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FILTRATION DESIGN MODELING STUDY WITH VARIATION IN NUMBER OF FILTERS, PALM OIL MILL EFFLUENT MESHING

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Abstract. Processing activities of oil palm fruit into CPO produce liquid waste that can pollute the environment, so there is a need for liquid waste processing in palm oil mills. This study aims to determine the best design of the variety of mesh and the number of sieves based on Ansys analysis. The mesh variation is 0.105 mm, 0.088 mm, and 0.074 mm, while the number of filters is 3, 4, and 5, with random order variations. The results obtained are the 3 filter formation (ABC formation) has the highest speed of 6,419 m/s, with a low cross flow rate. Meshing formation with a small size in the first position can increase speed and pressure.

Keywords: liquid waste, pollute, filtration

1. INTRODUCTION

Processing activities of oil palm fruit into CPO produce liquid waste that can pollute the environment, so it is necessary to process liquid waste in palm oil mills [1]. This study aims to overcome the pollution in the palm oil mill to meet their daily needs. Most people in the palm oil mill area use pure water. However, the surrounding communities don't know whether the healthy water is suitable for everyday use or not. Based on the research results, groundwater in the South Kalimantan area does not meet health if the water is consumed because it is acidic. Due to unfavorable situations and conditions, humans are forced to use water that does not meet the requirements for life. To give an idea of the properties of water, we must know the content of substances contained in water. Based on the clean water quality standards according to the Regulation of the Minister of Health of the Republic of Indonesia Number: 416/MENKES/PER/IX/1990 concerning the requirements for clean water quality, substances that are important to be chemically examined are Iron, Calcium, Magnesium, Arsenic, Flouride, Chloride, Sulfate, Nitrates and Hardness. In addition, the water must not contain other hazardous materials such as heavy metals and harmful bacteria [2].

The use of water whose degree of turbidity exceeds the permissible threshold can cause adverse effects on health, mainly because high turbidity is a reasonably good medium for the development of micro-organisms and can protect it from the influence of various threats so that the effect of disinfectants expects micro-organisms to be in the environment. the surface of the particles that cause turbidity, therefore the disinfection process requires stirring (mixing) and optimum contact time. One of the current clean water supply strategies is to utilize appropriate technology. Appropriate technology is the most suitable solution for addressing water and sanitation needs through innovative technology and empowering communities to achieve the desired goals [3]. Water content harmful to the human body needs to be filtered or filtered. Filtration is one of the physical water treatments. Filtration is a solid-liquid separation process by passing the liquid through a porous medium or materials to remove or remove as many fine particles of suspended solids as possible from the liquid [4][5].

In this purification process, several layers of membranes are needed to remove dissolved organic substances [6][7]. The Membranes filtration is suitable for the filtration of peat water, which contains a lot of dissolved organic compounds that cause water to turn brown and have an acidic nature. MBR With the hydrophobic PVDF membrane, the cake layer removal efficiencies are at 97% [8][9].

2. METHODS

The research method used is the first is a simulation to analyze the design results of the filtration device A set of computers for simulation

Tools and materials used

a) ANSYS Simulation;

b) Palm oil waste water data:

Density 876 kg/m3 [10].

Viscosity of palm oil waste is 3.53 Pa.s data is taken when the temperature of palm oil waste is 83.19^{o}C [11].

Table 1. Filter Name and Size

No.	Filter Name	Material	Mesh	Size (*meshing*)		
				in.	mm	µm
1.	Filter A	Nilon	140	0,0041	0,105	105
2.	Filter B	Nilon	170	0,0035	0,088	88
3.	Filter C	Nilon	200	0,0029	0,074	74

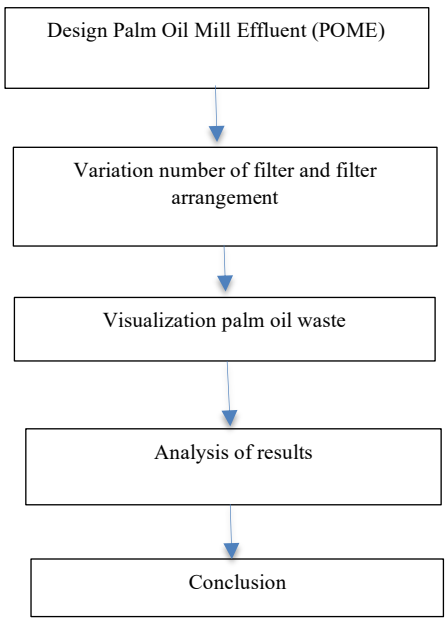


Figure 1. Research flow chart

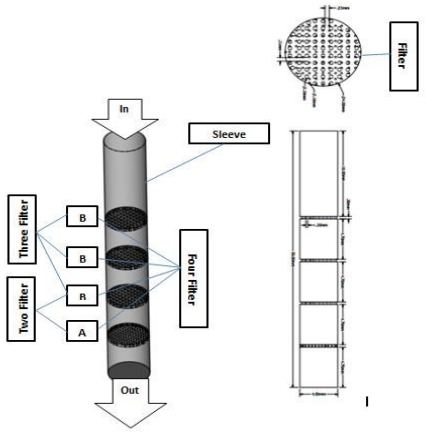


Figure 2. Palm Oil Wastewater Filtration Design

Variation of the number of filtration filters:

a. Variation of the Three filter type with the number and arrangement of 3 filters
b. Variation of the Four filter type with the number and arrangement of 4 filters
c. Five filter type variations with the number and arrangement of 5 filters

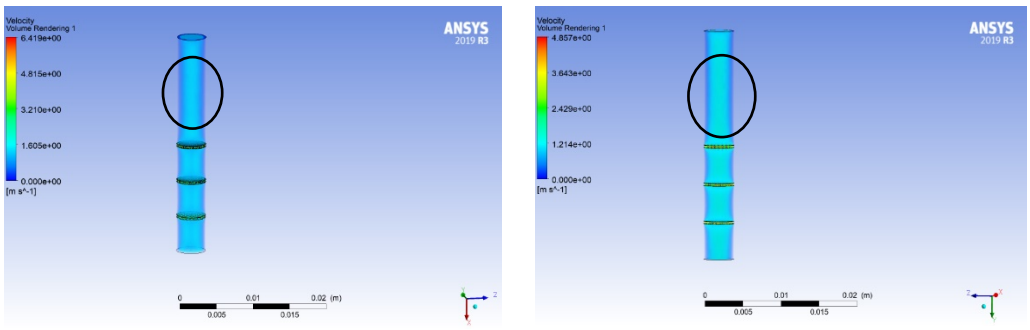
3. RESULTS AND DISCUSSION

The filtration simulation results on various filters 3, 4, and 5 are shown in Table 2. Each type with a filter arrangement: ABC, CBA, ABCA, CBAC, ABCAB, and CBACB. On the inlet side, a pressure of 1 atm is given, and a speed of 1 m/s, so the results are as in Table 2, where the effect of increasing the number of filters will increase the pressure and velocity in the filtration tube.

Table 2. Simulation Result using ANSYS Software

	Formation	Velocity (m/s)	Pressure (MPa)
1	ABC (3 filter)	6,419	15,58
2	CBA (3 filter)	4,857	13,48
3	CBAC (4 filter)	5,85	17,36
4	ABCA (4 filter)	6,84	32,14
5	ABCAB (5 filter)	4,87	25,48
6	CBACB (5 filter)	5,084	17,33

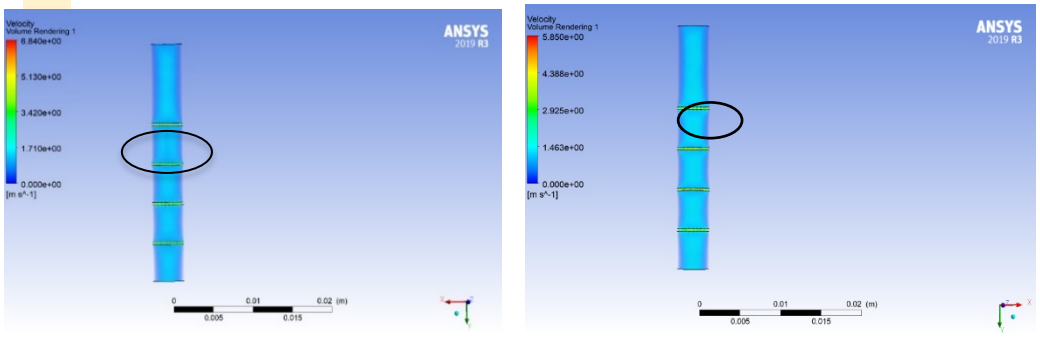
Filter Size Filter A : 0,105 mm
Filter B : 0,088 mm
Filter C : 0,074 mm



Formation ABC Formation CBA

Figure 3. Velocity Disribution three filter formation

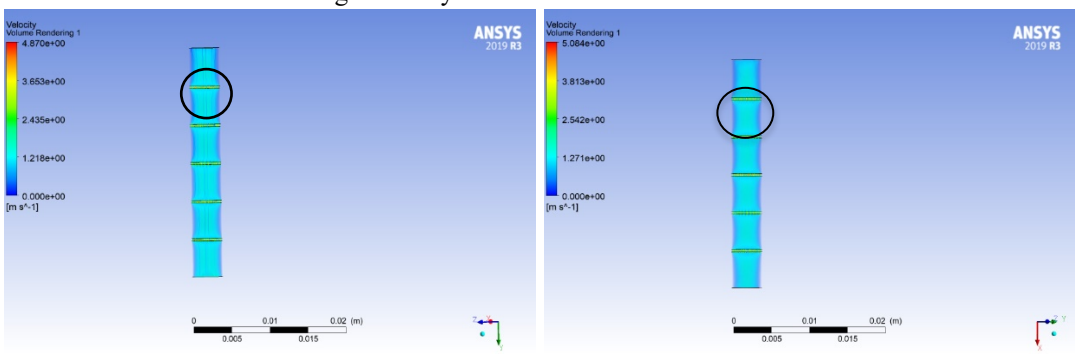
The velocity distribution in the ABC formation filter is more homogeneous in all filtration areas in the pipe, while the high velocity value CBA formation is concentrated in the middle.



Formation ABCA Formation CBAC

Figure 4. Velocity Disribution three filter formation

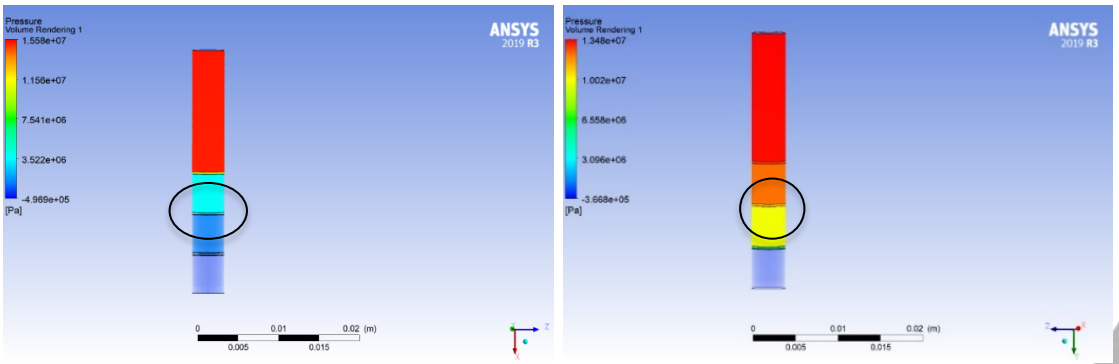
The velocity distribution in the ABCA formation filter is more homogeneous in all filtration areas in the pipe, while the CBAC formation - high velocity values are concentrated in the middle.



Formation ABCAB Formation CBACB

Figure 5z. Velocity Disribution three filter formation

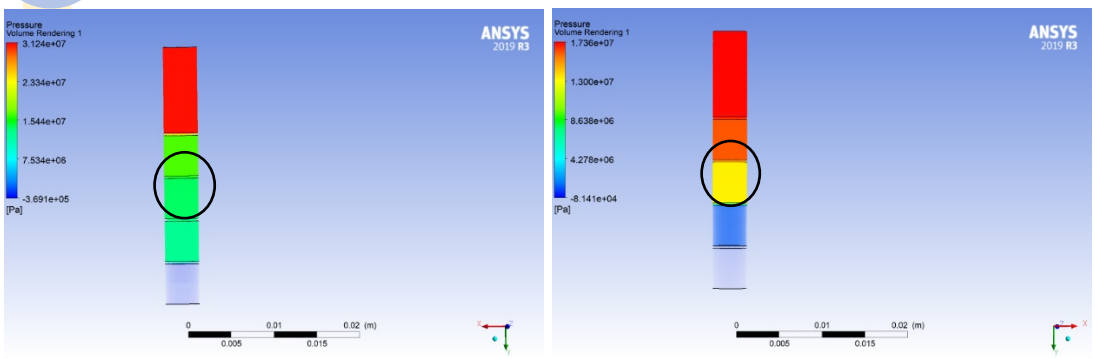
Velocity distribution in the filter formations ABCAB and CBACB high velocity values are concentrated in the middle Pressure analysis



Formation ABC Formation CBA

Figure 6. Pressure Disribution three filter formation

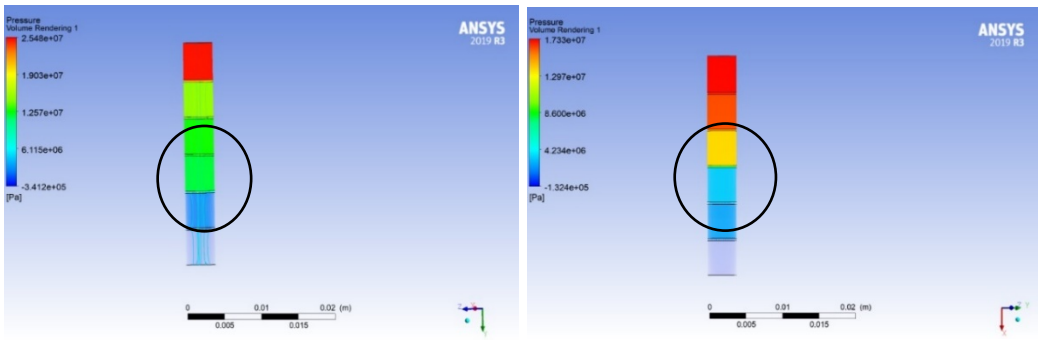
The ABC Formation has lower pressure than the CBA Formation, the ABC Formation has a more even distribution of pressure.



Formation ABCA Formation CBAC

Figure 7. Pressure Disribution three filter formation

The pressure distribution in the ABCA formation is more homogeneous than in the CBAC formation. It can see from the figure that the ABCA formation has a higher pressure value than the CBAC formation. Because diffusion has a very significant effect on filtration at high temperatures, the porosity of the filter cake is larger, which has less effect on filtration efficiency [12], [13].

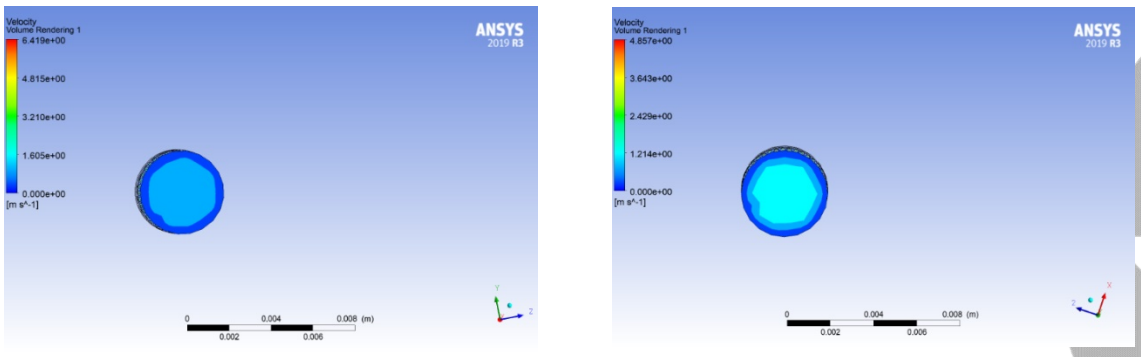


Formation ABCAB Formation CBACB

Figure 8. Pressure Distribution three filter formation

The pressure distribution in the ABCAB formation is more homogeneous than in the CBACB formation, as seen in figure 8. Besides that, the formation of ABCAB has a higher pressure than the CBAC formation. Therefore, cross Flow Reversal (CFR) occurs at condition 5 filters in the CBACB formation.

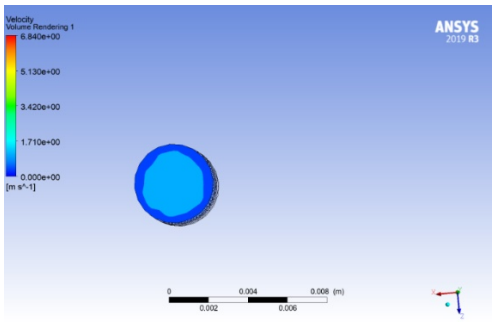
The highest speed with each value in the ABC formation is 6,419 m/s. It happened because of the most effective flow where only two colors are formed, indicating friction loss is the smallest than the other formations. Installation of a small meshing filter at the end of the filtration provides the advantage of reducing friction. At the last level, there is a reversal of the flow direction of fluid that causes an increase in pressure. When the pressure increases, it can reduce the friction loss on the filter, which is advantageous in the filtration process. There are three types of conditions according to [14], namely: filtration type at high pressure and low inlet velocity, high pressure and high inlet velocity, and low pressure and high inlet velocity. In the case of this study, it falls into the third category, namely pressure low and high entry speed. It is caused Cross Flow Reversal (CFR) reversal of flow direction.

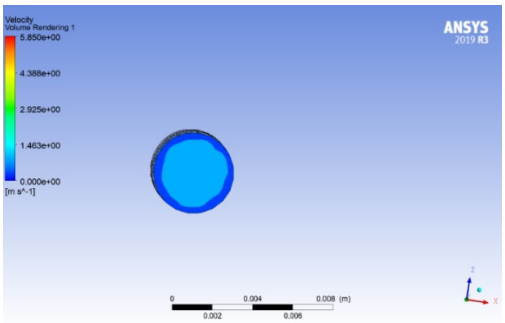


Formation ABC Formation CBA

Figure 9. Pressure Distribution three filter formation

From the cross-sectional image of the filtration, it can be seen that the image of the ABC formation is more homogeneous than the CBA formation, besides that the speed of ABC is higher than that of CBA.

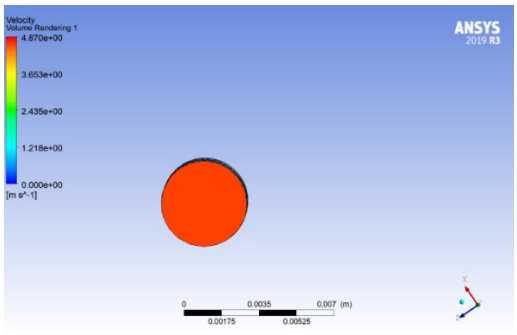


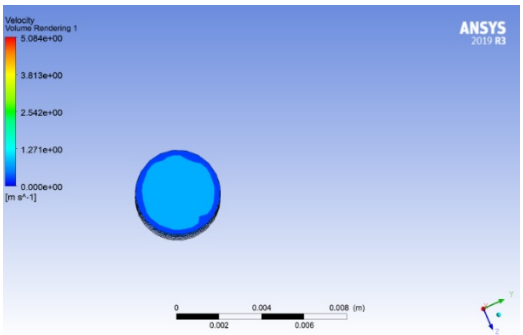


Formation ABCA Formation CBAC

Figure 10. Pressure Distribution three filter formation

From the Figure 10, can be seen that the ABCA and CBAC formations have an even velocity value (homogeneous). it is same with a single and four layers of fabric using linen to simulating cross-flow filtration with fabric filter medium, was also absolutely efficacious [15].





Formation ABCAB Formation CBACB

Figure 11. Pressure Distribution three filter formation

From the picture we can see that the ABCAB formation is more uniform than the CBACB formation, however, the CBACB formation has a higher speed than the ABCAB formation. The table shows the formation of 3 filter ABC formations has the highest speed of 6,419 m/s. When we place a large meshing hole on the first level, the speed and speed are smaller, this can be seen in the CBA, CBAC and CBACB formations. The meshing formation with a small size in the first position can increase the speed and pressure, we can see this in the ABC, ABCA and ABCAB formations. The addition of the amount of filtration can increase the pressure value, this can be seen in the formation of ABCA, CBAB, ABCAB, CBACB. While the reduction in the number of filters will reduce the pressure value, this can be seen in the ABC and CBA formations.

3.3 Citation and References

1. Definition of Filtration

Filtration is a process used to separate solids from liquids or gases using a filter medium that allows the liquid to pass, but not the solids. The term “filtration” applies whether the filter is mechanical, biological, or physical. The liquid that passes through the filter is called the filtrate. The filter medium can be a surface filter, which is a solid that traps solid particles, or a deep filter, which is a base material that traps solids. Filtration is usually an imperfect process. Some of the liquid remains on the feed side of the filter or remains in the filter media and some small solids pass through the filter. As a chemical engineer there is always some product lost, whether it's a liquid or a solid that collects [3] [16].

2. Filtration Types

Broadly speaking, Filtration is divided into three, namely: The filtration process without pressure or simple: is a filtering process using filter paper filter media. The way to do this is to cut the filter paper in a circle, then fold it in half, up to three or four times as much. Next, open it and place it into the separatory funnel so that it adheres to the separatory funnel.

Pour in the heterogeneous mixture to be separated little by little. The result of filtration is a solid called the resident and the liquid is called the filtrate.

a) The filtration process uses pressure: generally carried out by vacuum (aspirated using a vacuum pump). The separation process using this technique is most appropriate when the number of solid particles is much greater than that of the liquid..
b) Filtration process using a membrane: is a separation process using a pore size (0.1 micron) membrane. The principle of this membrane filtration technique is to filter the liquid in the form of a sample through the thinnest filter and made of cellulose-like material. The advantages of membrane filtration are: It can analyze large volumes of samples in a short time which is limited by the viscosity and turbidity of the sample liquid. Can analyze samples with a small number of microbes (improved microbial detection accuracy) [1]. Inhibitors on the sample that can inhibit microbial growth such as antibiotics, chlorine or preservatives can be rinsed off. In general, the cup used is small (50mm) so it can save the use of media and space in the incubator. Practical in preparation, it can be filtered repeatedly (multiply the funnel branch) and is reproducible. Through a certain drying process, membrane paper that has been overgrown with colonies can be used as permanent documents or data for the purpose of recording data. Disadvantages of using membrane filtration are: It is not suitable for counting samples with the number of microbes that are too concentrated, although dilutions can be carried out with graded dilutions. Several types of microbes with a diameter smaller than the pores such as Rickettsia and Mycoplasma are able to escape from the pores of the membrane paper.

3. Benefits and Purpose of Filtration

The addition of the amount of filtration can increase the pressure value, this can be seen in the formation of ABCA, CBAB, ABCAB, CBACB. While the reduction in the number of filters will reduce the pressure value, this can be seen in the ABC and CBA formations. Four Factors affecting filtration in the filtration process there is a physical and chemical reaction, so there are many interrelated factors that will also affect the quality of the efficiency, filtration etc. Some of these factors include: Filtration discharge causes the filter not to function efficiently, so it cannot occur perfectly, and causes some too fine particles to escape from the filter, the highest turbidity concentration in raw water results in clogging of the pores of the media (the occurrence of clogging) [17]. Any change in temperature or temperature causes the density, kinematic and absolute viscosity in water to change, so that there are differences in the size of the particles to be filtered. Depth of size, media, and material The selection of media and size is the most important decision in designing a filter structure. The thickness of the media determines the length of flow and filterability. The water level above the media and the loss of pressure on the condition of the high water surface above the media affect the amount of discharge and the rate of filtration in the media [18].

5. Filtration Research Method

Filtration methods are most often used in laboratories according to the sample being handled and the expected results. In general, there are two filtration methods that are often used, namely: the hot filtration method, which is used to separate solids and liquids, which in the process is not expected to produce crystals in the filter funnel area and other equipment. Cold filtration method, is used to separate between solids and liquids, where after filtration is expected to occur crystal formation. This method uses ice to cool the apparatus to be used, so that the temperature in the system will decrease drastically and can trigger crystal growth [19].

The current filtration method has undergone many modifications, including by combining the flow direction and the filtering media. the slow sand filter technology that is widely applied in Indonesia is the slow sand filter with the flow direction from top to bottom (down flow) [20]. The slow sand filter method can also be used with the up flow direction, namely the flow direction from bottom to top with the media arrangement being reversed as well. The excess of up flow if the filter is saturated or clogged, washing can be done by opening the drain valve. Clean water is entered from above then the sediment will go down by itself and come out through the faucet. In the area near the wall, the pressure tends to slow down due to CFR and friction with the wall [11].

6. Utilization of membranes for filtration

Comparison between cellulose membrane filtration and milliphore filter paper in filtration applications was carried out. The results showed that cellulose membranes were effective in the textile waste management filtration process. Cellulose membranes without a vacuum in the filtration process have better efficiency than other treatments [14]. Conducted research on filtration with chitosan and rice husk silica (biosilica) membranes using the phase inverse technique. The purpose of this study is to analyze the characteristics of the membrane flux, which

is one indicator of the quality of the membrane performance. The variation of the mass ratio of chitosan and biosilica is 1; 1.5; 2 and 3 for membranes A, B, C, and D [21].

4. CONCLUSION

The formation of 3 filter ABC formations has the highest speed of 6,419 m/s. When we place a large meshing hole on the first level, the speed and speed are smaller, this can be seen in the CBA, CBAC and CBACB formations. The meshing formation with a small size in the first position can increase the speed and pressure, we can see this in the ABC, ABCA and ABCAB formations. The addition of the amount of filtration can increase the pressure value, this can be seen in the formation of ABCA, CBAB, ABCAB, CBACB. While the reduction in the number of filters will reduce the pressure value, this can be seen in the ABC and CBA formations.

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