UDC. 687

ANTIMICROBIAL JETFILTRATIONS OF MEMBRANE TECHNOLOGY TO WATER/WASTEWATER FOR THE MIDDLE-EAST REGION

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Membranes for water/wastewater-filtrations are designed of volume porosity to meet of safety and the comfort for human beings. Porosity is the most important to be considered of features that represent a membrane technology structure. The properties of membrane were analyzed by determining the efficiency of filtrations porosity. The membrane technology structure, the technics and the type of nanofibrous are factors of fluid porosity, which as porous material enables to transmit water/wastewater-filtrations, air, heat energy, and liquid perspiration. Several methods considering thread distributions have been developed to determine the membrane fluid porosity. A mathematical model based on an ideal geometry of the porous structure of membrane water/wastewater-filtrations has been developed. We demonstrated the design and construction of special antimicrobial membrane of nanofibrous mats throw volume pore sizes as filtration materials for selective and efficient separation of water and wastewater as Jetfiltration for the middle-east region as the future the demand for membranes is envisioned to get incremented in the future with the growth of the emerging economies further strengthening the market.

Keywords: membrane technology, antimicrobial, water/wastewater, filtrations, fluid porosity, middle-east region.

1. Introduction

Jetfiltration technology is a process of removing particulate matter from water by forcing the water through a porous media [1]. This media of porosity can be natural, In the case of different size of sand, gravel and clay of different quality of water sources, it can be a membrane wall made of different materials [7]. Jetfiltration of antimicrobial of fluid porosity of membrane technology for treatment of water and wastewater as filtrations for all humanity in the region of Middle East, according the indictors of water permeates all aspects of life on Earth. Like the air we breathe, water sustains human, animal and plant life. The availability of freshwater has also fallen short of adequately meeting its increased demand in most parts of Asia, Africa and the Middle East. Investments in safe drinking water and sanitation have paved a path to economic growth. Such investments have high rates of return: for each US$1 invested, the World Health Organization (WHO) estimates returns of US$3-34, depending on the region and technology (WWAP, 2009). According to the United Nations Environment Programme (UNEP), that had established and investments in small scale projects, that provide access to safe water and basic sanitation in Africa region and that could return an estimated overall economic gain of about US$28.4 billion a year, or around 5 % of gross domestic product (GDP) (UNEP, n.d.) [10]. And several other studies show that the annual economic growth rate in poor countries, which have better access to improved water and sanitation services, the annual economic growth rate reached 3.7 %, while those who did not receive similar services improved annually growth of just 0.1 % (WHO, 2001) [10]. In spite of obvious benefits, there are many areas worldwide that still suffer from underinvestment in such infrastructure. The market potential of water and sanitation services, and related job creation, is expected to be significant in the coming decades. In Bangladesh, Benin and Cambodia alone, about 20 million people should gain access to rural piped water supplies by 2025, ten times the current number, representing a market worth US$90 million/year. On the sanitation side, a study in Bangladesh, Indonesia, Peru and Tanzania reveals a market potential for sanitation services of US$700 million annually[2,12]. Jetfiltration of antimicrobial of fluid of membrane in porosity technology as Innovation contributes to the continuous improvement of water management for the region of Middle East. Throw the famous technologies in membrane filtration: A. Reverse Osmosis (RO) B. Nanofiltration(NF); C. Ultrafiltration (UF). D. Microfiltration (MF) [8] throw Jetfiltration of composite multi-layer membranes: Antimicrobial Jetfiltration membrane of fluid porosity in technology of membrane combine two different structures into a single membrane as layer that is different can be formed elements independently with each an isotropic material or anisotropic filtering morphology with each having a distinct distribution porosity sizes and semblance ratio on porosity sizes of double layer of the membrane elements and thickness [5].

2. Experimental work

Materials: From the international technical textiles industry 6 October, 4 zone, street 57 No :40. Polyamide (PA6) (Sigma Aldrich, 181110), titanium (IV) dioxide (TiO2) (Sigma Aldrich, 718467, Aeroxide® P25), formic acid (Sigma Aldrich, F0507), acetic acid (Sigma Aldrich, 33209) were used as received. Isoproturon (Dr. Ehrenstorfer GmbH) and distilled water were used in photocatalytic activity tests.

Methods: 18 wt% PA6 solution and 5 wt% PA6 solution with 200 wt% TiO2 (with respect to the polymer weight) were used as the core and the shell solutions respectively to obtain coaxial Nanofibers with an actual TiO2 content of 8.4 wt%. Coaxial needle (Ramèhart Custom Needle, 100-10-COAXIAL-2016, outer needle: 1.7 mm OD, inner needle: 0.9 mm OD) was placed on the needle holder of the electrospinning setup. Two pumps (KD Scientific Pump Series 100) were used to feed the core and shell solutions respectively. A high voltage power supply (Glassman High Voltage Series) was used to apply high voltage to the outer needle. In order to see whether the shell solution was electrospinnable, it was used as the electrospinning solution on the basic setup using uniaxial needle. Uniaxial PA6 Nanofibers containing 50 wt% TiO2 was also produced for comparison. For uniaxial nanofiber production, a uniaxial needle (Sigma Aldrich, Z261351-1EA, Stainless steel 316 syringe needles, pipetting blunt 90 tip, 18 gauge, 6 inch) was placed on the needle holder. The electrospinning solution was fed to this needle by a pump (KD Scientific Pump Series 100). A high voltage power supply (Glassman High Voltage Series) was used to apply high voltage to the solution. Using a syringe of 10 mL, electrospinning solutions, were fed using PTFE tubing (OD=1/16’’=1.6mm OD) through the needle. The distance between the tip of the needle and the collector, the flow rates of the solutions and the voltage were adjusted to obtain stable electrospinning. Large homogeneous Nanofiber webs were obtained using the in-house developed electrospinning machine. Nanowebs with the same specific weight (10 g/m2) were produced. The speed of the aluminium foil was adjusted to obtain Nanowebs with the same weight. Distribution the densities' porosity size and there effects of membrane by modify the selectivity of the solute sieving coefficients and the Jetfiltration flow distribution modules included that are specifically mentioned of originative to equipping linear scaling from very small modules as suitable for practicability development ($A<50\ cm^2$) to large commercial scale devices capable of processing 15,000 L in 3 h. Jetfiltration of antimicrobial of fluid porosity in membrane technology modules are used with a special holder that provides access to filtrate ports at both ends of the module to achieve the desired co-current flow.

3. Results and discussion

The structures of composition that needs to be transported must first be dissolved terminate in the membrane structures, in general approaches of the Jetfiltration model is to assume the responsibility, that the chemicals potentials of the feed on and permeate water fluids are in equilibrium position with the adjacent to membrane surfaces, such things; that are appropriate action expressions of quantity for the chemical potential in the fluid of membrane phases of equated at the Jetfiltration membrane interface. This principle of operation is more than important for intensive membranes without natural pores, such as those are used for reverse osmosis and in fuel pump units, During the Jetfiltration process a boundary layers forms on the structures of membrane, This concentration gradient is formed by molecules instructions which cannot pass through the structures of membrane. Jetfiltration is the fundamentally intensive membrane as later process helps in the separation of wastewater and wastewater compositions reducing the costs of distillation processes as the following in Fig. 1: Innovation Jetfiltration design model of antimicrobial of volume porosity in membrane technology to water/wastewater-filtrations for the middle-east region.

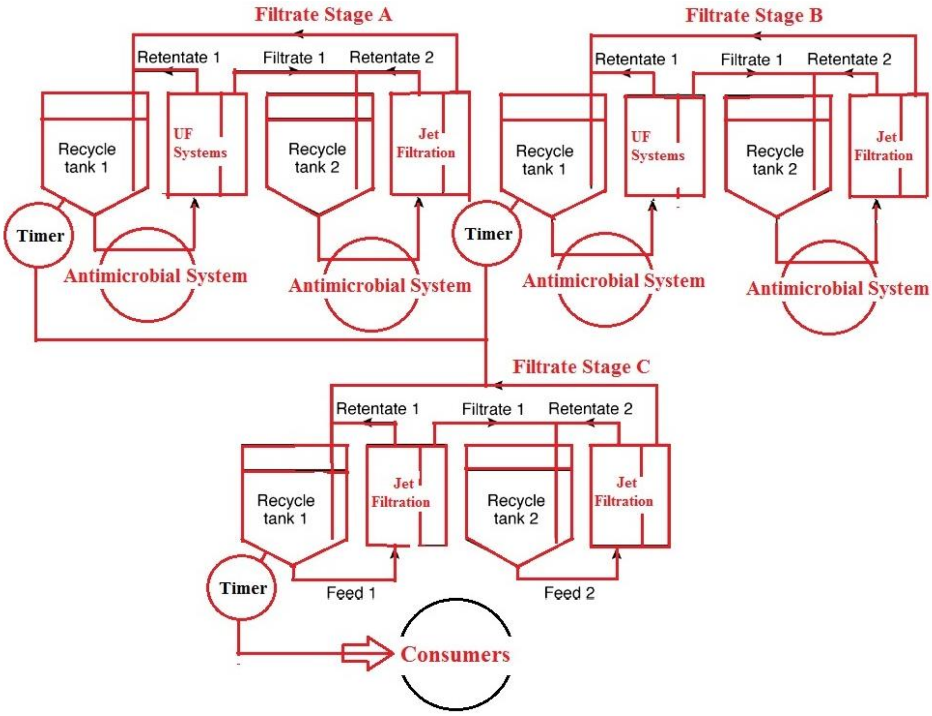

Fig. 1. Innovation Jetfiltration design model of antimicrobial of volume porosity in membrane technology to water/wastewater-filtrations for the middle-east region

Table 1 – Different liquid filtration techniques

Separating process	Reverse Osmosis (RO)		Ultrafiltration Nanofiltration	Jetfiltration Microfiltration (JF)	Ultrafiltration (UF)		Microfiltration (MF)	
Size ratio of substances to be separated	Solved slate Atomic radius	Sugar	Progens	Viruses Albumin (66KD)	Bacteria	Red blood cells	Yeast Pollen Human Hair	Sand
Micrometer Logarithmic Selected	0.001		0.1	0.1	1	10	100	1000
Angstroms Logarithmic Scaled	1		10	100	1000	10^4	10^5	10^7
Molecular weight (Dextran inKD)	0.5		50	7.000				

3.1. Porosity size and selectivity

Jetfiltration of antimicrobial of fluid porosity in structures membrane of volume porosity sizes of technically membranes are specified by differently from depending upon the producer. Exclusive a common distinction between the nominal porosity size, and its describes a noun the maximum volume porosities sizes distribution. With gives you only fuzzy information about the retention period capacity of a membrane, the exclusion criteria limit of the membrane is usually specified in the form of nominal molecular weight, Jetfiltration membranes are divided into four classes according to volume porosities sizes According this model suggested by ElNashar, 2005 [4], with equilibrium by use calculate Cross-section of yarns, and thereafter we can get adequate equation of functional applied for porosities of volume for Jetfiltration, throw the following equations:

$$R_v = 100 - \frac{\pi}{4*1000*T_{T_K}}$$

$$X\left[\begin{array}{c}\dfrac{UP(C_o^2*\eta_{o_B}*\eta_{o_R}*T_oP_o)+L_w(C_o^2*\eta_{o_B}*\eta_{o_R}*T_oP_o)}{UP[1-0.01.a_o)+L_w(1-0.01.a_o)]}\\ \dfrac{UP(C_y^2*\eta_{y_B}*\eta_{y_R}*T_yP_y)+L_w(C_o^2*\eta_{y_B}*\eta_{y_R}*T_yP_y)}{UP[1-0.01.a_y)+L_w(1-0.01.a_y)]}\end{array}\right] \quad (1)$$

$$x\,\frac{1}{IFC}$$

where the description of symbols is given in Table 2.

Table 2 – Description of the Symbols for equation (1)

Warp	Weft	Definitions
UP ηo_r	UP ηy_r	Considerable (grate)of yarn Cross-section
LW ηo_r	LW ηy_r	Considerable (grate)of yarn Cross-section
UP ηo_B	UP ηy_B	Smallness of yarn Cross-section
LW ηo_B	LW ηy_B	Smallness of yarn Cross-section
UP a_o	UP a_y	Crimp of yarn
LW a_o	LW a_y	Crimp of yarn
UP P_o	UP P_y	Number of yarn in inch for "warp-weft"
LW P_o	LW P_y	Number of yarn in inch for "warp-weft"
UP C_o	UP C_y	Yarn twist factor
LW C_o	LW C_y	Yarn twist factor
UP T_o	UP T_y	Yarn count in Tex system
LW T_o	LW T_y	Yarn count in Tex system

The internal porosity of cloth had given conception about porosity with worked the air vacancy between; inner of yarn, inner of fibers as the following:

$$Ri = RM - Rv, \quad (2)$$

where Ri – the air vacancy between inner of yarn, RM – general porosity, Rv – volume porosity, showed that the Jetfiltration flow rate can be approximated as:

$$R_v = \frac{Q_{rm}}{Q_o} - \exp/(-\beta t) + \frac{R_{rm}}{R_{rm}+R_{rp}}[1 - \exp\ (-\beta t)] \quad (3)$$

where R_{rm} is the resistance of the clean Jetfiltration membrane (equal to 1/*L*p) and R_{rp} is the resistance of the growing deposit:

$$R_v = 1/\mathrm{Lp}\ (R_{rm}+R_{po}) + (\sqrt{1+\alpha t}) - R_{rm} \quad (4)$$

and R_{po} is the resistance of the initial deposit and *α* is proportional to the specific resistance of the growing Jetfiltration, The comprehensive scope the framework implicit the combined porosities of Jetfiltration model has been extensive to launch to computation for the effects of the complex porosities morphology in current sterile Jetfiltration membranes, including both the asymmetric structure and the pore Jetfiltration interconnectivity. The interconnected pore structure allows fluid to flow under and around any pore blockage, significantly reducing the rate of flux density, Which be an alternative to the flow chart the decay method is general volume (V_{gen}) analysis. In this case, flux decay data are obtained over only a short filtration time (typically 15–20 min), through the information extrapolated value to prolonged times of Jetfiltration using the linearized chart of the porosities constriction model:

$$R_v = \frac{t}{v} / (\frac{1}{Q_o} + (\frac{1}{V_{\text{gen}}})t \quad (5)$$

The inverse linearized of the slope on a plot of Jetfiltration *t*/*V* versus *t* is the general volume of fluid that can be Jetfiltration before the membrane is completely plugged. Tabulate is then carried out by affecting that the available capacity which usually between 45 and 90% of V_{gen} , Scales of measurement linearly throw the membrane area as the V_{gen} procedure demand smaller volumes porosities of practicability fluid and squab by testing times, but it may lead to large errors in predicted capacity if fouling is not due to pore constriction.

Table 3 – Specification of membrane of fabrics technology to water/wastewater-filtrations

Entity / samples	1	2	3	4	5
Code	IT/FPES.500	IT/945.MS	IT/F-HAC.550 HE	AT/SW-PES. 1150	IT/F-PES. 500
Content	100% polyester		100% homopolymer acrylic	Needle felt for ironing Table	100% polyester
Warp		Multifilament	-	-	
Weft		Spun yarn	-	-	
Wight	500gr/m^2	300 gr/m^2 (+,- 5%)	550 gr/m2		550 gr/m2
Thickness	1.8 mm	4.5 mm	3.2 mm	11-12 mm	1.8 mm
Air permeability	200m3/m^2. Min	4.500 lt/dm^2. Hr	200 m^3/m^2. Min	4.800 lt/dm^2. Hr	200m^3/m^2. Min
VOLUME POROSITY	1.43	1.13	1.12	1.12	1.11
Working temperature	150 0c in dry condition		120 0c	120 0c	150 0c in dry condition
Pressure	+,-10%		+,-10%	+,-10%	+,-10%
Tensile Crosswise		1.150 kgf/5 cm			
Strength: Lengthwise		1.800 kgf/5 cm			
Composite layers of woven fabrics	-	×		-	
Nonwoven	×	-		×	×
Water repellent	Water repellent	Water repellent	Water repellent	Water repellent	Water repellent

3.2. Jetfiltration Membrane channels of mash woven fabric structure.

Jetfiltration using the multi-layers of membrane technology that are often used to Antimicrobial filtration are made from hydrophilic polyethersulfone and hydrophilic polyvinylidene fluoride, and renewed cellulose **:** Where: γ_{FV} , γ_{FL} , and $\gamma_{FV}\theta$ denotes interfacial tensions membrane between solid/liquid(water) and liquid/vapor, respectively, and is the equilibrium contact angle, *F*, which measures the difference between the surface energy (per unit area) of the substrate when dry and wet of upper fabrics:

$$F = (\gamma_{Fo} - \gamma_{Fo} + \gamma) \quad (6)$$

where γ_{FV} is surface tension of a antimicrobial Jetfiltration membrane (AJM) free or 'dry' solid surface, γ is surface tension of the liquid usually, we know γ γ_{LV} by separate measurements. If the parameter F is positive, the liquid spreads completely in order to lower its surface energy ($\theta = o$). Where Jetfiltration are Jet$_{\text{AVP}}$ (Jetfiltration Antimicrobial of volume prosody) as the following model:

$$Jet_{Avp} = \frac{P_o\left[UP(1000\pi d_{oB} - d_{o_r}\gamma - 4T_o) + L_w(1000 * d_{o_B} - d_{o_r}\gamma - 4T_o + \gamma_{FV} - \gamma_{FL} - \gamma_{FV}\theta\right]}{4T_{T_k}\gamma\left[UP(1-0.01.a_o) + L_w 4(1-0.01.a_o)\right]*1000)}$$
$$+ \frac{P_y\left[UP(1000\pi d_{y_B} d_{y_R}\ \gamma_{-4T_y}) + L_w(1000\pi d_{y_B} d_{y_R}\ \gamma_{-4T_y}) - (\gamma_{Fo} - \gamma_{Fo} + \gamma)\right]}{4T_{T_k}\gamma\left[UP(1-0.01.a_y) + L_w(1-0.01.a_y)\right]*1000} \quad (7)$$
$$\text{x}\ \frac{1}{IFC}\left[\gamma_{LV}\left(\frac{r}{\cos\theta}\right)\right] \div C^o$$

where *r* is the capillary radius, and C^o is temperature degree of desalination system [6]. Antimicrobial Jetfiltration membranes (AJM) were originally designed for use in tangential flow filtration with the feed flowing adjacent to the upper skin layer of the asymmetric membrane. (AJM) provides high flux by sweeping the membrane surface to reduce concentration polarization and fouling. However, the simplicity and lower capital cost of normal flow filtration (AJM) has led to the widespread use of virus filters specifically designed for AJM. Antimicrobial Jetfiltration membranes (AJM) have porosity sizes between > 0.1 μm-1 nm, and are purposed to supply high retention of proteins and different macromolecules and . Antimicrobial Jetfiltration membrane has ability to be used for protein purification utilize a known process as well as high execution tangential flow filtration [3].

Table 4 – Descriptions of Sample of membrane fabric

Sample of membrane fabric	POROSITY size	Molecular mass	Process	Filtration	effectiveness to Removal
(3) IT/F-HAC.550 HE &(2) IT/945.MS	> 0.1 μm-1 nm	> 5000 kDa	Jetfiltration	1-10 bar	larger bacteria, yeast, particles
(1)IT/FPES.500	100-2 nm	5-5000 kDa	ultrafiltration	1-10 bar	bacteria, macromolecules, proteins, larger viruses
(4) AT/SW-PES. 1150	2-1 nm	0.1-5 kDa	nanofiltration	3-20 bar	viruses, 2- valent ions
(5) IT/F-PES. 500	< 1 nm	< 100 Da	reverse osmosis	10-80 bar	salts, small organic molecules

The design and shape of the membrane structures into porosity are highly dependent on the producer's process and are predominatingly difficult to specifying the volume porosities. Exclusive potential is the Jetfiltration of macromolecules oftentimes dextran, polyethylene glycol and albumin. Latest mensuration of the cut off through gel force permeation chromatography as mainly used these methods that are for measure porosities of membranes for Jetfiltration applications. Second testing method for Jetfiltration of particles with defined volume size of porosity and their measurement with a particle porosity size and by laser induced derive breakdown spectroscopy. Alive description is to mensuration the repudiation of dextran blue and other colored molecules. Thus; the retention potentials of bacteriophage and bacteria and so-called of bacteriachallenge exam, that which can furthermore provide information about the sizes of volume porosities into Jetfiltration.

3.3. Processes of Jetfiltration

Jetfiltration (JA) of antimicrobial of fluid porosity in membrane technology Medium exchange and perfusion (JA) systems can be used to carry out cell-protein separation processes including medium exchange during fermentation. The process was originally developed for the production of recombinant human tissue-type plasminogen activator ovary cells were grown in successively larger seed fermenters with media containing serum to support cell growth. Performing the final production fermentation in the presence of serum proteins, resulted in several unique difficulties. High molecular weight complexes were formed between (JA) and serum proteins. Several proteolytically cleaved forms of Jetfiltration of antimicrobial were also generated in the presence of serum. Improved yield and product quality were achieved by developing a process in which the cells could be grown in serum-containing media throughout the cell culture seed train but then switched to a serum-free media for production. The penultimate cell culture (2500 L) was first concentrated six-fold and then media exchanged with 6 diavolumes of serumfree media using a (JA) system with either 24.5 m^2 of 0.2m autoclaved polypropylene hollow fibers or 19.6 m^2 of 0.65m of flat sheet membranes. The media exchanged cells were subsequently transferred to a 15,000 L production fermenter operated with serum-free media. Both (JA) systems used a wall shear rate of 4500 s^{-1} and a flux of 55 L/m2/h. Cell viability was maintained at very high levels [3]. Jetfiltration of antimicrobial systems sophisticated for medium commutation that can be used for culture perfusion pressure. Perfusions are the culture production method in which product is constantly removed and replaced with new medium the same Jetfiltration of antimicrobial technology that was originally developed for medium exchange has also been used to harvest recombinant driven proteins from both mammalian and bacterial cultures [3]. Jetfiltration of antimicrobial systems are generally larger due to the larger scale of production fermenters. A 174 m^2 hollow fiber system a 190 m^2 flat sheet system. These systems have been used for harvest of proteins from cultures with the same wall shear rate as medium exchange processes (4000 s−1) but at lower flux rates (around 26 L/m2/h) due to the higher cell debris load [13]. The smaller porosity size membrane enabled direct sterile filtration into the harvested cell culture fluid hold tank whereas the larger porosity size membranes required the use of depth filters prior to sterile filtration. The main membrane of volume porosities were in demand to realize adequate procedure capacity (114 L/m^2 including a 1.5x safety factor) on more challenging feed streams. Yields averaged 99% and membranes could be re-used 100 times [11]. The depth filtration as principles cells and debris are removed in depth filtration throughout the filter media, in contrast to the surface removal typically observed with microfiltration membranes. The depth Jetfiltration is representative used in conjugation with normal flow Jetfiltration which provided that cost dynamic process suitable to the considerable increase in capacity of the Jetfiltration. And this is in particular valid for heavily fouling feed stocks. Particle removal in depth filtration occurs by a variety of mechanisms. Cells and cell debris can be removed by physical capture in narrow volume porosities spaces. The structure of multilayer membrane with graded potential porosities sizes, to prolong the capability of removing different size debris within different layers of the Jetfiltration. Self-contained molded devices are also available. In both cases it is advantageous to use assemblies with integral air vents to avoid air entrapment and ensure complete utilization of the membrane area. These small-scale devices are important for process development studies with limited amounts of feed stream. Due to the variability in media, however, caution should be made in scaling up results obtained with such small filter areas. Some pilot scale devices are also available from certain manufacturers but there is no universal standard format at this scale. Industrial scale systems utilize stainless steel housings incorporating either 13 in. diameter of 1.7 to 2.5 m2, or 15 in. diameter at 3.4to 5.0 m^2, cartridges. Housing sizes range from 1 to 18 cartridges. Due to plant height limitations and safety concerns, housings are also available with split domes. Larger systems are often implemented with multiple housings in parallel for capacity and in series for two-stage filtration to capture different particle sizes. In some cases the series configuration of housings can be avoided by using multimedia cartridges. Therefore trade-offs to be made in terms of surface area per cartridge in which varies between manufacturer and depth filter media height of some multimedia cartridges only contains half the media height for each filter.

3.4. Jetfiltration technology of antimicrobial

Antimicrobial into fluid volume porosities in technology of Jetfiltration membrane throw hollow fiber and narrow porosities of membranes for tangential flow Jetfiltration are made from a variety of polymers inclusive polyethersulfone, polysulfone, polypropylene, polyvinylidien fluoride, and blended cellulose and polyester. These fibers typically have inner diameters of 0.2 to 1.8 mm, providing laminar flow with moderate shear rates, to enable autoclave sterilization the polypropylene ingredients were annealed to reduce stresses in the polymer. The external cage of the cartridge was likewise strengthened by a thicker design to withstand heating and cooling cycles.

The cartridge diameter over insulation was made minimal to decrease the absolute differences in thermal amplification and shrinkage of the polypropylene and polyurethane components. Manufacturing scale procedure of Jetfiltration of antimicrobial of fluid porosity in technology of membrane model utilize the cartridges and housings and using many of itself basics as Jetfiltration.Healthy procedure as closed loop processing is maintained with chemical sanitization as typically 0.1tp 0.5N NaOH, and the following assembly and previously to use so Pre-use integrity and safety testing may be done to assure appropriate cartridge installation to militate against risk of having to Re-operation the feed stream must the post-use integrity test fail, then testing is required to insure that the claimed virus clearance was in fact accomplished since it is not feasible to determine the virus content in the Jetfiltration at the low levels required for human pharmaceuticals produced from mammalian cells. Permeability of Jetfiltration of antimicrobial of fluid porosity in membrane technology of permeability is typically evaluated from the Process permeability for polysulfone membranes tend to be lower than those for regenerated cellulose due to the greater extent of protein adsorption on the more hydrophobic polysulfone.

4. Conclusions

Antimicrobial throw the gravity of volume porosity into technology membrane to Jetfiltration for Water Purification and wastewater filtrations for the region of Middle East, the Jetfiltration has classic has been viewed as a purely porosities size based exclusion criteria phenomenon. The nominal diameter molecular as weight cut off Antimicrobial Jetfiltration Membrane (AJM) supply minimum information on produce retention period since membranes with the same AJM, However several sizes of porosities which in densities distributions can have very various behavior modification at the >99% detention level needed for Jetfiltration operations. The deep-rooted trade-off between the hydraulic hose of permeability and protein reservation, Those effects can be perfectly spectacular with the sieving coefficient reduced by more than 105 fold consequent to a reduction in sand and salt concentricity from 100 to 1 mm. Thus hexagonal icons symbolize data that obtained for a negatively affect into charged composite material of renewed cellulose Jetfiltration membrane manufactures by chemical as ecofriendly of sulfonic acid functionality for the region of Middle East.

5. Acknowledgements

The author gratefully acknowledges contributions and support from Prof. MR. Erden Sonmez , Director-General of the international technical textiles industry 6 October, 4 zone, street 57 No:40, whose support was instrumental in preparing the textiles materials.

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