Evaluation of the Effects of Gas Plasma test in a Tangential Flow Filter

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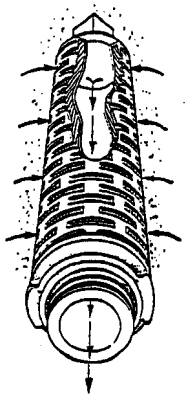
Abstract**—***In this article you will see the combination of two technologies that produce an efficient product. One of the productions of the new form is the separation and filtration combined by retaining a plasma gas treatment. This treatment is to change the polarization of the filter making the filtration more efficient. This type of filter is used to separate abase molecule of its size. The plasma gas applied to the filter changes the condition producing an efficient filtration. It takes three different exposure times and the filter as a standard will define the flow and pressure of Diafiltration. The flow is measured in a define pressure by a control filter establishing and comparing it with other filters to see which is the suitable time for the plasma gas exposure and that does not affect the filter. The elapse of time has been identified as the most effective and adequate increasing the flow and the exposure time.*

Key Terms**—***Diafiltration, Gas Plasma and excellent performance.*

PROBLEM STATEMENT

The Pharmaceutical and Biopharmaceutical use different types of filters for the sterilization of their final products with the intention to prevent any contamination introduced during the manufacture, as well to maintain the integrity of product fluid and product potential. Pall's membrane can be filtrated in both sides, but the assembly of the filtration is one way, (see Figure 1).This filter will be washed to remove particles and reduce Extractable level. [1]



Out Flow

Figure 1
Flow Filtration

Research Description

This chapter will describe the development of High Flow in Tangential Flow Filtration (TFF). This type of filtration will be used in the Biotechnology Industry. It applies to manufacture health care processes, food and other industry environment. The main characteristic of these different uses for this cartridge is the pore size defined by the molecular weight. Gas Plasma Test (GPT) treatment will be applied using Medical devices, obtaining effective and optimized results in the blood filter. Applying GPT as well using different parameters of this gas combination will obtain a high flow filtration.

Research Objectives

A new filtration method will provide a high flow and reduce pressure in the moment of Diafiltration within the Biopharmaceutical Industry.

Research Contributions

The new filter will be presented to the company marketing sell. The Biotechnology filtration process will be faster with large batch product. Therefore, the filtration bath will duplicate and provide other options of filtration for Biotechnology industry.

LITERATURE OVERVIEW

The Pharmaceutical and Biopharmaceutical use different types of filters to sterilize their final products to prevent contamination throughout their manufacturing, in addition to maintain the integrity of product fluid and potential. The filters are important for any industrial company. Filtration is the separation of particles from fluids that come from solid bulk or any particle in small portion of 0.01% or less of filtration fluid [1].

This chapter will demonstrate an effective method, different types of media worked in different areas and manufacturing design. The purpose of filtration is to sterilize all fluid by passing through it. The filter must remove all microorganisms and particles as well as some filters can remove viruses.

Tangential Flow Filter

The TFF Cartridge has diverse types of methods to classify the use of different types of manufacturing process as: Proteins, Nucleic Acid, Carbohydrates and Lipids. For all these types of use this Cartridge characterizes the pore size which is defined by the molecular weight. The process utilized is the Ultrafiltration Method separates the dissolvent solution as basis from the molecular size. This separation technique depends on membrane porosity, which is classified as microfiltration and or ultrafiltration [2].

- Microfiltration membrane will be used for 0.001µm up to 10µm pore. The main function is the sterilization that removes micro particulates.
- Ultrafiltration membrane will be used for smaller pore as 0.001 µm up to 0.1 µm, used for desalting and classifying molecular weight, and Nanoparticle filtration used in the Polyvinyl Alcohol in Australian [2].
- Two different filtration modes can be used in both methods.
- Direct Flow Filtration is perpendicular to membrane filtration of 100% pass fluid. (See Figure 2)
- Tangential Flow Filtration cross flow and passes parallel to the membrane. (See Figure 3)

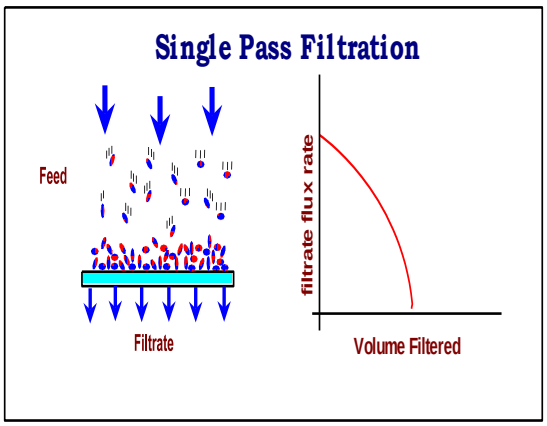


Figure 2
Current Flow Filtration

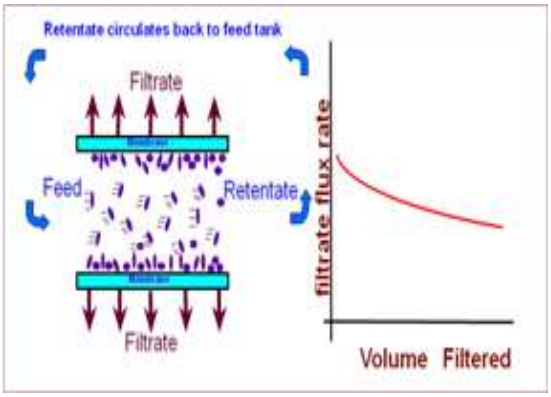


Figure 3
Tangential Flow Filtration

Application of the TFF

This type of mode filtration will use to concentrate the organic compound in the Diafiltration process. This process consists in removing the entire molecular from the solution.

The molecular concentration can be conducted for more than one occasion of filtration [3].

The concentration of TFF is a simple process consisting of the elimination of some fluid from solvent. This concentration in the filtration consists of a separation of different molecular weight that exists in the solution by obtaining a continuous filtration of three to six times. (See Figure 4) [4].

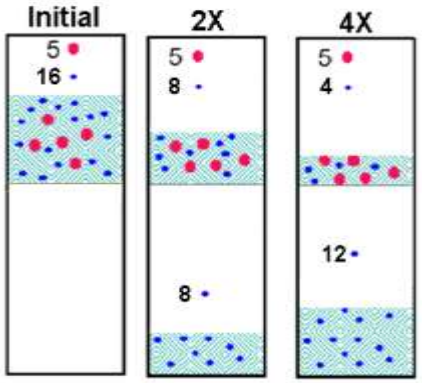


Figure 4
Concentration

The molecular size pore is defined by fluid type in the solution. The membrane selects molecular weight when filtrated of a solvent or concentrated in a production batch.

The flow filtration at moment of filtration is important to pre determine the pore size of filter. The flow will apply pressure determined by viscosity of solvent, type of particle and / or molecular weight. The filtration assembles for this filtration method is not common as fluid filtration in Pharmaceutical industry. The filtration fluid storages in different vessel as it original vessel come, but the solvent return to the original vessel to continue with the filtration. (See Figure 5) [4].

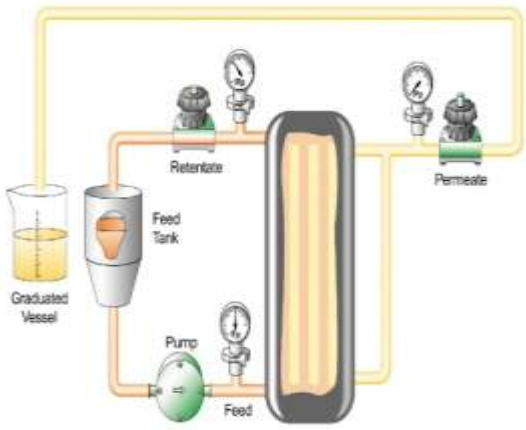


Figure 5
Layout of TFF

Gas Plasma Test

The term plasma was developed by Dr. Jiving Langmuvir in 1929, trying to move the electrons and the ions of the atom in an element, but the case was loses the electrons. So the energy used to move the electron from the atom faith called PLASMA.

The plasma gas is a technique used by the Physicists and Chemicals to change and charge particles in the electrons. That method works electrically charged molecules so sawing a magnetic field around the molecule. This application work affects physically the molecular area, energy, density and horn. Should be considered in the plasma density at moment of application, because it can affect matter electronically the filter membrane. Upon application of the element temperature will be lowering of 10° to 7° Kelvin and forming a cosmic ray. [5]

The Gas Plasma Test application consists of three different inorganic gases. One of these gases is primary gas. It applies to conduct the membrane permeability determined by time, vacuum pressure and gas flow. This gas has ionized properties that change the media functional at the moment of the filtration. This provokes more fluids to absorb high flow rate into the membrane. The process will continue with a second gas into the chamber. This function gas removes some elements that the first gas remains in the membrane at the moment to

apply. The third gas used in this application has a special feature. One property of this third gas is that removes the first two gases inside the chamber cleaning all the system. This gas is known as inert gas; it doesn't let any residue in the surface of the filter and the chamber.

METHODOLOGY

We will take the filtration method pursuant to the gas plasma membrane filter, in addition the interpretation of data that is acquired and compare the regular filtration of TFF.

Diafiltration

This filtering method has a concentrating salt type called whole. This whole method is used to filter small molecules as Tortozine yellow color and the Blue Dextros, which also sodium Chloride is added to maintain the Gel layer of the filter. This different molecular will dissolve into 2 Liter of water priority to Diafiltration. For this method will be using 10 Kilo Dalton filter cassette (10 KDa).

GPT

The application of gas plasma into the membrane uses a vacuum pressure of 150 to 175 mili- tor with a difference of timing of 15, 25 and 35 minutes with 0.35 scm gas flow in the chamber applied in three different filters. The fourth filter without the application will convert in retaining control, obtaining the flux parameter as feed pressure, and retentive pressure.

Statistically proceeding

The high flow will establish to determine test pressure using a non-treated filter. Using the formula as the company would determine the flux filter. Then we made an application for other three filters and the calculation graph as company (J vs. DF). Continue using ANOVA tool [5].

RESULTS

The fourth filter without application was flux determined as on (Table 1) with 5psi ΔP in all pressure of 5psi to 25psi inlet and 0 psi to 20 psi outlet. The flux conducted the pressure that has more flux was in 22.5 TMP with 96 LMH.

Table 1
Flux determination of 4th Filter

Lot # 30076048R

Objective	TMP psi	Q perm lpm	J@T LMH
J vs TMP	2.5	0.464	13
	7.5	0.348	46
	12.5	0.432	67
	17.5	0.456	84
	22.5	0.436	96

The pressure was set 22.5psi TMP with a ΔP of 5 psi, preceded Diafiltration taking the reading from 0.0ml to 1800 ml interval of 300 ml see Table 2. These results are compared with the reading of the other filters treated.

Table 2
Diafiltration of 4th Filter

Lot # 30076048R

Objective	Q ret lpm	Q perm lpm	J@T LMH
J vs DF	0.436	0.160	96
	0.441	0.158	95
	0.444	0.154	92
	0.426	0.154	92
	0.429	0.142	85
	0.435	0.134	80

The first filter was applied with the Plasma gas for 15 minutes with a minimum of 170 Tor and 0.35 scm gas flow. The pressure used was for a maximum flow of four filters establishing a 22.5 psi TMP and with 25 psi inlet and 20 psi outlet. The

results observed in (Table 3) during the recollected data of the Diafiltration.

Table 3
Diafiltration of 1th Filter

Lot# 3007647R

Objective	Q ret lpm	Q perm lpm	J@T LMH
J vs DF	0.198	0.119	71.4
	0.198	0.119	71.4
	0.197	0.118	70.8
	0.189	0.113	67.8
	0.181	0.109	65.4
	0.155	0.093	55.8
	0.146	0.088	52.8

The second filter was applied with the Plasma gas for 25 minutes with 163 Tor pressure at 0.35 gas flow. The results observed in (Table 4).

Table 4
Diafiltration of 2th Filter

Lot# 30076046R

Objective	Q ret lpm	Q perm lpm	J@T LMH
J vs DF	0.330	0.140	84
	0.340	0.140	84
	0.340	0.140	84
	0.340	0.140	84
	0.360	0.150	90
	0.360	0.150	90
	0.380	0.160	96

The third filter was applied with the Plasma gas for 35 minutes with 157 Tor pressure at 0.35 gas flow and results on (Table 5).

Table 5
Diafiltration of 3rd Filter

Lot# 30175051R

Objective	Q ret lpm	Q perm lpm	J@T LMH
J vs DF	0.400	0.180	108
	0.420	0.180	108
	0.420	0.180	108
	0.410	0.180	108
	0.400	0.180	108
	0.400	0.170	102
	0.400	0.180	108

The flux of the first filter in the application reflects the same behavior without applying the filter, high flow starts decreasing as time passes that is the filter has a poor permeable membrane. While the second filter different behavior reflects increased as time passes that is the filter has a good permeable membrane, only the third filter which reflects a constant flux throughout the Diafiltration time that is the filter has a high permeable membrane.

The variation flux observed versus gas plasma application for their filters. The analysis continued and proceeds using the ANOVA calculation to identify some variability in there filters.

ANOVA

The variation flux observed versus gas plasma application for their filters. The analysis continued and proceeds using the ANOVA calculation to identify some variability in there filters. [6]

One-way ANOVA

Source	DF	SS	MS	F	P
Gas Plasma Time	3	36720	18360	24.19	0.000
Error	23	715.6	31.1		
Total	26	6978.8			

S = 5.578 R-Sq = 89.75% R-Sq (adj) = 88.41%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev	+---------+---------+---------+-------
0	7	90.0	6.23	(--*--)
15	7	65.06	7.71	(--*--)
25	7	87.43	4.72	(--*--)
35	8	178.75	2.27	(--*-)

+---------+---------+---------+-------
60 75 90 105

Pooled StDev = 5.58

Figure 6
VCF DATA Flux versus GAS PLASMA Time

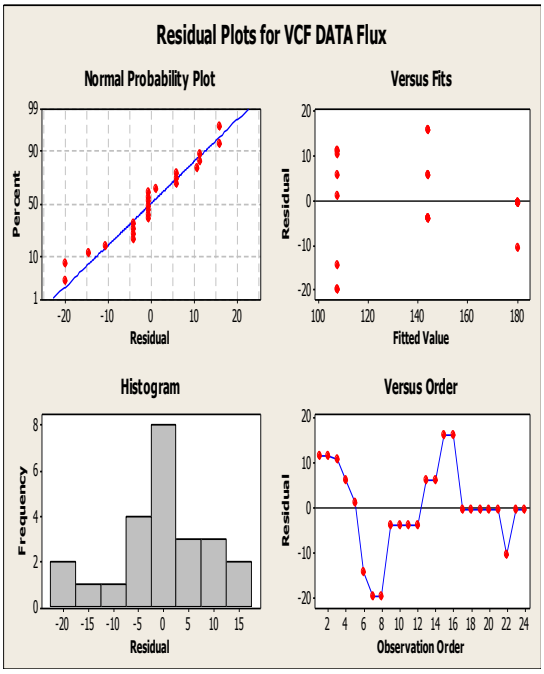


Figure 7
Residual Plots for Data Flux

This data was calculated based on the set pressure of 22.5 psi, included the filter that was not treated with gas plasma as 0 time nominee; other on are based on the time exposure. We have a P value of <0.05 represents that there is a statistical significant difference with an adjusted R-Sq 88.41% indicates the acceptable confidence data (Figure 6). In Box plot have a variability in time of 35 minute almost 0. Where we see a steady flow during Diafiltration there one point out that was taken before adding 1L DI water being that the process requires. This indicates that the time of Gas Plasma application meet the hypothesis of increasing the flow at fixed pressure on standard filter.

The residual Plots chart we see the application has filtrated Normal distribution, the next graph the variance and ultimately constant are independent of each other (Figure 7).

CONCLUSION

The company graphic indicates the flux increased during the gas plasma time using the same standard parameters of 5 psi delta P. The time was determined by the volume obtained up to 2800 ml.

The exposure time of the gas in the filter function is a critical pair, therefore increasing its flow. Using the parameters set in the run of the fourth filter flow, we obtained greater time of 25 and 35 minutes. The result of the ANOVA can determine that the exposure time is an important variable in the process of the functionalism filter. Obtaining a P value of 0.0 and an R-sq of 88.41%, we conclude that the best time of the Gas Plasma application was 35 minute that still has a high flux of 17 LPM unlike the flow remaining constant during the entries Diafiltration process.

The data compiled demonstrate that the application of gas plasma can be effective to conduct for the Omega Filter T-12.

FUTURE RESEARCH

To continue with the application of Gas Plasma must have into count this gas does not affect the molecular composition of proteins. We also work with living thing like bacteria and some kind test that does not affect the viability cell

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