

UTILIZATION OF CELLULOSE ACETATE MEMBRANE MADE FROM SHRIMP SHELL WASTE IN MAKING *MAGIC MASK*

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1. Introduction

Indonesia is an archipelago with 17.604 islands populating its regions. Certainly, within the country there are many varieties of natural resources taken from forests, mining, fishing, and so on (Ambiri, 2015). But it is unfortunate that behind the abundant natural resources, Indonesia is still experiencing many problems - environmental problems that can be said to be fairly severe. One of the most dominant ones being environmental pollution (Bagas Aldilah, 2012).

Indonesia is a maritime country known for its abundant sea produce, such as *pisces*, *theutida*, *crustaceae*, etc. Based on a research conducted in 2008-2013, the average amount of shrimp or Crustaceae produced reached an amount of 320,000 tons per year, this can be said to be a very large amount (Indonesian Trade Ministry).

Besides this, Indonesia has the fourth biggest population worldwide with more or less 254,9 million residents (BPS, 2014). Due to this fact, population growth in Indonesia is high, and with it the demand for means of transportation. This causes a large number of motor vehicles in Indonesia that will result in air pollution from the smoke of burning fuel.

Research has proved that 42%-57% of a shrimp's shell consists of chitin and the amount of shrimp shell waste in Indonesia is incredibly high. Furthermore, chitin from the shrimp shell waste can be transformed into chitosan powder, which can be used in the making of cellulose acetate membranes. This cellulose acetate membrane can be utilized due to its function as an ultra-filtrate in the making of *Magic Mask*. Therefore, the object of shrimp shell waste serves as the object and basic material of this study.

Based on the above descriptions, the use of *Magic Mask* could become one of the alternatives in reducing harmful gases inhaled by people (especially for motorists and pedestrians) of the community and in increasing the use value of shrimp shell waste that has been turned into chitosan, then turned again into

cellulose acetate membrane. This membrane can be used as an ultra-filtrate layer in the mask itself that functions to filter incoming gas as well as increasing the mask's density with its small pores.

2. Problem Statement

The number of shrimp shell waste in Indonesia is very high and has not been optimized, this becomes concern to the environment as the waste will pile up and cause air pollution due to its aroma. Besides that, the large amount of vehicles in Indonesia also becomes one of many causes of air pollution from harmful gasses emitted by the aforementioned vehicles. This will become extremely dangerous when the polluted air is inhaled and enter the human body. And so from that, a solution is needed to overcome these issues.

3. The purpose of the investigation

This research is conducted for the main purpose of reducing the level of harmful gasses causing air pollution with probability of becoming inhaled by humans (especially for motorists and pedestrians). Other than that, this research is intended to increase the use of shrimp shell waste (*recycle*) by transforming it into cellulose acetate membranes as an alternative in increasing the density of the mask as well as an ultra-filtrate in the mask itself.

4. Research Method

This research was done by processing shrimp shell waste into cellulose acetate membrane that is then applied to the *Magic Mask*, then, to determine the value of the function in reducing the levels of harmful gasses causing air pollution from the *Magic Mask*, a gas emission examination process is done from premium fueled vehicles, one of Indonesia's most used fuels. The processing of the shrimp shell waste in this research is done through a 10-step procedure: cleansing of the shrimp shell waste, smoothing the shrimp shells into shrimp shell powder, transforming the shrimp shell waste into chitosan through deproteinization, demineralization,

depigmentation, deacetylation, proceeding with the mixing of the chitosan with 1% acetate acid, molding and drying, application to the *Magic Mask*, then gas emission testing. In further detail, these processes are described as such.

- (1) The shrimp shells are cleaned repeatedly using clean water.
- (2) They are then left to dry in open air until completely dry.
- (3) The shrimp shells are then transformed into powder using a 40-50 mesh electric blender.
- (4) The **deproteinization** stage is done to remove protein from the shrimp shell by using a 4% NaOH solution (with a ratio of 1:10, in this case, 35 grams of shrimp shell powder is dissolved in 350 ml of NaOH). Heated in a temperature of 80 centigrade and stirred for 1 hour.
- (5) The **demineralization** stage is done to remove minerals from the shrimp shell by using a 1M HCL solution (with a ratio of 1:15, in this case, 20 grams of the deproteinized result dissolved in 300 ml of 1M HCl). Stirred for 1 hour at room temperature.
- (6) The **depigmentation** stage is done to remove colour and absorbment of possible impurities by using a 4% NaOCl solution (with a ratio of 1:10, in this case 15 grams of the demineralized result dissolved in 150 ml of NaOCl solution). This will result in the forming of chitin. Stirred for 1 hour at room temperature.
- (7) The **deacetylation** process is the stage where chitosan is formed. The chitosan is manufactured by removing acetyl groups contained in the chitin in a concentrated alkaline medium by using a 40% NaOH solution (with a ratio of 1:15, in this case 10 grams of the depigmentation result reacted with 150 ml of a 40% NaOH solution). Heated in a temperature of 80 centigrade and stirred for 1 hour.
- (8) The chitosan is then stirred with a 1% acetate acid solution for 24 hours until homogeneous by using a magnetic stirrer.
- (9) Next, the membrane is molded and left to dry for 24 hours in open air then dried even further in an oven set to 60° for an hour to ensure that the membrane is absolutely
- (10) Finally, the cellulose acetate membrane is applied to the *Magic Mask*.

A process is then conducted to test the level of reduction towards the harmful gasses. This process involves gathering data from a gas emission test done in Nusa Jaya Sentosa, Bandung.

5. Results and Analysis

8 grams of chitosan was produced from 35 gram of shrimp shell waste after deproteinization, demineralization, depigmentation and deacetylation. The reduced mass of chitosan is caused by particles having been removed during the filtration process. In every stage of the making of the chitosan, there are specific solutions that serve as keys to producing the chitosan and the filtration process to separate the particles from the solution. After filtering, a drying process is done in an oven set to 60° in order to remove water and prevent growth of microorganisms. The four stages in the making of chitosan becomes very important as it gives colour, contents, and also the scent of the chitosan itself. Throughout the stages of deproteinization, demineralization, depigmentation and deacetylation, physical changes-- such as colour change, scent, contents--will occur due to the reaction between the shrimp shell powder and the specific solutions, and also changes in mass due to the filtration process. After all the stages have been completed, a quality chitosan powder is left.

The membrane is made by dissolving the chitosan powder with a 1% acetate acid solution and stirring for 24 hours using a magnetic stirrer until homogeneous. Afterwards, the solution is molded and left to dry in open air, proceeding with heating it in an oven set to 60° with the intention of drying as well as preventing the growth of microorganisms. The molded membrane is then applied to the *Magic Mask* and gas emission tests are then conducted to evaluate the reduction of harmful gasses produced by motor vehicles. The data collected from these tests are as following:

Table 1. Gasses Emission Analyzer Without Mask (Premium Fuel)

Test	CO	CO ₂	HC
1	7.43%	13.50%	142 ppm
2	7.31%	13.60%	132 ppm
3	6.70%	13.50%	226 ppm
Avrg	7.14%	13.53%	166 ppm

*Note:

Avrg = average

Table 2. Gasses Emission Analyzer With Normal Mask

(Premium Fuel)

Test	CO	CO ₂	HC
1	6.70%	13.60%	205 ppm
2	6.57%	13.60%	164 ppm
3	6.63%	13.50%	168 ppm
Avrg	6.63%	13.56%	179 ppm

*Note:

Avrg = average

Table 3. Gasses Emission Analyzer With Magic Mask

(Premium Fuel)

Test	CO	CO ₂	HC
1	6.07%	13.30%	185 ppm
2	5.90%	13.10%	174 ppm
3	5.30%	13.50%	182 ppm
Avrg	5.75%	13.33%	180 ppm

*Note:

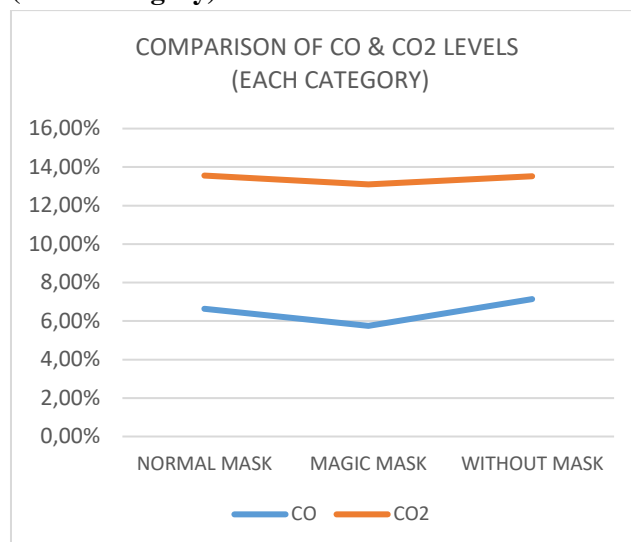
Avrg = average

The fuel that used in these gas emission tests are a premium because the majority of vehicles fuel that used by Indonesian are premium fuel because it is cheap. Therefore, the dominance of air pollution by harmful gasses of combustion fuels produced by premium vehicle.

In these gas emission tests used Suzuki Esteem car that still use carburettor where there is no catalytic converter system (a kind of filter) so that the harmful gasses are produced more. Actually, CO levels can to be reduced continuous up to a certain point when they get in one test with Magic Mask, but because of the extra fan that make the vehicle machine work more so that the vehicle gas emissions becomes greater. Therefore, when the extra fan is working, gas emission tests need to be stopped.

In these gas emission tests, they are be tested for three times in each categories, there are test without a mask, test with normal mask, and test with Magic Mask. It aims to avoid uncertainty in take the data because of the instability of the amount of exhaust gasses those produced by the vehicle. Can be seen in the table, that the levels of CO and CO₂ at Magic Mask smaller than normal mask.

Graphic 1. Comparison of CO and CO₂ (Each Category)



Based on the gas emission test results tabel and the graphic above, it is known that the *Magic Mask* has a higher density level in comparison with normal masks. This is shown through the reduction of harmful gasses emitted by the motor vehicles, it shown at **Graphic 1**, CO and CO₂ level in *Magic Mask Category* is the lowest in that graphic. The quality of the *Magic Mask* is shown by the cellulose acetate membrane that is in the mask functioning as an ultra-filtration mask. This *Magic Mask* can be used as a solution for both motorists or pedestrians on highways rich in air pollution so as to prevent from various illnesses caused by harmful gasses for the reason that the aforementioned gasses have been reduced by the *Magic Mask*. With this, the *Magic Mask* can be said to have many benefits, notably for human health.

6. Conclusion

Shrimp shell waste can be transformed into cellulose acetate membranes that function as an ultra-filter in a *Magic Mask*. Based on the results taken from the gas emission tests, the *Magic Mask* is able to reduce the level of harmful gasses emitted from motor vehicles that inhaled by people (especially for motorists and pedestrians).

Furthermore, this product is able to add to the use of shrimp shell waste by way of recycling. Hence, shrimp shell waste can be processed to become a very usefull and beneficial mask.

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