Effects of Organic Antifoam Agent on Filtration Performance

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***Abstract*— Contamination events are often found to give a negative impact toward many organization in term of the lost batches and also production time. Filter are the main priority to handle this problem from ensuring the quality of product especially in biopharmaceutical from being effecting by unwanted impurities of particles. Another problem that can lead to contamination is foaming. Foam that are existing in the product will be minimizing and maximizing the product of interest, to prevent this antifoam agent are introduced. In this study, the concentrations of antifoam added into the solutions are 0.2%, 0.6% and 1.0% v/v and solutions were filtered using constant flow method. There are three types of membranes use to run the experiment which is Cellulose Acetate, Cellulose Nitrate and Polyethersulfone, PES. Results demonstrated that, when using the PES membrane, the flux rates increases about 5% to 15.5% for both 0.2% and 0.6% v/v antifoam for the initial 1000LMH and only 0.6% v/v antifoam increases for the initial 2000LMH which is about 7.0% flux rates. This show that, for both 0.2% and 0.6% v/v does not give a major effect to the process run. While for Cellulose Acetate, it is indicates that, the flux rates for 1000LMH are increases in range of 4.0% to 6.0% for the Control and 0.2% v/v antifoam respectively. Next, for Cellulose nitrate the initial flux rates initial flux rate of 1000LMH the control is increases about 2.85% from 910.931LMH to 937.617 LMH. This later has led to increase as the concentration of antifoam loaded in the solution increased. The calculated resistance (psi/LMH), PES membrane for initial flux rate of 1000LMH are in range of 34.5% to 53.28% from 0.0150 psi/LMH to 0.0229 psi/LMH and 0.0315 psi/LMH respectively for both 0.6% and 1.0% v/v antifoam, while it is in range of 30.89% to 83.36% for 0.2%, 0.6% and 1.0% v/v antifoam from 0.00481 psi/LMH from the control sample to 0.00696 psi/LMH, 0.0154 psi/LMH and 0.0289 psi/LMH respectively for initial flux rate of 2000LMH. While, cellulose acetate, control and 0.2% v/v antifoam are increases about 54.0% and 67.0% from 0.006 psi/LMH to 0.04 psi/LMH and 0.002 psi/LMH to 0.007 psi/LMH at the end of 500ml sample of resistance respectively. Next, for cellulose nitrate the control sample are increases about 42.41% of resistance from 0.000775695 psi/LMH to 0.001347001 psi/LMH for the initial flux rate of 2000LMH. For the viscosity before experiment for this three membrane are in range between 164 cP to 579.9 cP and viscosity after for three membrane are in range of 108.3 cP to 507.9 cP. The antifoam agent which is added to the solution may reduce the efficiency and cause negative effects on the dead end filtration performance and it filtration process. The findings in the study emphasized on the dead end filtration performance includes the flux rates and it viscosity and loading filtration capacity on membranes filter.**

Keywords— **:** *Bioprocessing, antifoam agent, Dead end filtration, Flux rates, Resistance*

I. INTRODUCTION

In industrial application, to separate the undesired well soluble organic matter as particles or colloids, method to prevent this is by using the membrane as separator for example filtration (Y.Bessiere, P.Bacchin, & B.Jefferson, 2005). At the equal scale, every particles have it different size to be separated depending the specifications of the study (lee & D'Amore, 2011).The most common method as principle in the filtration and membrane separation technologies which are suitable in all condition of the manufacturing in the industry that as good ways to apply are: Justifying the cells from the fermentation broth and conditioning the cells for mechanical or chemical disruption (1), Justifying the yield from the homogenate of cellular debris after a disruption process (2), Clarifying extracellular product from the culture after fermentation (3), and concentration and diafiltration of a clarified product for chromatography (4). (lee & D'Amore, 2011).

Filtration is the top common methods for the downstream processing of the fermentation products and it is used at all production scales. The basic principle filtration are to separate the suspended particles or wide range of molecular mass components which is can be found when these particles if flow along together at the bulk of liquid. There will be several parameters that affect the ability of filtration processes, such as pore size, pressure and the temperature.

In this work, Polyethersulfone, PES and Cellulose are as a based membrane. One of the example filter that are used in this performance are Dead-end filtration or normal flow filtration. There will be two types of filter that often used for running the process of Dead-end filter such as depth filters and the absolute filter (lee & D'Amore, 2011). By research, the function of the Dead-end filtration are applied in drinking water production, effluent polishing, and as pre-treatment for reverse osmosis (RO) in seawater desalination. Also, Dead-end filtration function is the feed stream is forced completely through the membrane which at the end cause particle to accumulate on membrane surface and a particle free permeate in Direct Flow Filtration (DFF). In DFF, the filter are usually used for the clarification, gas and vent filtration, virus reduction, and process fluid sterilization. (Mahar, Krishnan, Kaligotla, Gerra, & Powell, 2017).

This experimental is study the evaluation performance of filtration process with samples-containing antifoam agent. The dead-end filters from different characteristic of membrane material will be focus with the membrane area off 0.00152 m^2. The organic antifoam will be used which with different concentration were being tested.Throughout the experimental works, the data on volumetric rate and differential pressure were recorded in order to access the changes of pressure applied on the filter membrane, especially the final maximum pressure. As for developing the flux rate pattern for every process runs, the volumetric flow rates were analysed.

METHODOLOGY AND MATERIALS

A. Sample of Preparation (Lysogeny Broth (LB) and Antifoam 204 (Organic Antifoam)

Initially, the Lysogeny Broth (LB) is actually already prepared in the laboratory and no need for student to prepare from the first step of LB procedure. The total volume of the Lysogeny Broth (LB) need to

running this experiment is 500 ml for every percent of the organic antifoam that will be used. Before the experiment to be conducted, LB will be place in the 500 ml beaker as preparation to the next step. About 12.5g LB are needed which can produce about 500 ml of LB solution after mixed with the demineralized water. Then, the antifoam was inserted into the media according to the required concentration. For 0.2% v/v of antifoam about 1ml antifoam were added into the solution of LB and distilled water after the solution is well mixed.

B. Viscosity, cP

Firstly, the sample before and after initial flux rate for 1000LMH and 2000LMH for every sample from Control, 0.2%, 0.6% and 1.0% v/v Antifoam into the falcon tube about 30ml. After that, for every sample, put the falcon tube below the spindle of the viscometer. After that the spindle of the viscometer are immersed into the falcon tube by adjusting the viscometer. Make sure the falcon tube is remains in stationary and avoid from touching the wall of falcon tube due to prevent any error occurred during taking the data. Then record the value of viscosity.

C. Filtration

Firstly, the method used are Dead-end filtration method. The material such as Lysogeny Broth (LB) and organic antifoam are prepared for the entire process. A cellulose acetate, nitrate and PES filter with filter area of approximately 15.2 cm2 from Sartorius filter was used for each of the process runs. The experiments were conducted using constant flow method where the initial flow rates were fixed. The initial flux rates were set for these experiments in order to normalize the constant data to filter membrane area. Initially, the experiment will began with flux rates where 13 ml/min for 1000 LMH. Before running, it is must start with the one control sample which the LB that did not contain antifoam agent for each of the initial flux rate for different percent of antifoam concentrations loaded: 0.2%, 0.6% and 1.0%. After that, start with LB that have antifoam. For concentration loaded antifoam 0.2 % about 1 ml are added into 500 ml LB in the beaker after convert into ml of the antifoam. While for 0.6% about 3 ml and lastly for 1.0% about 5 ml of antifoam added to the 500 ml of LB. After convert the experiment can start to run start with the 0.2% of antifoam first with opened the peristaltic pump. The pressure gauge will be start to rise with different pressure produce from the pump. Next, the liquid will be flow through the Sartorius filter. Lastly, the volume and differential pressure were observed and recorded at a specific time interval with the stop watch. The experiment will be repeated three times to get the best result. The step can be used for flux rates of 26 ml/min for 2000 LMH with the same procedure. The flux rates can be determine by using the Darcy equation. Where the flux rates is in unit of LMH (L/m2/h) by follow equation below:

$$J = \frac{Q}{A} \qquad \textbf{Equation 1}$$

Where;
J = flux rates, LMH (L/m2/hr)
Q= Volume flowrates (L/hr)
A= area of filter (Cellulose Acetate) (m2)

Filtration capacity determination by using the relationship between Resistance (psi/LMH) Versus Capacity (L/m2), and the flux rates determination by using the relationship between Flux rate Versus Time. Lastly, the viscosity reading determination by using relationship between Viscosity Versus Time for both initial flux rates of 1000LMH and 2000LMH.

RESULTS AND DISCUSSION

A. Flux Rate

1. Flux rate profile for Polyethersulfone, PES membrane

From figure 1 and figure 2, a part of the flux rate are decreases and increases with time due to the loaded of antifoam that added to the solution. For figure 1, when 0.2% and 0.6% of antifoam agent are added, the flux rates increases for both for the initial 1000LMH.While for figure 2 only 0.6% are increases when antifoam agent added for the initial 2000LMH. The percentage reduce for flux rate in figure 2 is more higher as compared to figure 1 which is 74.02% and 53.22% for both 1.0% v/v antifoam starting from 1732.991LMH to 447.119LMH and 856.056LMH to 400.477LMH respectively. This indicates that when higher initial flux rates was set it will encourage to faster fouling action apart of the presence of antifoam which is said to be a fouling factor based on (Li & Chen, Membrane Fouling and Cleaning in Food and Bioprocessing, 2010) which are caused by the accumulation of organic material found in process streams or filter membrane for this case, such as macromolecules (proteins, carbohydrate, humic, polysaccharides). Moreover, declining of the flux rate was also supported by (MK, AG, & PL, 1997) when using the PVDF microfiler to filter it will causing the PES membrane pose to equal attributes due to same criteria such as hydrophobic.Thus, it may having an interactions between organic antifoam agent which may assist in maintaining the flux rate and the hydrophobic component of the PES membrane filter. But for final flux rates for both figure 1 and figure 2 for 1.0% are approximately in range of 400-450LMH. From the control, it show that when the initial flux rate was setting in larger value as in figure 2, the percent of flux rates reduce also large and it is can be proved from the result where from figure 2, about 32.76% from 2153.110LMH to 1447.690LMH for control are reduce with time while from figure 8 it was reduce a bit about 15.84% from 973.323LMH to 819.522LMH. If the PES membrane were mixed with antifouling such as multiwall carbon nanotubes (MWCNT) and lithium bromide (LiBr) as additives in dimethylacetamide (DMAC) the efficiency of flux rate performance will excellent as co pared to pure PES membrane. (Khairuddina, Idris, & Hock, 2018). From this comparison, it is can conclude that, percent of antifoam and initial setting of flux rates value are effecting the result of flux rates which is respect to time.

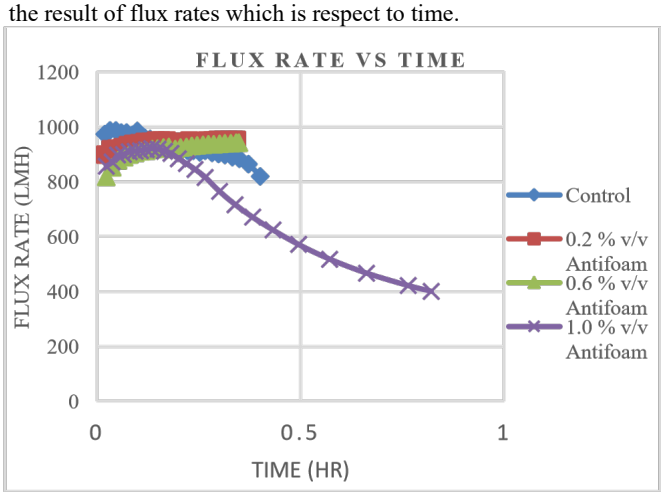


Figure 1: Flux rate versus Time (Initial Flux Rate: 1000 LMH)

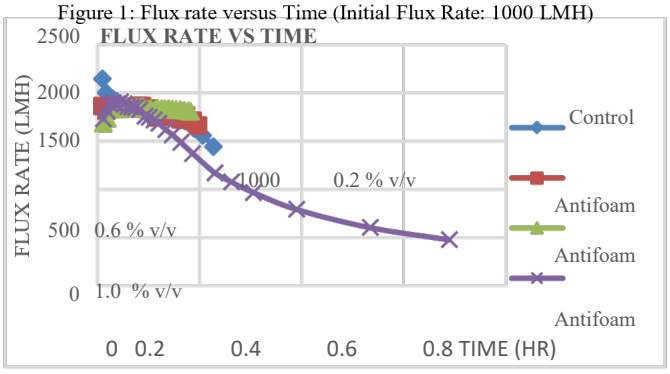
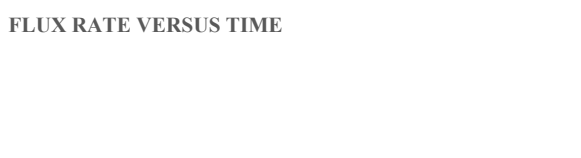


Figure 2: Flux rate versus time (Initial Flux Rate: 2000LMH)

2. Flux rate profile for Cellulose membrane

From figure 3, a part of the flux rate for cellulose acetate are decreases and increases with time due to the loaded of antifoam that added to the solution. From figure 3, the flux rates for both control and 0.2% v/v antifoam for the initial flux rates of 1000LMH are increases while for cellulose nitrate, the sample of antifoam concentration cannot be determined until 500 ml sample, it is only can filter until 30 ml sample for both initial flux rate of 1000LMH and 2000LMH antifoam due to leakage happen which is same condition to cellulose acetate with initial flux rates of 2000LMH. For final flux rates for all the experiment for the cellulose acetate starting from control, 0.2% v/v antifoam and 0.6% v/v antifoam are approximately 974LMH, 907LMH, and 370 LMH respectively for the initial flux rates of 1000LMH. While for the final flux rates for all the experiment starting from control, 0.2% v/v antifoam and 0.6% v/v antifoam are approximately 1736.379LMH, 1480.263LMH, and 530.244 LMH respectively for the initial flux rates of 2000LMH cellulose acetate. For cellulose nitrate, the initial flux rate of 1000LMH, the flux rates for control are increases with time which is about 2.85% from 910.9311741LMH to 937.6172022LMH. While initial flux rate of 2000LMH, the flux rates for control are decreases with time which is about 25.13% from 1869.806094LMH to 1399.776036LMH after filter until 500ml of solution. For 0.6% for the initial flux rate of 1000LMH the data flux rate are 370.066LMH which only 30 ml of solution can be filter due to the leakage during filtration process and same goes to initial flux rate 2000LMH only can filter about 30 ml of solution due to leakage which given the data flux rate is about 530.244 LMH. In case of cellulose nitrate, for both initial flux rate of 1000LMH and 2000LMH, the flux rate of 0.2% v/v antifoam as recorded are 470.547LMH and 449.700 LMH respectively. From the figure 3 also which is cellulose acetate, it is show that the flux rates is increases about 4% from 934.903LMH to 973.857LMH for control which initial flux rate of 1000LMH. While for 0.2% v/v antifoam it is are increases about 5.6% from 856.056LMH to 906.746LMH respectively. While for 0.6% the data for it flux rate is about 370.066LMH and the membrane cannot filter until 500ml solution due to leakage happen during the process is running. For initial flux rate of 2000LMH of cellulose acetate, the flux rates is decreases about 12.02% from 1973.684LMH to 1736.3801LMH for control while for 0.2% and 0.6% the data for it flux rate is cannot determine either it is decreases or increases due to the leakage which are effecting the result due to efficiency of the cellulose membrane to filter the sample. When the 0.2% v/v ,0.6% v/v and 1.0% v/v antifoam are added for both initial flux rate of 1000LMH and 2000LMH both membrane of cannot filter until 500ml solution during the process is running. This indicates that the filtration performances has been directly affected by the amount of the antifoam agent loaded and types of the membrane being used. Based on (Perry, 2007) dead-end filtration defined as the particles that cannot permeable through the pores size of the membranes or the particles that have larger than the pores sizes cannot penetrated into the membranes and all those thing is subjected as a cake formation due to it is stopped at the surface of membranes even it is done after the treatment (flow of fluid at the bulk plus with particles stopped due to size). According to (Vaulina, Widyaningsih, Kartika, & Romdoni, 2018) also, if the cellulose acetate membrane have a high concentration during process of preparing cellulose acetate membrane or cellulose acetate membrane type that have a higher concentration of formamide as additives, it will cause higher rejection and smaller flux rate but in term of tensile it is very strong and have a small pore. Lastly, based on (Royce, 2018) for any pore volume or membrane area that undergoes in reduction and cannot filter the sample are claimed as a fouling.



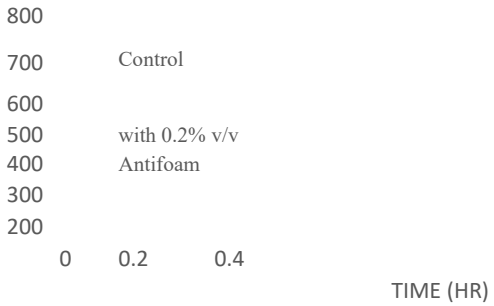


Figure 3: Flux rate versus Time (Initial Flux Rate: 1000 LMH

B. Filtration Capacity

1. Filtration Capacity Polyethersulfone, PES Membrane

From figure 4 and 5 for both initial flux rate of 1000LMH and 2000LMH the graph both show that the value of control sample and 0.2% have smaller different in value that can be observation from the graph pattern and same goes to the 0.6% and 1.0% sample. From figure 4, only 0.2% are undergoes reduction in resistance as compared to figure 5 which all of the samples are increases without having any reduction in resistance. As a conclusion, higher initial flux rates will giving a maximum percent increases in the resistance which can show in figure 4 about 83.36% for 1.0% while about 53.28% are increases in resistance in figure 5 from the control sample for both initial flux rates. The results for both proved that antifoam load have giving an effect towards the dead end filtration performance. As typically, based on (K, Z, W, & U, 2011) the results are may be due to the formation of cake that are deposited at the surface area of the filtration membrane during the experiment was run over the time as the filtration mode are in a normal flow filtration where there was no filter recovery action was take place throughout the experimental runs. However, the relationship of antifoam with fouling causing it is accelerated in the feed solution. In addition, some research have recommend using a silicone agent and inserted it into solution to avoid it is from fouling effect that are often happen . Lastly, this result show that flux rate profile shown an improved technology of membrane filters as dead end filtration process does not pose the membrane recovery action as compared to the Tangential flow filtration.

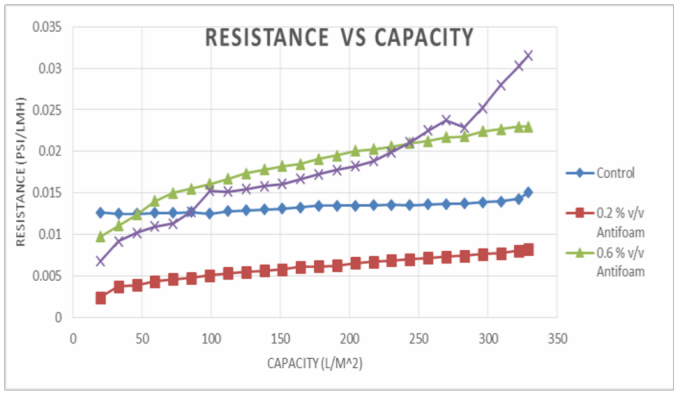


Figure 4: Resistance versus Capacity (Initial Flux Rate: 1000LMH)

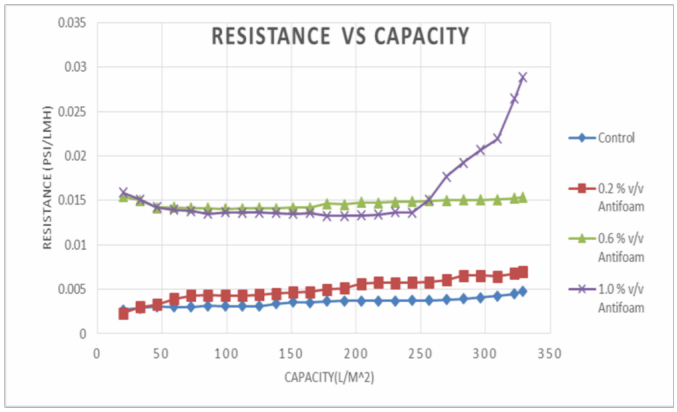


Figure 5: Resistance versus Capacity (Initial Flux Rate: 2000LMH)

2. Filtration Capacity Cellulose Acetate Membrane

The relationship between resistances with filter capacity of initial flux rate of 1000LMH is shown in figure 9 and figure 10. From figure 9 and figure 10 both control sample demonstrated that the higher resistance occurred during experiment run which are approximately to 0.007 psi/LMH and to 0.003 psi/LMH with the feed load of about 328.947 L/m^2 respectively. For the filter capacity is remain unchanged for all samples until the end of experiment due to same area of the membrane filtration. From figure 9, 0.2% v/v antifoam show that have a maximum resistance about 0.014 psi/LMH and followed by control sample which are approximately 0.007psi/LMH respectively for equal filter capacity value but for 0.6% it cannot be determined either it is have maximum or minimum resistance value due to leakage happen during filtration process was running. While from figure 10, only control sample can show the maximum resistance value which is approximately 0.003 psi/LMH for equal filter capacity value but for 0.2% and 0.6% it cannot be determined same as a case happen in figure 9. From figure 9, for the 0.2% v/v antifoam the resistance is increases about 54.03% from 0.006 psi/LMH to 0.014 psi/LMH and control as a references also increases about 66.71% from about 0.002 psi/LMH to 0.007 psi/LMH at the end of 500ml sample. While for 0.6% v/v antifoam it is cannot be determined due to leakage only can gain the value resistance until 30ml solution sample. Next, for figure 10, control sample it is increases about 47.31% in resistance from 0.001764 psi/LMH to 0.003 psi/LMH. While for 0.2% and 0.6% v/v antifoam it is cannot be determined which is due to same problem occur during the sample is running when taking 0.6% v/v antifoam for the 1000LMH. Lastly, this result show that flux rate profile and loading capacity from this study has shown having an improved technology of membrane filters as dead end filtration process does not pose the membrane recovery action as compared to the Tangential flow filtration. Apart from that, based on (Royce, 2018) for any pore volume or membrane area that undergoes in reduction are claimed as a fouling. New membranes that is clean have an effective area for fluid to through or flow through the pores and other than that the pore are restricted or blocked. In constant pressure operation, it will give a lower flow rate due to reduction of the area for the pores to open.

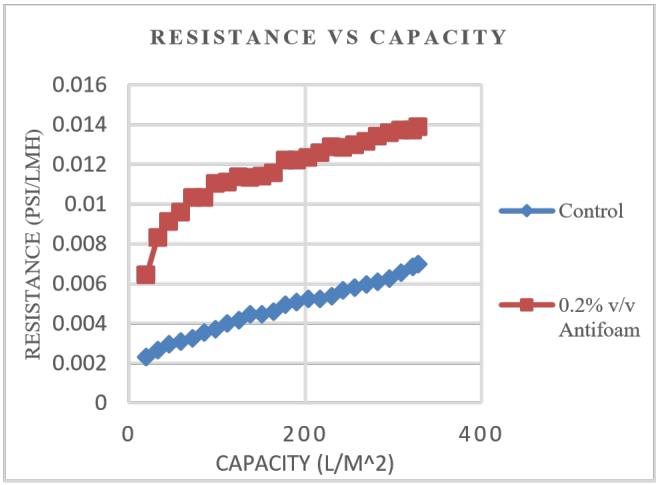


Figure 9: Resistance versus Capacity (Initial Flux Rate: 1000LMH)

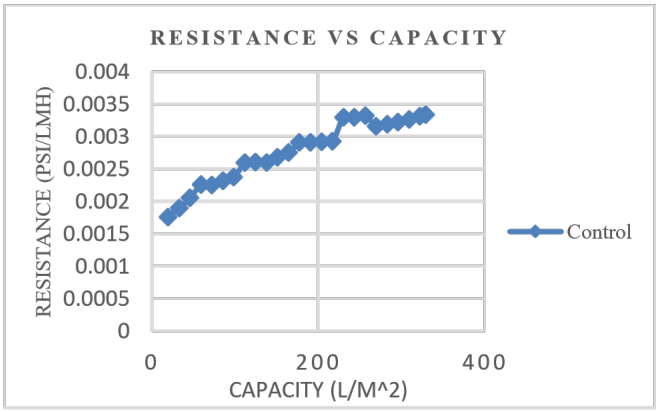


Figure 10: Resistance versus Capacity (Initial Flux Rate: 2000LMH)

3. Filtration Capacity Cellulose Nitrate Membrane

The relationship between resistances with filter capacity of initial flux rate of 1000LMH is shown in figure 11 and 12. From the graph of figure 11, the control sample demonstrated the value of resistance is 0 psi/LMH. While for figure 12, the control sample are increases about 42.41% from 0.000775695 psi/LMH to 0.001347001 psi/LMH until the last of 500ml of solution filtered. So that, the control sample in figure 12 can show the maximum value of resistance approximately 0.001347 psi/LMH. For sample of 0.2% v/v antifoam for both figure 11 and figure 12, it can only measure until 30ml which give the resistance approximately 0.03543 psi/LMH and 0.04677 psi/LMH respectively. For the case of control sample in figure 11, during experiment the pressure do not raise and the needle is still in 0 psi position even no deflected happen and this causing the resistance value 0 psi/LMH but differ from figure 12 which is the value of resistance can be recorded due to have pressure. By referred to the result that have been obtained in the table 11 and 12, it is show that the value for the filter capacity is remain unchanged for all samples due to equal area of the membranes filter and constant value of sample to be taken as for every different percent of the antifoam agent used for easier to be measured. During observation was made, the data of pressure and flux rates of 0.2% until 1.0% v/v antifoam for both figure cannot be recorded. Due to this, all sample from 0.2 until 1.0% v/v antifoam cannot show the resistance value either it is increases or decreases due to leakage and excess maximum pressure and also no pressure occurred during recorded the pressure data for each sample. Every agent have different resistance which is occurred due to the pressure, volume flow rates and also the area of the filter that are supplied or used during the experiment runs. According to (Hermindez, 1995)

generally, fouling can happen due to particulates being trapped on top of a membrane surface due to their size or shape, particulates being trapped inside the matrix due to their size or shape and this will increases the pressure reading and also adsorption of particulates on the pores of the membrane. In addition, (Abdelrasoul, Doan, & Lohi, 2013) also prove the factor that affecting fouling are depending on the properties and the operating condition such as, membrane properties: pore size, hydrophobicity, pore size distribution and membrane material, Solution properties: solid (particle) concentration, particle size and nature of components and Operating conditions: pH, temperature, flow rate and pressure.

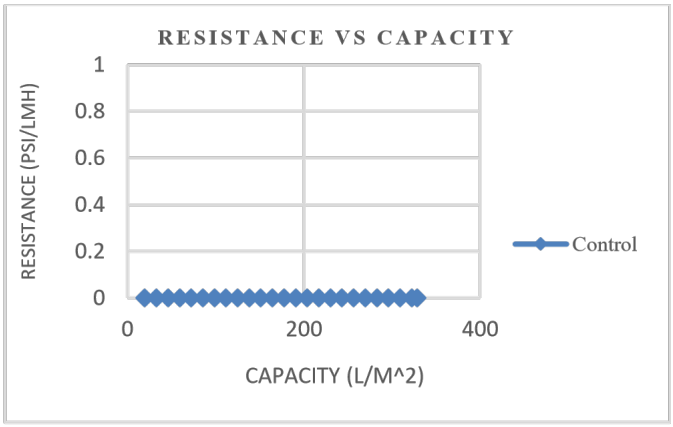


Figure 11: Resistance versus Capacity (Initial Flux Rate: 1000LMH)

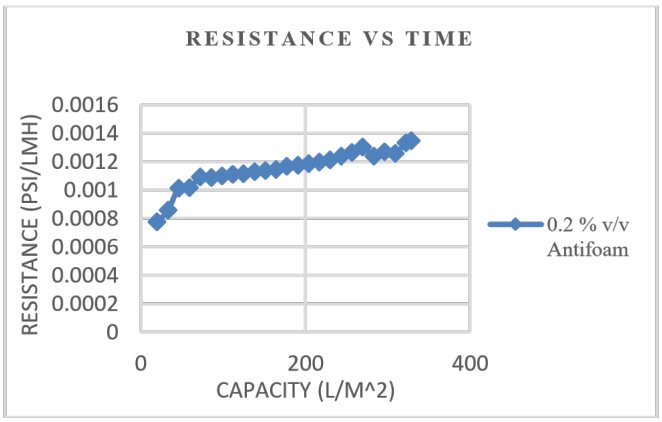


Figure 12: Resistance versus Capacity (Initial Flux Rate: 2000LMH)

C. Viscosity

1. Viscosity Polyethersulfone, PES Membrane

From table 1 and table 2, the viscosity for the PES membrane for the initial flux rate of 1000LMH and 2000LMH for both are decreases with time for all the sample from control to 1.0% v/v antifoam. For table 1 and table 2 the control is reduced about 54.11% and 9.21% from initial viscosity concentration which is 387.9 cP to 178 cP and 380 to 345.0 cP respectively. Time to finish filtration until 500ml of control sample for both figure 1 and 2 are approximately 0.41 hr and 0.23hr respectively. While for 0.2% v/v antifoam both figure it is reduced about 7.44% and 10.19% respectively from initial viscosity concentration of solution which is 387.1 cP to 358.3 cP and 345.5 cP to 310.3 cP. Time to finish filtration for both figure until 500ml of 0.2% v/v antifoam sample are approximately 0.35 hr and 0.20 hr respectively. For 0.6% v/v antifoam table 1 it is reduced about 10.57% and for table 2 it is reduced about 11.63% from initial viscosity concentration which is 393.5 cP to 351.9 cP and 412.7 cP to 364.7 cP respectively. Time to finish filtration until 500ml of 0.6% v/v antifoam sample for both table 1 and 2 are approximately 0.035 hr and 0.18 hr. Lastly for 1.0% v/v antifoam, for both table 1 and 2 it is decreases about 38.64% and 16.53% respectively from original viscosity concentration which is 406.3 cP to 249.5 cP and 406.3 cP to 387.1 cP. While for time for it to finish filter until 500ml for both figure are approximately 0.82 hr and 0.69 hr respectively. It is show that, when the initial flux rate are increases from 1000LMH to 2000LMH the reduction of percentage of the viscosity are decreases with time which give the time to complete filtration also decreases for the control. When the antifoam was added to the solution of the Lysogeny Broth the percentage of reduction viscosity of the initial flux rates 1000LMH to 2000LH for 0.2% v/v antifoam are change where the higher initial flux rate are reduce more as compared to the lower initial flux rate. While in term of time to filter until 500ml it is same as control sample which is consumed more time to filter at the lowest initial flux rate. Maybe it is due to fouling occur at the surface when refer to (Hermindez, 1995) generally, fouling can happen due to particulates being trapped on top of a membrane surface due to their size or shape. A part to that, according to, (Abdelrasoul, Doan, & Lohi, 2013) also prove the factor that affecting fouling are depending on the properties and the operating condition such as pore size, hydrophobicity, pore size distribution and membrane material. For 0.6% and 1.0% v/v antifoam it is the same as control where more reduction occur at the lowest initial flux rate as compared to higher flux rate, but in term of time it consumed much time to filter at the higher initial flux rate and lower flux rate respectively it is maybe due to same condition occur to 0.2% v/v antifoam.

Table 1: Viscosity before and after experiment for PES Membrane (Initial Flux Rate of 1000LMH)

Sample	Viscosity	
	t_0	t_f
Control	387.9	345
0.2% v/v antifoam	387.1	310.3
0.6% v/v antifoam	393.5	364.7
1.0% v/v antifoam	406.3	323.1

Table 2: Viscosity before and after experiment for PES Membrane (Initial Flux Rate of 2000LMH)

Sample	Visc osity	
	t_0	t_f
Control	380	345
0.2% v/v antifoam	345.5	310.3
0.6% v/v antifoam	412.7	364.7
1.0% v/v antifoam	387.1	323.1

2. Viscosity Cellulose Acetate Membrane

From table 3 and table 4, the viscosity for the Cellulose Acetate membrane for the initial flux rate of 1000LMH and 2000LMH are decreases with time for all the sample from control to 0.6% v/v antifoam. For the control n table 3 and 4 it is reduced about 16.67% and 68.98% from initial viscosity concentration which is 407.9 cP to 339.9 cP and 579.9 cP to 179.9 cP respectively. Time to finish filtration until 500ml of control sample for both figure are approximately 0.34 hr and 0.19 hr respectively. For 0.2% v/v antifoam for both table 3 and 4 it is reduced about 64.53% and 19.75% from initial viscosity concentration of solution which is 563.9 cP to 200.0 cP and 319.0 cP to 256.0 cP respectively and this can be obtain from table 3 and 4. Time to finish filtration until 500ml of 0.2% v/v antifoam sample for both figure are approximately 0.36 hr and 0.013 hr. For 0.6% it is reduced about 71.23% and 14.63% for both figure 3 and 4 respectively from initial viscosity concentration which is 570.0 cP to 164.0 cP and 164 cP to 140.0 cP. But for case of 0.6% v/v antifoam for both figure the time to finish filtration until 500ml cannot be determined due to leakage happen and only can measure until 30ml of sample for 0.6% v/v antifoam sample which are approximately 0.053 hr 0.037 hr respectively. Lastly for 1.0% v/v antifoam for both figure, it is cannot determined

either it is decreases or remain unchanged due to leakage happen during the experiment which then cannot filter desired sample which are should be filter until 500ml of sample. It is show that, when the initial flux rate are increases from 1000LMH to 2000LMH the reduction of percentage of the viscosity are increases with time which give the time to complete filtration decreases for the control. When the antifoam was added to the solution of the Lysogeny Broth the percentage of reduction viscosity of the initial flux rates 1000LMH to 2000LH for 0.2% v/v antifoam are change where the lower initial flux rate are reduce more as compared to the higher initial flux rate. While in term of time to filter until 500ml it is same as control sample which is consumed more time to filter at the lowest initial flux rate. For 0.6% v/v antifoam, the value of percentage reduction viscosity are the same for both initial flux rates and only can filter until 30 ml for both so the time is more spend at the lowest flux rate as come to higher flux rate. Lastly, for 1.0% v/v antifoam for both figure, the percentage of reduction of viscosity cannot be determined due to fouling or maybe condition of the membrane used in the experiment and based on (Royce, 2018) for any pore volume or membrane area that undergoes in reduction are claimed as a fouling. Apart from that, (Li & Chen, Membrane Fouling and Cleaning in Food and Bioprocessing, 2010) have found that antifoaming agent is the factor that can cause fouling in food and bioprocess applications.

Table 3: Viscosity before and after experiment for Cellulose Acetate Membrane (Initial Flux Rate of 1000LMH)

Sample	Viscosity	
	t_0	t_f
Control	407.9	339.9
0.2% v/v antifoam	563.9	200.0
0.6% v/v antifoam	570.0	164.0

Table 4: Viscosity before and after experiment for Cellulose Acetate Membrane (Initial Flux Rate of 2000LMH)

Sample	Viscosity	
	t_0	t_f
Control	579.9	179.9
0.2% v/v antifoam	319.0	256.0
0.6% v/v antifoam	164.0	140.0

3. Viscosity Cellulose Nitrate Membrane

From table 5 and 6, the viscosity for the Cellulose Nitrate membrane for both initial flux rate of 1000LMH and 2000LMH are decreases with time for all the sample from control to 0.2% v/v antifoam. For table 5 and 6 the control it is reduced about 48.44% and 69.05% from initial viscosity concentration which is 387.9 cP to 200 cP and 351.9 cP to 108.9 cP respectively and this can obtain from table 5 and 6. Time to finish filtration for both until 500ml of control sample are approximately 0.36 hr and 0.24 hr respectively. For 0.2% v/v antifoam for both figure, it is reduced about 11.81% and 30.46% from initial viscosity concentration of solution which is 575.9 cP to 507.9 cP and 575.1 cP to 399.9 cP. For 0.2% v/v antifoam fo both figure, it only can filter until 30ml of sample due to leakage during the process and cause over pressure which give time to filter the 30ml are approximately 0.042 hr and 0.044 hr respectively. For 0.6% and 1.0% v/v antifoam for both figure, it is cannot determined either it is decreases or remain unchanged due to leakage happen during the experiment which then cannot filter desired sample which are should be filter until 500ml of sample. It is show that, when the initial flux rate are increases from 1000LMH to 2000LMH the reduction of percentage of the viscosity are increases with time which give the time to complete filtration decreases for the control. When the antifoam was added to the solution of the Lysogeny Broth the percentage of reduction viscosity of the initial flux rates 1000LMH to 2000LH for 0.2% v/v antifoam are increases also where the higher initial flux rate are reduce more as compared to the lower initial flux rate. While in term of time to filter until 30ml it is consumed more time to filter at the higher initial flux rate. Lastly, for 0.6% and 1.0% v/v antifoam for both figure, the percentage of reduction of viscosity cannot be determined due to organic fouling which is is caused by the accumulation of organic material found in membrane or process streams, such as macromolecules (proteins, carbohydrate, humic, polysaccharides) and antifoams. (Chen, et al., 2012). Moreover, it also impurities that have a larger than pore of the membrane that is cannot penetrated through the membrane which causing liquid flow from the pore is reduced or stuck and adsorption, material is adsorbed to the membrane surface reducing the path through the pore. (Royce, 2018).

Table 5: Viscosity before and after experiment for Cellulose Nitrate Membrane (Initial Flux Rate of 1000LMH)

Sample	Viscosity	
	t_0	t_f
Control	387.9	200.0
0.2% v/v antifoam	575.1	507.9

Table 6:
Viscosity before and after experiment for Cellulose Nitrate Membrane (Initial Flux Rate of 2000LMH)

Sample	Visc osity	
	t_0	t_f
Control	351.9	108.9
0.2% v/v antifoam	575,9	399.9

II. CONCLUSION

As conclusion, the most basic for the filtration in this study is dead–end filtration, where the feed flow is forced through the membrane and there will be matter trap or deposited on the outer layer of the membrane. Dead-end filtration is a batch process as the accumulated matter on the filter decreases the filtration capacity due to clogging and need other step to remove the accumulated matter and this method is good for concentrating compounds. As the deadend filtration is force perpendicular to the membrane surface, the pressure for sure will be increase due to matter that are trap on the surface and this will cause some recommendation to be suggested for the initial flux rates for the sample in order to avoid any over pressure that pressure gauge cannot withstand which in not exceed than 2 bar (29.008Psi). If exceed, the accident during running experiment may be occurred such as the hose that connecting to the pressure might be missed connection and causing the sample sprayed out to the surrounding. Besides that, based on the result, the time to complete the 30ml to 500ml of the solution sample it take around 0.6 minute to 50 minute (0.01-0.83 hr) for both initial flux rates of 1000LMH and 2000LMH for three types of membrane that are tested. The highest flux rates that can be obtain from three membrane that are tested were 1810.7195 LMH by using PES membrane with initial flux rate of 2000LMH and the lowest flux rate that can obtain from three different membrane that are tested were 400.477LMH which also by using PES membrane with initial flux rate of 1000LMH due to presence of the antifoam it is may assist to maintaining the flux rate. While for resistance the highest that can be achieved are 0.0470 psi/ LMH and the lowest resistance are 0.0000 psi/LMH which by using cellulose acetate membrane and by using cellulose nitrate membrane for the initial flux rate of 1000LMH respectively. Lastly, the for the highest viscosity that can be achieved are 507.9 cP and the lowest are 108.9 cP which by using cellulose nitrate membrane for the initial flux rate of 1000 and 2000LMH respectively.

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