[15]APPLICATION OF MIXED BASED MEMBRANE TECHNOLOGY FROM COMPONENT MATERIALS BINTARO, ZEOLITE AND BENTONITE TO REDUCTION OF SONG

By hatta dahlan

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Application of Mixed Based Membrane Technology from Component Materials Bintaro, Zeolite and Bentonite to Reduction of Songket Waste Liquid Cloth

Muhammad Hatta Dahlan[1, a)], Abdullah Saleh[1], Faisol Asip[1], Akbar Makmun[2], and Defi[2]

[1]*Chemical Engineering Department Lecturer, Sriwijaya University,*
[2]*.Student of Chemical Engineering department Jalan Raya Palembang Prabumulih Km32, Indralaya , Ogan Ilir , 30662 South Sumatera, Indonesia*

[a)] Corresponding author: halogenated@hotmail.com

Abstract. Application of membrane technology based on clay mixture, Activated Carbon from Bintaro, Zeolite and Bentonit to process the waste water of Songket cloth is Palembang traditionally cloth. The applied research is into the superior field of industrial and household waste processing with membrane ceramic technology. The objective of this research is to design the liquid waste separation tool of jumputan cloth using better and simpler ceramic membrane so that it can help the artisans of Palembang songket or songket in processing the waste in accordance with the standard of environmental quality standard (BML) and Pergub Sumsel no. 16 in 2005. The specific target to be achieved can decrease the waste of cloth jumputan in accordance with applicable environmental quality standards the method used in achieving the objectives of this study using 2 processes namely the adsorption process using activated carbon and the separation process using a ceramic membrane based on the composition of the mixture. The activated carbon from bintaro seeds is expected to decrease the concentration of liquid waste of Songket cloth. Bintaro seeds are non-edible fruits where the composition contains organic ingredients that can absorb because contains dyes and filler metals. The process of membranization in the processing is expected to decrease the concentration of waste better and clear water that can be used as recycled water for household use. With the composition of a mixture of clay-based materials: zeolite, bentonit, activated carbon from bintaro seeds are expected Find the solution and get the novelty value in the form of patent in this research

INTRODUCTION

Palembang songket cloth is increasingly popular among the middle class and above. It can be seen the development of songket industry homeland that competes in fashion and in ceremonial events such as weddings, birthdays etc. Along with the increase of Palembang songket industry which produced an industrial house that many spread in the city of Palembang, the emergence of environmental problems in the form of waste of songket cloth that is not processed professionally so much contaminated with water like river and sewer. Not a lot of literature that discusses fabric waste. This songket in detail, conventionally this waste is left alone in the body such as ponds, channels, and culverts that do not flow within a few days the color of the waste will turn into smelly with darker colors and pollute the environment in terms of estitika.

This research is intended to find solutions of environmental problems from songket wastewater with several methods, including using adsorption process using activated carbon-based avocado seeds and bintaro seeds, because these two seeds are known as waste that can be utilized as a natural adsorbent. Some researchers have tried to use activated carbon from activated charcoal but the results are not yet optimal. Researchers tried to use the adsorption process and the membrane process using a ceramic membrane. With the adsorption process is expected to get optimal activated carbon composition, with the membranisasi process is expected to separate the wastewater of songket cloth

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towards better with the mixed composition of avocado seeds and bintaro as a mixture of components Zeolite and bentonite.

In this study, the bintaro seed was made activated carbon at 500C with a phosphate acid catalyst for 4 hours. Furthermore, after the adsorption results are obtained, followed by the manufacture of ceramic membranes made from bintaro seeds. Using ceramic membrane made from clay, zeolite, bentonite and activated carbon aims to know the characteristics of the membrane in accordance with the composition and process performed.

The purpose of this research is to know whether the ceramic membrane made from bintaro seeds, zeolite and bentonite can reduce the concentration of liquid waste of songket cloth optimally. Benefits derived from this research is to open the scientific knowledge about the use of activated carbon of bintaro seeds on the waste of songket cloth. Encourage local government especially as a bintaro producing area not to dispose of alpikat seeds as untreated waste but can be processed by the chemical process into active adsorbent and as the material of ceramic membrane maker.

MATERIALS AND METHODS

Liquid Waste Songket Cloth

Songket is traditional of Palembang woven cloth with colors like gold and silver thread and is commonly used on official occasions. Now the existence of Palembang songket become attention lately, more attracted to people outside of the Palembang city or Abroad who buy songket as souvenir gift and official dress party or other official events. Along with the increasing sector of songket industry, the problem of liquid waste songket is increasing. The resulting liquid waste comes from the staining process using chemical or synthetic dyes. One of the commonly used dyestuffs is the procion blue dyes that are toxic to humans and living creatures. The decline in water quality is indicated by the increased turbidity of water caused by dye pollution, thus blocking the entry of sunlight to the bottom of the waters and disrupting the balance of the process Photosynthesis, coupled with the mutagenic and carcinogenic effects of the dyestuff.

Basic Material Selection

Preparation of the basic ingredients in the manufacture of activated carbon needs to be done in order to obtain the appropriate activated carbon with the goal. Preparation of basic materials can be the selection, formation, and cleaning of basic materials. In the selection of active carbon base materials, several criteria to be met include the availability of basic materials for industrial scale, inexpensive, high carbon content and low inorganic (ash) elements (Manocha Satish, 2003). Shape and size, activated carbon is present in several types such as powder and granule. Activated carbon powder form is commonly used for liquid phase absorption while the granular form is primarily used for applications in the gas phase. In addition, the purity of the activated carbon is a parameter affecting the adsorption capacity of the activated carbon (Bahl et al, 1987). Therefore, the basic material needs to be prepared by going through the washing process and drying process.

Carbonization Process

The process of carbonization is the process of heat treatment in very limited oxygen conditions (pyrolysis) of the base material (organic matter). The heating process causes the decomposition of the material and the release of volatile components and carbon begins to form the pore structure. Thus, the base material has a surface area but its absorption is still relatively small because there are still tar residues and other compounds that cover the pores. The carbonized base material is called carbon or carbon. According to Yang et al, 2003, the carbonization process is carried out at a temperature of 400-500 ^oC so that the volatile material contained in the base material will be lost. Meanwhile, according to Satish, (2003), the carbonization process is carried out at temperatures of less than 800 ^oC. Hsisheng, (1996) in his research carried out carbonization at temperatures of 800-950 ^oC. Nugroho Y, (2000) in his research obtained Tanjung Enim coal will be depleted volatile matter in the temperature range 850-950 ^oC

Activation Process

The activation process leads to the release of hydrocarbons, tar and organic compounds that are still attached to the carbonization of carbons. According to Sontheimer, 1985 on the process of activation occurs the formation of pores that are still closed and increasing the size and number of small pores that have been formed. Thus, activated carbon activation results have a larger internal surface area. Activated carbon is also called activated carbon.

The activation process is the most important process because it determines the quality of active carbon produced both the area of the surface and the adsorption power. The activation process can be done in two ways, namely chemical activation and physical activation.

Ceramic Membranes

The membrane is a selective barrier between two phases. Membranes have different thicknesses, some are thick and some are thin and some are homogeneous and it is also a heterogeneous. Viewed from the material membrane consists of natural materials and synthetic materials. Natural materials are materials derived from nature such as pulp and cotton, while synthetic materials are made from chemicals, such as polymers. Apart from being a separator as well as a means of insulation and purification of a solution passed on the membrane. Membrane technology has several advantages over other processes, such as continuous separation, generally relatively lower energy consumption, membrane process can be easily combined with other hybrid processing, and membrane material varies so easily adapted to its use. Lack of membrane technology. Such as flux and selectivity because in the membrane process generally occur flux phenomenon inversely proportional to the selectivity.

Principle of Membrane Separation

In principle, the process of separation by using membranes is the separation between solvent and solute. The solvent is separated by a solute to be retained by a membrane called a concentrate, while the solvent passes through a membrane called permeate. According to the flow pattern, the membrane is divided into two types, namely the laminar filtration membrane (dead end) and tangential (cross flow). In laminar filtration, the feed stream is perpendicular to the membrane surface so that only part of it accumulates. In the dead-end configuration, there is no retentate whereas if there is a retentate called cross flow. So in the cross-flow configuration, there are some feeds (solvents) that do not become permeate. For dead-end cases, the resistance increases by the thickness of the fouling layer formed on the membrane surface.

Membrane Performance

The performance or efficiency of displacement within the membrane is determined by two parameters:

- Permeability
- Permeability is often referred to as the speed of permeate or flux. Flux is the number of permeate volumes passing through a single membrane surface area of a given time with a force of thrust in the case of pressure. In the filtration process, the commonly used flux value is the volume flux expressed as the volume of the feed solution which can pass through the membrane per unit time per unit area of the membrane. Factors affecting permeability are the number and size of the pore, the interaction between the membrane and the feed solution, the viscosity of the solution and the pressure from the outside.
- Selectivity
  The selectivity of a membrane is a measure of the ability of a membrane to hold a suspension or pass through a certain other suspensions. Factors that affect selectivity are the size of the particle going through it, the interaction between the membrane, the feed solution, and the pore size.

The parameter used to describe membrane selectivity is the rejection coefficient (R), ie the fraction of solute concentration not penetrating the membrane. Some of the factors that affect the use of membranes include:

- Molecular Size
- The size of membrane molecules greatly affects membrane performance.
- Membrane Form

- Membranes can be made in various shapes, such as flat shape, tubular shape, and hollow fiber form.
- Membrane Material
- Differences in the membrane material will affect the rejection and pore size distribution.
- Solution Characteristics
- The characteristics of this solution will have an effect on membrane permeability
- Operational parameters
- Types of parameters used in operations generally consist of membrane pressure, membrane surface, temperature, and concentration.

Advantages of membrane technology include:

- Separation by molecule so that separation can operate at low temperature (ambient temperature).
- Relatively low energy usage because usually separation using membrane does not involve phase change.
- No use of chemical aids and no additional waste products.
- Modular, meaning in scale-up by multiplying the unit.
- Can be combined with other types of operations

Membrane technology is widely used because the separation process has many advantages, such as not needing additional chemical substances, continuous process, operational temperature, and low energy consumption, will not damage samples and components to be separated, the technology is sterile so it will not cause pollution problems New, more competitive, highly specific membranes can be tailored to the desired needs and easily combined with other separation processes (hybrid processes) and up-scale up-to-membrane readability.

Research Method

Activated carbon is a carbon compound that has increased its adsorption power by carbonization and activation. In the process occurs the removal of hydrogen, gases, and water from the carbon surface so that there are physical changes on the surface. This activation occurs because of the formation of active groups due to the interaction of free radicals on the carbon surface with atoms such as oxygen and nitrogen. Activated carbon comprises 87 - 97% carbon and the remainders are hydrogen, oxygen, sulfur and nitrogen and other compounds formed during the manufacturing process. The volume of active carbon pores is usually greater than 0.2 cm^3/gram. While the internal surface area of activated carbon that has been studied is generally larger than 400 m^2/gr and can even reach above 1000 m^2/g (Sudibandriyo, 2003). According to Yang et al, (2003), the surface area of activated carbon characterized by the BET method ranges from 300 - 4000 m^2/g.

Basically, activated carbon can be made from all carbonaceous materials from plants, animals, and minerals such as various types of wood, rice husk, animal bones, coal, coffee bean shell, coconut shell, coconut shell, crown Pineapple and others (Manocha and Satish, 2003).

Activated carbon is used in various application fields according to its type. Activated carbon can adsorb certain gases and chemical compounds or selective adsorption properties, depending on the size or volume of the pores and surface area. Functional groups may form on activated carbon when activated, due to the interaction of free radicals on the carbon surface with atoms such as oxygen and nitrogen, derived from processing or atmosphere. This functional group causes the surface of activated carbon to become chemically reactive and affect its adsorption properties. The surface oxidation in the production of activated carbon will produce hydroxyl, carbonyl, and carboxylic groups which give the amphoteric properties of carbon so that the activated carbon buffer is both acidic and alkaline. (Sudirjo, E. 2006).

RESULTS AND DISCUSSION

TABLE 1. Ceramic membrane with composition based materials 50% clay;50% zeolit

Time (minute)	pH	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	Turbidity (mg/L)
0	5	250	720	1420	336
30	7.7	175	395	185	98
60	7.7	69	249	160	67
90	7.5	58	152	136	37
120	7.5	54	120	100	35

TABLE 2. Ceramic membrane with composition based materials 50% clay;40% zeolit,10%bintaro

Time (minute)	pH	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	Turbidity (mg/L)
0	5	250	250	1420	336
30	7.7	95	95	168	86
60	7.7	59	59	130	60
90	7.5	48	48	104	43
120	7.5	46	46	64	38

TABLE 3. Ceramic membrane with composition based materials 50% clay;30% zeolit,10%bintaro

Time (minute)	pH	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	Turbidity (mg/L)
0	5	250	720	1420	336
30	7.7	65	165	126	78
60	7.7	56	155	76	52
90	7.5	46	134	32	22
120	7.5	36	70	18	18

The decrease in test levels directly proportional to the process time can be known from the data table above. The longer the sample of songket liquid waste flowed in the membrane, the lower the content of the test content, but from the three membranes above shows that the clay-based ceramic membrane with the composition of 30% zeolite 20% activated carbon shell bintaro 20% and 50% clay better in lowering the pH, BOD, COD, TSS and turbidity test.

Permeat Flux

The permeate flux is the amount of volume of water passing over a certain surface area per unit of time that is affected by the thrust force of pressure. The decrease of flux along with the increase of time can be seen in the picture below. At the 30th minute to the 120th minute it appears that the flux is decreasing, this is because of the deposits of dissolved particles in the pores of the membrane surface called fouling. While in the 120th minute, to 150 is backwash, which is the regeneration method of membrane by washing back to lift the particle.

Settles on the surface of the membrane. In the 120th minute was the best result of the total time spent in this study. The longer the processing time, the less volume will be obtained. However, the results obtained will be better.

Permeat pH

The quality standard of pH value specified for songket industry waste ranges from 6-9, but in the initial sample of songket waste with pH 5 which is an indication that the waste is acidic and dangerous if directly thrown into the environment. Therefore, we do pretreatment first to raise the pH value. In order for the pH to rise, Polyaluminium Chloride (PAC) is used. In the sample analysis, pH meter is used to see the pH obtained after the addition of PAC, to the displays of different numbers from range 7-8.

TSS Decrease Efficiency (total suspended solid)

Percent efficiency of TSS decrease shows the ratio of TSS in songket waste when prior to processing with membrane and after processing using a membrane. From the observation, it can be seen that with the longer processing time of songket waste and with the activated carbon composition of bintaro shells more and more, there is a bigger decrease of TSS. The decrease of TSS concentration in the final processing result can occur because ceramic membrane has the ability to filter (filtration) and absorb (adsorption) suspended solids contained in Songket waste water.

Biological Oxygen Demand (BOD)

BOD is the amount of oxygen needed by microbes to decompose organic matter. The maximum BOD limit set is 100 mg / l, however, in the initial sample, BOD obtained was for songket liquid waste of 250.7 mg / l. With the value in getting known that Songket liquid waste will pollute the environment if not processed first. In the waste treatment conducted in this study, first adsorbed this is done so that the amount of microbes is reduced and the smell of liquid waste Songket will be reduced. From the result of the sample test which has the least amount of BOD is the membrane with the activated carbon composition of bintaro shell 20%.

After processing, the value of BOD obtained is reduced. In the graph above shows a decrease in BOD on bentonite and zeolite membranes. From the results obtained the smallest BOD value is found on the membrane with the activated carbon composition of bintaro shell 20% at minute 120 that is 36 ml / g. This indicates that the best result is found in a sample of Songket liquid waste with an activated carbon membrane shell membrane composition of 20%.

Total Suspended Solid (TSS)

Total suspended solid is another term used for suspended solids that cause turbidity in water. In Songket liquid waste has as much as 1460 mg/liter. TSS (Total Suspended Solid) which causes turbidity in the waste that culminates in color. The color of the initial Songket liquid waste is very dark brown and very much clearly visible particles of dissolved substances. In reducing the content of TSS, the initial treatment is in the form of chlorine delivery. Total suspended solid is actually a suspended solid that can settle itself without the aid of additional substances (coagulant) but requires a relatively long time. In the graph, it can be seen that the zeolite membrane has good ability to decrease the content of TSS in songket liquid waste. The best decrease of TSS is on the membrane with activated carbon composition of 20% bintaro shell. In contrast to the composite membrane without activated carbon reaching 100 mg/liter but on the membrane with activated carbon composition of 20% bintaro shell of 32 mg/liter. This is because the pore size of the membrane with the activated carbon composition of bintaro shells is 20% denser than the pore size of the membrane without activated carbon of bintaro shells.

Chemical Oxygen Demand (COD)

COD or chemical oxygen demand is the amount of oxygen required to oxidize organic substances in organic matter. The amount of COD contained in the Songket waste is known to be 720 mg/liter which means that the high organic compound cannot be biologically biodegradable contained in the waste

In the picture above shows the COD decrease with time. Membrane membranes with activated carbon composition of 20% bintaro shells exhibit excellent work compared to membranes without activated carbon of bintaro shells in reducing COD. The membrane with the activated carbon composition of the 20% bintaro shell has lowered the COD initially amounting to 720 mg/liter to 70 mg/Liter on the membrane with the activated carbon composition of the 10% bintaro shell can decrease by 114 mg/Liter while in the membrane without activated carbon the bintaro shell can Decrease by 120 mg/Liter. It can be concluded that Membrane with activated carbon composition of bintaro shells 20% better/quality in producing liquid waste processing Songket. And the lowest COD test result obtained is the sulfuric acid of 70 mg/L.

Turbidity

Turbidity is the number of substances that are inundated in water. Turbidity can be measured from the results of the spread of light from the grains of stagnant substances. The higher the power of the greatest rays, the higher the turbidity. Here no maximum limit is allowed. (Source: Center for Environmental Health Engineering and the Class I Illness of Palembang) for turbidity analysis. But with the processing of this waste, the turbidity value dropped dramatically. In the A membrane sample with 50% clay composition and 50% zeolite, the result of analysis before processing was 336 NTU scale, after processing the result was 34.55. In membrane sample B with clay composition

50% zeolite 40% and activated carbon shell bintaro 10% analysis result before processed is 336 scale NTU. After processing, the results obtained are 38. For a sample of membrane C with clay composition 50% zeolite 30% and activated carbon shell bintaro 20% analysis result obtained before processing is 336 while after processing is 18.

CONCLUSIONS

The conclusion of the research of the waste treatment of songket liquid using ceramic membrane is as follows: 1. a ceramic membrane with composition 50% clay, 30% zeolite and 20% activated carbon bintaro shell is the best variation to treat the sewage of songket industry. These results were indicated by a decrease in BOD up to 36 mg/l, a decrease in COD to 70 mg/l, a decrease of TSS up to 32 mg/l in a sample of songket wastewater. 2. The best processing time is 120 minutes to get the decrease of BOD, COD, TSS and turbidity 3. The best result obtained in this research is found in a sample of songket liquid waste with membrane composition of 20% activated carbon of bintaro shells.

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