Conference Paper

Transport of Aniline through Bulk Liquid Membrane with Transition Metal Ion As Receiving Phase

Refinel[1], Paska Apriani. S[1], Emil Salim[1], and Hermansyah Aziz[2]

[1]Electrochemical and photochemical Laboratory, Department of Chemistry, Faculty of Mathematics and Natural Sciences,University of Andalas, Kampus Limau Manis, Padang, 25163, Indonesia
[2]Organic Chemistry Laboratory, Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Andalas, Kampus Limau Manis, Padang, 25163, Indonesia

Abstract

Aniline is a common carsinogenic chemical in industrial wastewater. Aniline above 2 mg/L may harm living organisms in the water that have been contaminated with aniline. The method that can be used is the bulk liquid membrane, which is currently effective in the recovery of aniline from the water. Aniline was transported initially the 4 x 10^{-5} M feed solution to the $FeCl_3$ in the receiving phase is 90.17% in 90 minutes, feed phase at pH 6, stirring rate 180 rpm, and time equilibrium 15 minutes, while remaining at feed phase is 12.42%. The result from FTIR (*Fourier Transform Infrared Spectroscopy*) characterization indicate the presence of aniline in receiving phase, absorption characteristic of C-N and N-H in IR spectrum in the stripping phase.

Keywords: Bulk liquid membrane, aniline, transport, UV-Vis spectrophotometry

Corresponding Author:
Refinel
refinel@csi.unand.ac.id

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1. Introduction

Pollution is always continue to occur and getting worse from year to year. This is due to the construction of the hospital, home industry, and especially the construction industry in Indonesia are increasing rapidly. However, in the developing countries such as Indonesia the removal of residual production is carried out only with the accumulation and disposal of waste waters without any recycling proceases. As a result various types of hazardous organic wastes couses a serious problem for health and the environment [1].

Aniline is one of the organic waste that is toxic and dangerous. According to Rath, the threshold of aniline in water is about 2 mg / L, if aniline in waters more than safe levels, can lead to the death of aquatic ecosystems and surrounding areas, so it is feared to damage coral reefs, plants, marine animals, and poisoning and even death in humans who consume aniline contaminated water [2-4].

Water that has been contaminated with aniline need serious at treatment. The method can be used is a of BLM (Bulk Liquid Membrane), method which has a highly selectivity, simple used, membranes can be recycled, and the extraction process takes place in one stage (continue),allowing transport process or recycle contaminated aniline waste. Bulk liquid membrane technique is more practical than the solvent extraction technique [5], which have drawbacks such as high cost, complicated operation, and has low efficiency in removing dissolved compound, and more practical than the emulsion method, that produce emulsion that are unstable, so that a sustainable transport process cannot be carried out [6-7].

Based on the description above, the purpose of this study was to look at the ability of bulk liquid membrane in the recovery phase from liquid aniline, aniline transport determine optimum parameters in the bulk phase liquid membrane method, and determine the recipient phase which has high efficiency in the transport of aniline. The results of this study is expected to provide information on methods of effective and efficient to separate the aniline from liquid, so that waste discharged into the environment friendly and safe for living things, and the aniline which has been recovered can be reused, so this method can be used hospitals and industry in controlling waste aniline.

2. Materials and Methods

2.1. Equipment

The tools used in this study is the bulk phase liquid membrane cell, which is a cylindrical tube with a surface area of 3.14 cm^2, and a 100 ml beaker with a surface areaof 7.07 cm^2, UV-Vis spectrophotometer (S.1000 Secomam Sarcelles, French), magnetic bar, analytical balance, pH meter, and other laboratory equipment.

2.2. Material

The materials used in this study is $C_6H_5NH_2$, $CHCl_3$ (Merck), $Cu(NO_3)_2.3H_2O$ (Merck), $FeCl_3.6H_2O$ (Merck), HCl, NaOH (Merck), and aquoeous.

2.3. Preparation of source phase

Aniline as much as 0.91 mL pipette was dissolved in 100 mL volumetric with distilled water until the properboundary to obtain stemaniline concentration 0.1 M. Then, diluted with doubly distilled water in a 50 mL volumetric flask into concentration of 2 x 10^{-5} M; 4 x 10^{-5} M; 6 x 10^{-5} M; 8 x 10^{-5} M; and 10 x 10^{-5} M

2.4. Preparation of membrane phase

Chloroform as membrane phase in the form of 30 mL pipette.

2.5. Preparation of the receiving phase

Ion solution of $Cu(NO_3)_2$ and $FeCl_3$ concentration of 10^{-2} M prepared by dissolving 0.2416 g of $Cu(NO_3)_2.3H_2O$ and 0.2703 g $FeCl_3.6H_2O$ in 100 mL volumetric flask and diluted with distilled water until the properboundary to obtain stemconcentration. 10^{-2} M.Then, 0.5 ml solution pipette diluted with doubly distilled water in a 50 mL volumetric flask obtain the stock solution of $Cu(NO_3)_2$ and $FeCl_3$into concentration of 10^{-4} M. The $Cu(NO_3)_2$ and $FeCl_3$ 10^{-4} M diluted back with a variation of a concentration of 1 x 10^{-5} M, 3 x 10^{-5} M, 5 x 10^{-5} M, 7 x 10^{-5}M, and 9 x 10^{-5}M in the volumetric flask 25 mL.

2.6. Procedures

2.6.1. Determination transport of aniline by bulk liquid membrane

Transport processes carried out such an experiment safavi. Cylindrical tube (surface area 3.14 cm^2) put in a 100 mL glass cup (surface area 7.07 cm^2) perpendicularly, then inserted magnetic stirrer into a cylindrical tube. Beaker put 30 mL of chloroform, 6 mL of solution-phase source, ie, a solution of aniline with particular concentration in the cylinder and outside cylinder 12 mL of the recipient phase, ie 12 ml of $Cu(NO_3)_2$ and 12 mL $FeCl_3$.

Mechanical operation performed by using a magnetic stirrer at a speed of 180 rpm for 1 hour. After 1 hour strring, and left for left 15 minutes, then the source and receiv phases are taken to determine the concentration of aniline in source phase and receiv phase by measuring at maximum absorption.

2.6.2. Determination of the concentration of aniline with UV-Vis spectrophotometer

Aniline in sources phase and transports after each concentration determined using UV-Vis spectrophotometer. A calibration curve created from absorbance measurements of aniline concentration as a standard solution with a variation of 2 x 10^{-5}M; 4 x 10^{-5} M; 6 x 10^{-5} M; 8 x 10^{-5}M; 10 x 10^{-5} M at maximum wavelength of aniline. After that, the absorbance of samples obtained either in phase source and receiv phase compared with the absorbance of standard solutions used in order to obtain the concentration of aniline.

2.6.3. The determination of the optimum conditions of aniline transport

pH variation on the source phase

The experiments were performed similarly to 2.6.2. to phase pH variation varied sources, namely 5, 6, 7, 8, and 9.

Selection of the receiving phase

The experiments were performed similarly to 2.6.2. and receiving phase are of $Cu(NO_3)_2$ and $FeCl_3$ solutions in variation source.phase pH.

Variations in the concentration of phase sources

The experiments were performed similarly to 2.6.2. to phase concentration variations source (aniline) will the variation 2 x 10^{-5} M; 4 x 10^{-5}M; 6 x 10^{-5}M; 8 x 10^{-5}M; 10 x 10^{-5}M. Phase sources are used with optimum pH conditions of Experiment 2.6.3.1 and the type of receiver phase of Experiments 2.6.3.1 and 2.6.3.2.

Variations in the concentration of the receiving phase

The experiments were performed similarly to 2.6.2. by varying concentrations receiving phase 1 x 10^{-5}M; 3 x 10^{-5}M; 5 x 10^{-5}M; 7 x 10^{-5}M; and 9 x 10^{-5}M. In this experiment used the optimum conditions at source phase optimum pH,, the type good receiving phase, and the concentration of resources optimum phase.

Variations stirring time

The experiments were performed similarly to 2.6.2. variation stirring time 15 minutes, 30 minutes, 45 minutes, 60 minutes, 90 minutes, and 120 minutes. In the experiment used the as optimum conditions of pH in sourcephase, the type of receiver phase, phase concentration of resources and the concentration of the receiving phase.

3. Results and Discussion

3.1. Concentration measurement of aniline

Aniline solution absorbance measurement after transport in the phase source solution and receiving phase is done by using UV-Vis spectrophotometer at a wavelength of 230 nm.

3.2. Determination of optimum conditions transport aniline varying kind of receiving phase

Aniline is an amine derivative compound which has a cluster of NH_3 which is a neutral ligand [8], so that the receiving phase greatly affect the type of aniline transport membrane phase to the phase of the receiver. Aniline complex with a strong receiver phase capable of attracting aniline of membrane phase, so that the aniline in membrane phase to receiving maximum transported. The $FeCl_3$ recipient is stronger attracted to aniline compared with the $Cu(NO_3)_2$ as shown in Table. 1.

Table 1: Determination of transport aniline with variations in the type of receiving phase.

Kind of Receiving phase [M]	Percentages of Aniline(%)	
	P. Source	P. Receiving
$Cu(NO_3)_2$ $FeCl_3$	16.01	5.68
	13.25	22.13

3.3. Determination of optimum conditions transport aniline with pH variation in source phase

pH source phase is one of the conditions of that effect the transport of aniline from aqueous solution to the membrane phase, because the source phase pH affect the shape of aniline in sources phase. The source phase pH greater than the pKa of the aniline, the aniline in the form of molecular neutral, whereas if it is smaller than a pKa of the aniline, the aniline in the form of anilinium, where the value of pK a 4.63 aniline in the literature [4]. Aniline can be transported to the membrane phase in the form of neutral molecules [9], so that the source phase pH greatly affects the transport of anilinefrom an aqueous solution to an organic solution of chloroform.

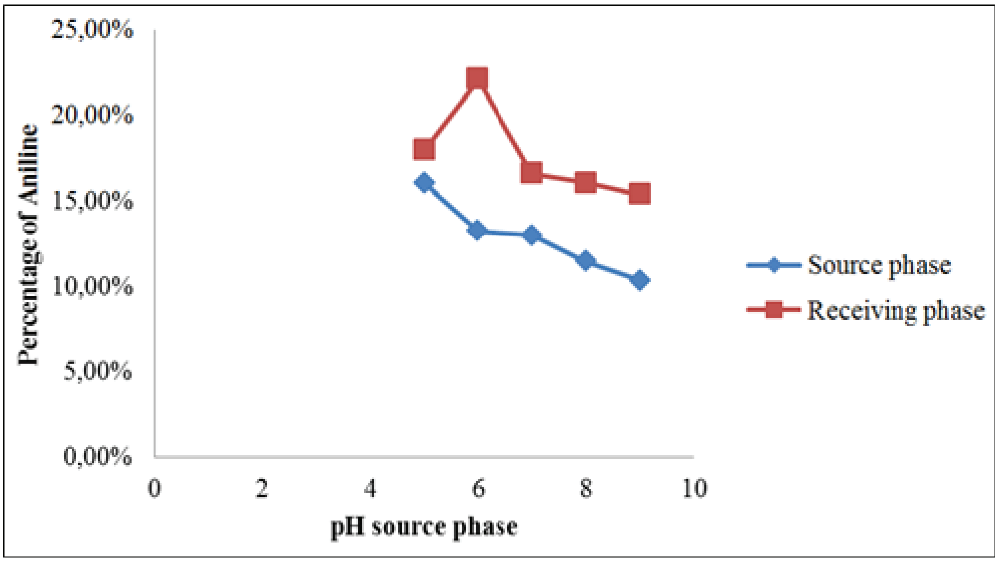

Figure 1: Effect of pH aniline in sources phase to transport of the aniline to the receiving phase.

Fig. 1 shows the increasing of aniline transport at pH 6, because aniline at pH 6 is neutralmolecule anddiffusion of aniline from the source to the membrane phase was increased, therefore the pH of 6 is the optimum pH in the sources phase [4].

3.4. Determination of optimum conditions transport aniline with concentration variation of phase source

Fig. 2 shows the percent reduction in transport aniline source and receiving phase with increasing concentration of aniline in phase sources. This indicates that chloroform as a membrane capable of extracting the aniline of resources to the maximum phase, so that the aniline remaining in the phase of diminishing resources towards zero [5]. However, the amount of aniline were transported to the receiving phase of diminishing with increasing concentration of aniline in source phase, it indicates the saturated $FeCl_3$ recipient phase experiencing burnout and therefore can not attracted the aniline molecules transported to the membrane. The optimum concentration phase source is 4 x 10^{-5} M.

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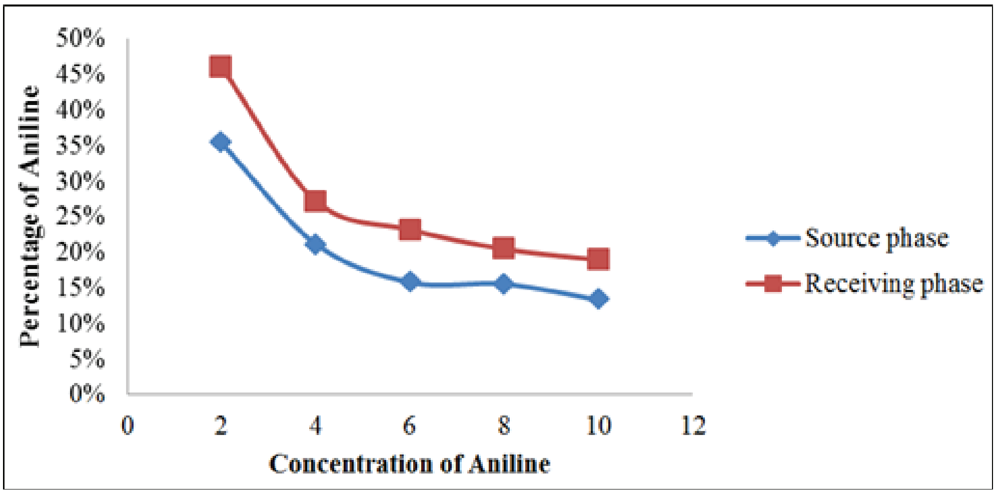

Figure 2: The influence of the concentration of aniline in the transport phase to the percentage of aniline source to the receiver phase.

3.5. Determination of optimum conditions transport of aniline varying concentrations phase receiving

Percent of aniline were transported to the receiving phase is determined by the amount or concentration of the receiving phase.

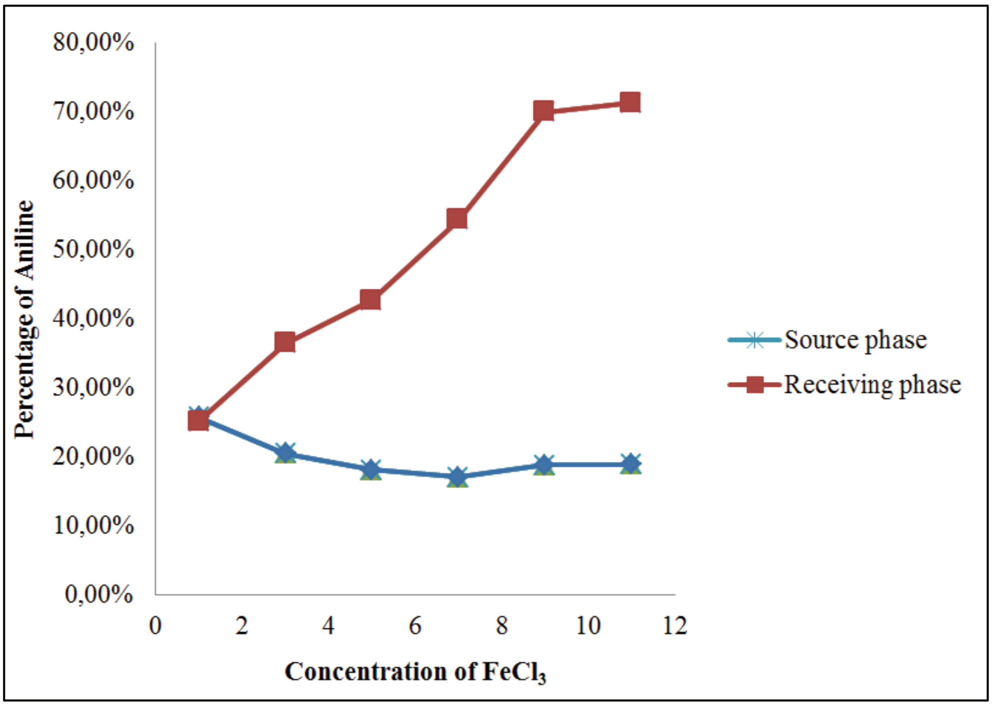

Figure 3: The influence of the $FeCl_3$ concentration in the receiving phase on the aniline transport phase to the receiving phase.

Concentration of $FeCl_3$ 9 x 10^{-5} M, aniline were transported to the receiving phase the remaining 70.22% and 18.82% in phase source, as shown in Fig. 3. Whereas the concentration of 11 x 10^{-5} M aniline were transported to the receiving phase is 71.35%, this proves that the addition of $FeCl_3$ concentration in the receiving phase had no effect on complex formation. So the optimum concentration of $FeCl_3$ in the receiving phase to determine the next aniline transport parameters is expected to be 9 x 10^{-5} M.

3.6. Determination of optimum conditions transport stirring time-varying aniline

Aniline transport in the bulk phase liquid membrane diffusion takes place [9], therefore the stirring affects the amount of aniline were transported to the recipient phase. As shown in Fig. 4, aniline transport in 90 minutes is the optimum, where the percentage of aniline in the receiving phase us 90.17%. This proves that $FeCl_3$ able to attract aniline in perfect than the membrane phase with acid (HCl) which forms a salt with aniline [5].

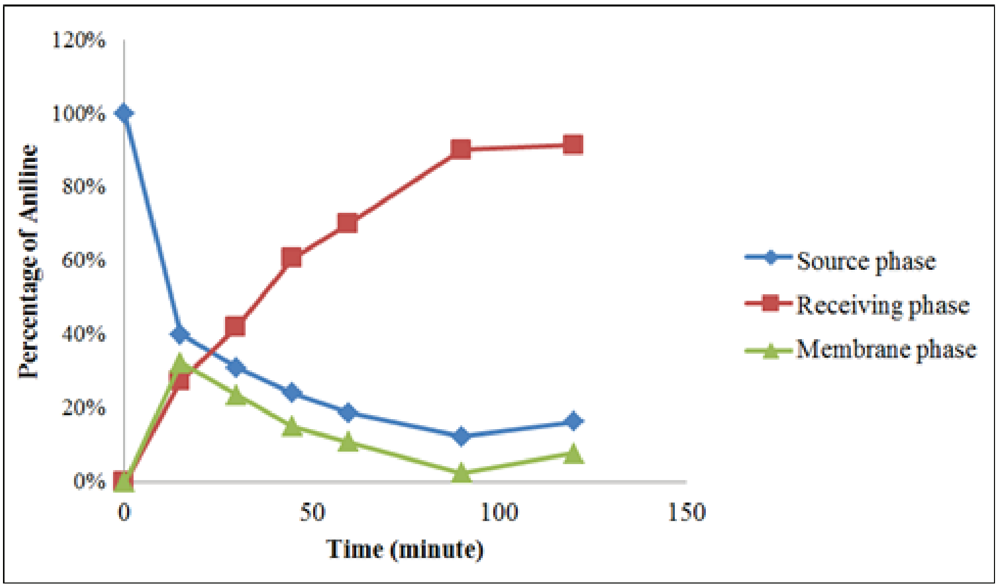

Figure 4: Effect of stirring time on the percentage of the aniline transport.

3.7. Fourier transform infrared (FTIR)

FTIR results showed absorption at wave number 1800-1500 cm^{-1} showing the functional group NH bending, absorption at the wave length 1200-1000 cm^{-1} shows the C-N group, and at wave number 750 - 600 cm^{-1} indicates the NHgroup which this cluster group showed aniline compounds ofsources phase as shown in Fig. 5. This proves that aniline is transported to the receiving phase $FeCl_3$.

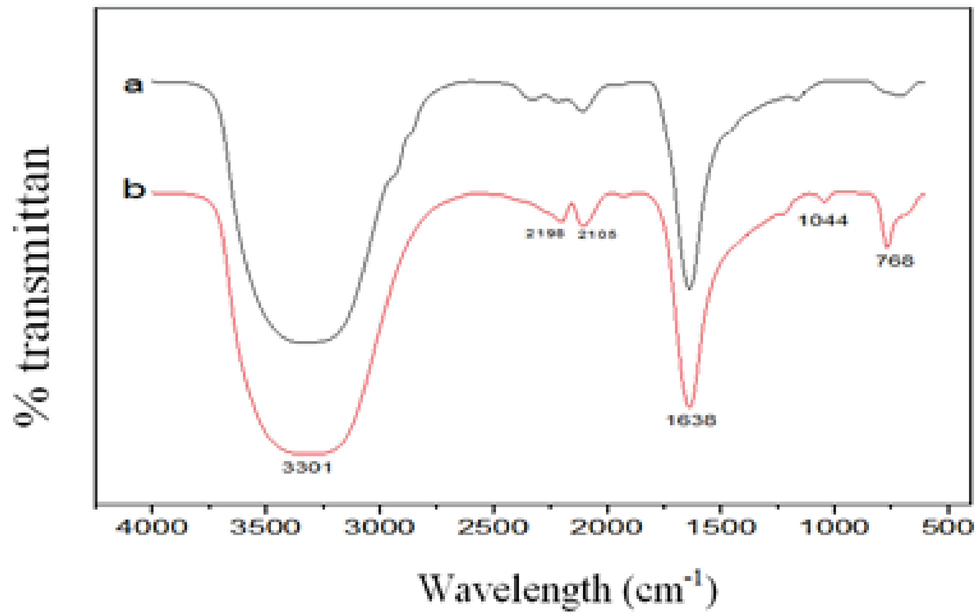

Figure 5: The FTIR spectra of the receiving phase (a) before, (b) after transport.

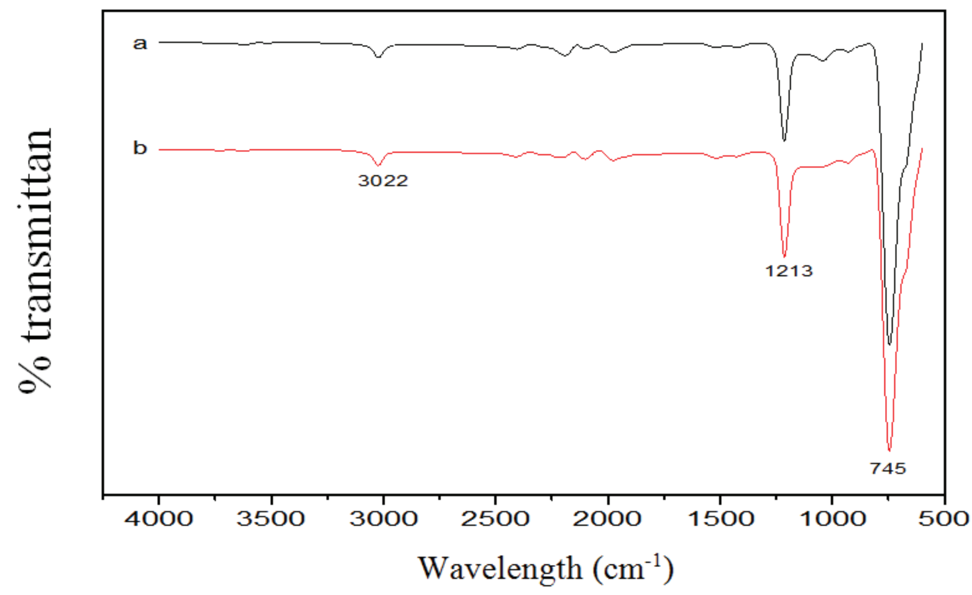

Figure 6: The FTIR spectra of the membrane phase (a) before, (b) after transport.

FTIR results in Fig. 6 showed a sharp absorption at wave lenght 600-900 cm^{-1}, which shows the strong absorption of C-Cl functional groups, and the emergence of absorption at the wave lenght 3100-3000 cm^{-1} shows the CH the functional groups, which groups show the compound of chloroform in the membrane phase [9]. After transport also indicates the absence of aniline in membrane phase, it is proved that the $FeCl_3$phasehas strong attraction to aniline in membrane phase.

4. Conclusions

From the research can be concluded that aniline can be recovered by using a bulk phase liquid membrane (Bulk Liquid Membrane). Aniline were able to be transported by 90.17%. The optimum conditions of transport is at source phase concentration 4 x 10-5 M at pH 6, the type of $FeCl_3$phase solution with a concentration of 9 x 10-5 M, the stirring speed of 180 rpm, stirring time of 90 minutes, and equilibrium time 15 minutes. FTIR characterization indicate that the recipient phase $FeCl_3$ able to attract aniline of membrane phase, which is evident from N-H and C-N absorbtion peaks after transport.

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