to time, to finally determine the flow of the permeate Knowing the surface area of the membrane.

2.1. Permeate flux:

The permeate flux is given by the resistance in series model law:

$$J = \frac{\Delta P}{\mu(R_m + R)} = \frac{\Delta P}{\mu R_T}$$

J: permeate flux;
ΔP: Transmembrane pressure (PTM);
Rm: membrane resistance;
R: resistance of the deposit;
R_T: total resistance.

3. Results:

3.1. Flow of permeate and total Resistances:

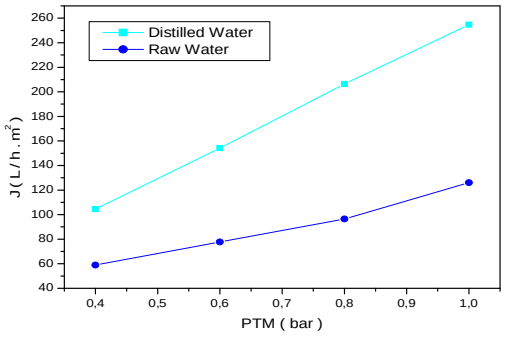

Figure 2. Variation of the flow of permeate transmembrane pressure

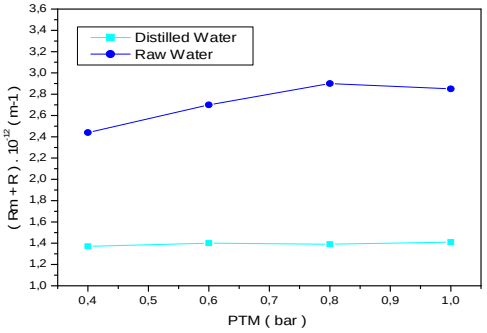

Figure 3. Variation of the Resistances according to the according to the transmembrane pressure

3.2. Color of the water

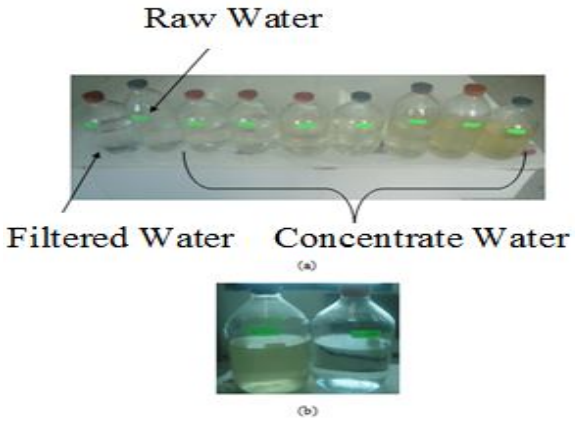

Figure 4. Variation of the color of the filtered water Compared to raw water and the of the concentrate water (recycled)

3.3. Suspended matter:

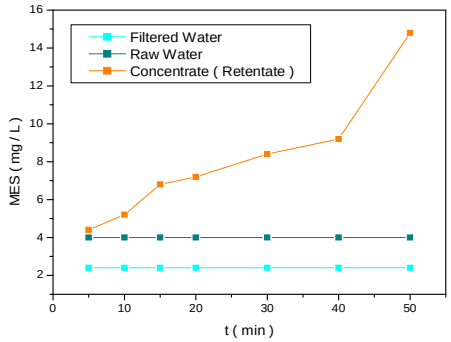

Figure 5.Variation as of suspended matter according to the time of filtration

3.4. Dry Residue :

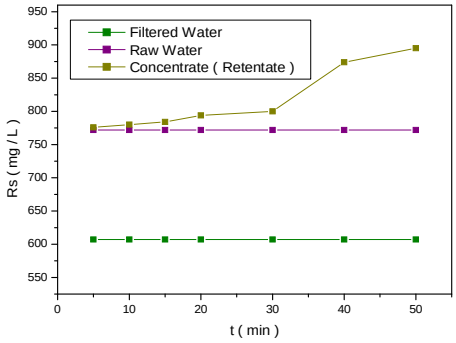

Figure 6. Variation of the dry residue according to the time of filtration

3.5. Turbidity:

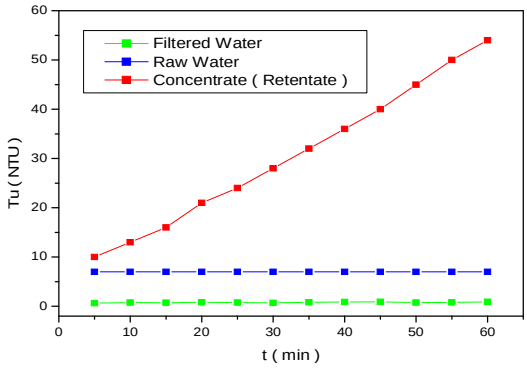

Figure7. Variation of turbidity according to the time of filtration

4. Discussion:

a) Permeate flow:

In this case, the filtration time was set at 10 minutes, and the transmembrane pressure (TMP) was variable. Figure 2 shows that le flow of Permeat Increased dramatically according to transmembrane

pressure Darcy's law; The flow in the case of distilled water was higher than that of the raw water. Figure 2 shows a linear distilled water flow rate, with a high slope which means clustering the regularity of the membrane, no deformation or failure of this lathing, and less clogging phenomena during filtration, confirming the maximum flux Darcy's law. In the case of raw water the obtained flow rates were much smaller, indicating a deposit on the surface area of the membrane blocking its pores [1].

b) Membrane and total resistances:

The membrane and total resistances are presented in this part, using the Darcy law knowing the permeate flux values for different transmembrane pressures. The membrane resistance was determined when the distilled water was used, and the total resistance in the case of the raw water was (RT = Rm +R) with R is the resistance of the deposit.

d) Color of the water:

In this case the time of filtration was set up for a period of 50 minutes , it is Followed by the color of filtered water this is Realized as preliminary experience, the figure 4 ((a) and (b)) shows the variation of the color of filtered water in comparison with the one of the concentrate and raw water.

According to the face (figure4), we notice a very good clarification of the water filtered, translated by very clear (net) change of the color during the microfiltration of the raw water (food) ((supply)). It Was Noticed as well, as After several tries (essays), an unwanted smell appeared in the raw water and concentrate this unwanted smell disappeared in the filtered water

c) Suspended matter:

in Figure 5 the lines there for obtained shows That There is one rating of abatement as of Suspended matter (MES) for the filtered water in front of raw water, both, show that quantity of the MES constant according to rest time; this result shows that membrane: has a limit of collecting of MES; Reviews on the other hand the concentrate, quantity of Suspended matter is Increasing through broken line; MES retentate (concentrate) Increase during the filtration Proves the a retention of Suspended matter .

e) Dry Residue:

In Figure 6 there for obtained a one line shows that quantity of the residues is constant dryness in filtered water (It Does not vary with the time of filtration) Explains why this has always some quantity of the dry residue After filtration a less wide quantity Compared to the second right-hand side which Represents the quantity of the residues dryness of feed water (raw water), the last variation of the dry residues of recycled water is that, one note that there is an Increase in the dryness residues with time which Explains why the membrane lets pass water and pure water Prevented a significant Amount of the non dissolved matters.

f) Turbidity:

The study of turbidity confirmed the results as of MES and of the dry residues, Figure 7 showed the variation of turbidity according to time, for raw, filtered and recycled water. The time of filtration was fixed at 60 minutes.

In Figure 7 shows Obtaining two straight lines parallel with the x-axis, there are filtered water and raw water, it should be noted that for filtered water we obtain a turbidity respecting standards' of drinking

water That we obtains a filtered water turbidity Respecting the standards of drinking waters (Lower Turbidity or equalizes to 1 NTU).

The second line port whose feed water turbidity is between 5 and 10 NTU. A third line there for obtained recycled water (concentrated) but this one Increase with time, this Increase Explains why the pure water from the solution was separated by filtration.

5. Conclusion:

Membrane separation processes are more and more developed these last years, particularly those based on microfiltration, ultrafiltration and nanofiltration. These latters have shown their capacities in the production of drinking water.
The present study showed that when microfiltration was used in the treatment of drinking water since significant improvements of water quality were recorded with performance in terms of flow, of permeability, resistors and Suspended matter. Through the obtained results, one can conclude that microfiltration represents a very interesting technology in the field of water treatment destined to consumption

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