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Optimization Formalin Transport Through Bulk Liquid Membrane Technique.

Refinel, Djufri Mustafa, Rini Oktavia, and Deswati*.

Department of Chemistry, Faculty of Mathematics and Natural Science, Andalas University, Kampus Limau Manis, Padang 25163, Indonesia.

ABSTRACT

Transport of formalin from the source phase into the receiver phase had been researched through bulk liquid membrane which consisted of 12 mL formalin as a source phase, 24 mL H_2O_2 as a receiver phase and 30 mL chloroform as a membrane phase. The experiment operation technique was assisted by magnetic stirrer mixing at 250 rpm speed within 15 minutes equilibrium time. The measurement of formalin concentration that transported to receiver phase and residue in source phase was determined by titration method. The research results that optimum condition were at pH 2 of source phase; 0,03 N formalin concentrate at source phase; 0,06 N H_2O_2 concentrate at receiver phase and 150 minutes transport time with formalin percentage which was transported to receiver phase 76,34% and residue in source phase 20,03%.
Keywords:formalin, bulk liquid membrane, titration.

***Corresponding author**

INTRODUCTION

Water pollution due to waste from various industries remains unresolved environmental problems. Formalin is one substance that is widely used as an anti-bacterial in convection industry, furniture, fishery and in medicine as a preservative corpse. Formalin is one of the dangerous chemicals that are carcinogens. According to the Occupational Safety And Health Administration (OSHA) formalin in general threshold is 1 to 0.1 mM. This figure shows that formaldehyde can have a negative impact on human health in very small quantities.

Methods of separation of contaminants that are often used include the reaction of precipitation, solvent extraction, chromatography and membrane technology. Among all the techniques of separation, membrane technology is used more often lately. Membrane technology is more selective than the other separation methods. There are several types of liquid membrane techniques namely bulk liquid membrane phase, liquid membrane emulsion and supporting liquid membrane. The bulk phase liquid membrane system has a simple design and ease of control. This causes the bulk phase liquid membrane system is more often done in the laboratory [1,2].

Bulk phase liquid membrane technique is a modification of the extraction process back where this technology combines solvent extraction and stripping processes in a mix that is very attractive for the separation of certain species at low concentrations [3]. Here is a liquid membrane that is semipermeable separating two liquid phases are mutually dissolved while the membrane does not dissolve in the solution separation. Membranes are usually in the form of organic solvent that acts as a mediator of transport with or without the presence of certain messenger substances [4].

In this technique the liquid membrane provides the entire solution in facilities (bulk) and the interface to the scene of the transport processes. Here transport occurs by diffusion differences, because the difference in ion interactions at the interface. The advantage of the method of separation with bulk liquid membrane phase is relatively simple implementation, the use of chemicals bit, high flux and can be used continuously [5].

In this research, transport optimization formaldehyde and formalin able to check whether transported by using the technique of bulk liquid membrane phase in the absence of a carrier in the membrane phase.

RESEARCH METHODOLOGY

Chemicals, equipment and instrumentation

The materials is used this study were :formalin (HCOH) 37% hydrogen peroxide (H_2O_2) 50%, chloroform ($CHCl_3$) (Merck), hydrochloric acid (HCl) (Merck), sodium hydroxide (NaOH) (Merck), oxalic acid ($H_2C_2O_4.2H_2O$), phenolphthalein indicator **and doubly distilled water**.

The tools is used in this study were :the bulk phase liquid membrane cell, a magnetic stirrer (AGIMATIC REV-E), analytical balance (ALJ 220-4NM), pH meter (Metrohm 827) and tools other laboratory glassware.

Work procedures

Prepared beaker 100 mL and 30 mL chloroform incorporated as membrane phase. In a solution of this membrane phase silendris dipped a glass tube and pipetted 12 mL of a solution of formalin-phase source with a certain concentration. Beyond the glass tube is pipetted 24 mL H_2O_2 0.06 N. Technical operations performed by stirring using a magnetic stirrer at a speed of 250 rpm for 1 hour. After 15 minutes, the receiver phase and phase each source is taken as much as 5 mL to measure the amount of formaldehyde concentration contained therein titration method.

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RESULTS AND DISCUSSION

Effects of pH Formalin in Source Phase

Determination of the effect of pH is done to obtain the optimum conditions in which formalin can be transported well. In determining these optimum conditions, formaldehyde is oxidized to formic acid.

$$HCOOH \leftrightarrow HCOO^- + H^+$$

To be transported by either the intended conditions of formic acid is in the form of the molecule. In accordance with the principle of equilibrium, to obtain formic acid in the form of molecules then the source should phase in an acidic state. So that the equilibrium shifts to the left where formic acid tends to form molecules.

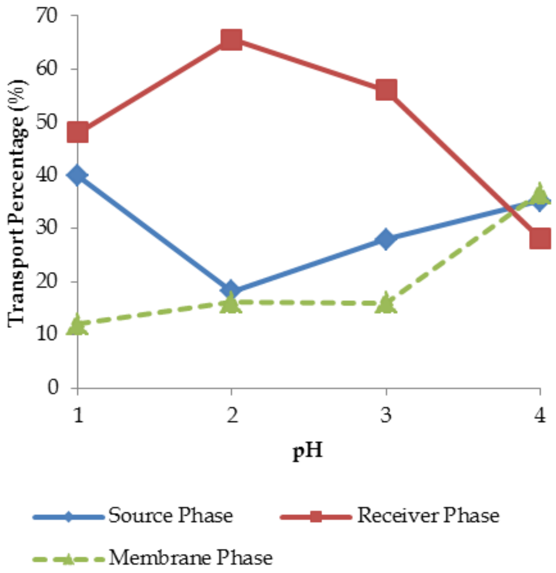

Fig. 1. The effects of pH on traansport percentage (%)

Conditions : Phases source 12 mL formalin 0.03 N with variations in pH, 30 mL of chloroform membrane phase, phase receiver H_2O_2 24 mL of 0.06 N

Fig. 1 shows that the optimum pH is used for phase 2 source is the pH at which the condition is the tendency of formalin-shaped molecule more. The pKa value of formic acid is 3.75. This figure shows the tendency of molecules to dissociate occurs at pH ≥ 3.75.

Effects of Formalin Concentration in Source Phase

The concentration of formalin in phase sources affect the amount of formaldehyde that is transported to the recipient phase. The greater the concentration of formaldehyde, the greater also is transported.

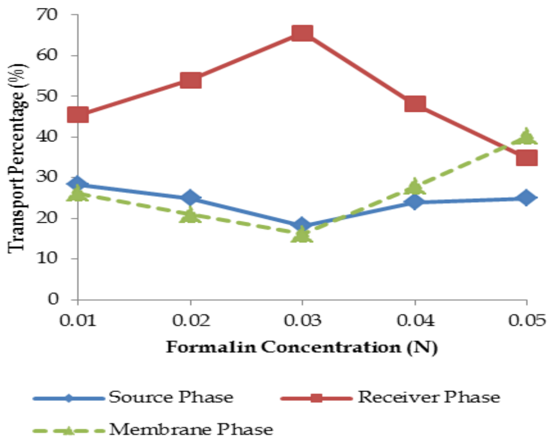

Fig. 2 The effects of Formalin concentration on transport percentage (%)

Conditions : Phases source 12 mL pH 2 with variations of concentration, 30 mL of chloroform membrane phase, phase receiver H_2O_2 24 mL of 0.06 N

Fig. 2 shows that the optimum concentration is used to phase the source is at a concentration of 0.03 N with a percentage formalin were transported to the recipient phase reached 65.59%. This indicates that the maximum capacity of the liquid membrane phase as a transport medium with 1 hour transport time is at a concentration of formalin concentration of 0.03 N. For larger decrease the amount of formaldehyde that is transported to the recipient phase. This happens because of the reduced ability of H_2O_2 to oxidize formaldehyde into formic acid at a concentration greater formalin.

Effects of H_2O_2 concentration in Receiver Phase

The concentration of H_2O_2 as the receiver phase is very important in the transport of formalin. The greater the concentration of the recipient phase, the greater the number of molecules of formaldehyde that can be transported to the recipient phase.

Fig. 3, shows that the optimum concentration of H_2O_2 is used for the receiver phase is at a concentration of 0.06 N. At these concentrations of formaldehyde transport to the recipient phase reached 65.59%. At concentrations of H_2O_2 smaller, formalin transport from phase to phase sources receiver is also small. This is due to the inability of H_2O_2 to oxidize formaldehyde perfectly. While the concentration of H_2O_2 the greater the possibility of damage to the formalin since H_2O_2 is a substance that is an oxidant.

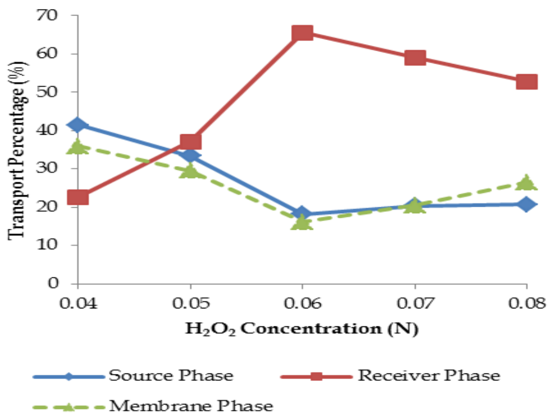

Fig. 3. Effects of H_2O_2 concentration on transport percentage (%)

Conditions : Phases source 12 mL formalin 0.03 N with a pH of 2, 30 mL of chloroform membrane phase, phase receiver 24 mL H_2O_2 with various concentrations.

Effects of Time Transport

Transport time can be determined by the length of the stirring is done during the process of transport of molecules of formaldehyde from phase to phase source recipient, stirring duration is greatly influencing the interactions between molecules in accelerating the process of transport [6].

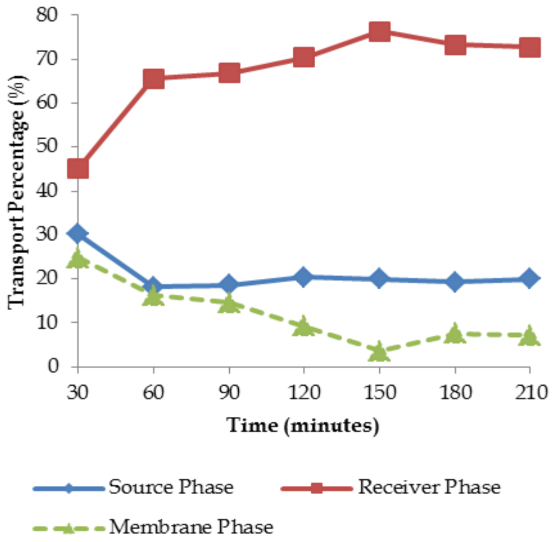

Fig. 4. Effects of stirring time on transport percentage (%)

Conditions : Phases source 12 mL formalin 0.03 N with a pH of 2, 30 mL of chloroform membrane phase, phase receiver H_2O_2 24 mL of 0.06 N, stirring time was varied

Fig. 4 can be seen that the optimum stirring time is reached within 150 minutes, where the percentage of formalin were transported to the membrane phase is quite large. This can be shown by the amount of formaldehyde in a small phase concentration source that is 20.03% while the phase formalin were transported to the receiving 76.34%. Therefore, with increasing time the formaldehyde in membrane phase will be transported to the source phase. That is, the transport speed of formalin-phase source to the membrane phase is greater than the transport speed of formaldehyde from membrane phase to phase or to discharge formalin recipient of membrane phase to phase receivers require quite a long time.

With increased stirring time more and more of formaldehyde which penetrates the membrane so that the amount of formaldehyde that is in phase receivers are getting bigger and the amount of formaldehyde that lag phase has been a constant source. Having reached a state where the maximum amount of formalin then by increasing time stirring the amount of formaldehyde that transported to the recipient phase decreased. This happens because of the ability of the membrane has been saturated for transporting formaldehyde to phase receiver and H_2O_2 damage as a receiver phase for long been in contact with formalin which is a substance that H_2O_2 oxidation.

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CONCLUSION

It can be concluded that transport formaldehyde can be done through a bulk phase liquid membrane technique. The optimum condition was obtained at the time of transport formalin pH source phase 2, the concentration of formaldehyde as a source of 0.03 N phase, the concentration of H_2O_2 as the receiver phase of 0.06 N and a stirring time of 150 minutes. In this condition the percentage obtained formalin transport to the receiving phase by 76.34% and the percentage of residual formaldehyde in phase source of 20.03%.

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