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Performance of Activated Carbon Adsorption and Ultrafiltration Membrane Hybrid Process for Leachate Treatment

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ABSTRACT

Leachate is wastewater that contains pollutants dominated by organic matter. Conventional leachate treatments have some disadvantages therefore alternative treatments are needed. One of that alternative treatments is ultrafiltration membrane and adsorption as pretreatment. The aims of this study are to analyze adsorption isotherm and kinetic model for UV_{254} (UV adsorbance at 254 nm wavelength) adsorption, the performance of powdered activated carbon (PAC) adsorption and ultrafiltration membrane hybrid process for UV_{254} of leachate removal, and the effect of pretreatment towards membrane fouling. The result of this study are Freundlich isotherm and pseudo second order kinetic model best fitted model for ultrafiltration membrane hybrid process condition for UV254 removal level are at pH 6; 120 minutes contact time; and 4 g/L PAC doses. Adsorption as pretreatment can reduce membrane ultrafiltration fouling.

Keywords: Adsorption, Leachate, Powered Activated Carbon (PAC), Ultrafiltration, UV_{254}

1. Introduction

Leachate is the water of the rain and the surface of the seep of garbage produce who seepage with the very high polluter, one of them is organic matter. So that was required processing of the leachate in order to avoid dangerous for the environment. Some leachate management which has been applied in Indonesia has several weaknesses. So it takes alternative technology to cultivate the leachate, one of these was membrane ultrafiltration.

Membrane ultrafiltration may be able to send down parameter like substance organic and cloudiness, as the concentration of a compound entering the showcase event qualifying organic in water peat moss in order (Mahmud, 2002; Notodarmojo and Anne, 2004). Ultrafiltration (UF) is the process of separation by membrane porous measuring between 2 nm - 100 nm use pressure as a force of thrust (Mulder, 1996; Susanto and Roihatin, 2001). Technology membrane can operate on low temperatures, frugal energy, and cannot make the negative impact on the environment (Syarfi and Khairat, 2013).

Although having an excess, membrane also have weaknesses as a tendency a decline in flux respect to the operation of time due to the deposition or sticking material in the membrane surfaces, known as fouling and scaling. To overcome the weakness, it was needed to manage the pretreatment process. It was for reduce the membrane, increase flux, and extend the membrane surgery time. One of process that can be used is adsorption.

Adsorption with carbon active widely used to lower materials organic, ammonia, and materials toxic in water treatment container garbage (Xing, 2007). Because of its surface which is broad, a

structure that *Microporous* and powdered activated carbon (PAC) is one of the methods most attractive in lowering the womb materials that is hard to degradation on the leachate.

This study aims to analyze isotherm and kinetics adsorption corresponding to adsorption UV_{254} on leachate to KAB, the performance of the adsorption process and membrane UF in processing leachate, and influence the pretreatment adsorption to fouling process membrane of UF. In addition, it is also expected to usage method of leachate management by adsorption carbon active and membrane UF surveyed in this research program could be one of an alternative form solve the problems that had occurred leachate management and quality of some products.

2. Research Methods

Making membrane in this research used inversion phase method, material that used were acetone, cellulose acetate, formamide, and aquades. Membrane has formed then printed according to the forms of instrument UF membrane and conducted characterization by permealibilitas test and SEM test (Scanning Electron Mycroscopy) to know about morphology.

The pretreatment of adsorption used leachate that was taken in a pool of leachate at TPA Cahaya Kencana and KAB. Leachate with variations pH 200 ml and dosage of KAB with the variation of certain, will be put in Erlenmeyer and will beaten use rotary a shaker with varied time.

The next step was experiment with the process of UF membrane in leachate that processing of a method adsorption formerly with the variation of a dose KAB on pretreatment adsorption. The equipment used in this research was a tube pressure, team membrane, an errant hose, etc

GENESYS™ 10S UV-Vis *Spectrophotometer* used to measure UV_{254} in samples of leachate, the result of the first sample; a sample after pretreatment adsorption; and sample after UF membrane.

3. Results And Discussion

The manufacture and characterization membrane

Making membrane in this research using inversion of the phase method. The flux membrane will be bigger while increasing the pressure exerted on the UF membrane. The permeability resulting from the process of characterization was 124,2 L/m^2.jam.bar. Whenever referring to the literature which unites that UF membrane permeability to be around 0,5 m3/m2.hari.bar (200 L/m2.jam.bar) (Wenten, 1999; Fachrozi, 2013).

Processing Leachate TPA Cahaya Kencana By Adsorption Carbon Active as Pretreatment

The effects of pH

On this experiment study, the process of adsorption with the variation of pH, carried out over a range of variation pH of the acid until a base 2, 4, 6, 8, 10, and 12, with 3 times repetition each pH .

The effect of time contact

Based on the previous research, by Salim (1992) the research of TOC and COD had decrease on leachate using activated carbon (PAC) adsorption, got the equilibrium time at 180 minutes, however, it is important to remember that adsorbent and a water sample have different time equilibrium.

The influence of carbon active doses

A number of carbon active with variation doses of 2 g/L; 4 g/L; 6 g/L; 8 g/L; 10 g/L; and 12 g/L will be added into leachate in conditions of pH and contact steady time.

Along with the increase of KAB doses and so the allowance percentage UV_{254} was more bigger. Because of the difference of percentage an allowance after doses 4 g/L is not too large, so that was chosen doses 4 g/L as steady doses on this research for the efficiency of using adsorbent. The results from Shabiimam (2012) where adsorption TOC on the leachate got 5 g/L steady doses carbon active.

Isotherm adsorption

In this research will be used two models of isotherm that commonly used, there are isotherm Langmuir and isotherm Freundlich, and also to be added another model isotherm, isotherm Temkin. The value of determination coefficients for isotherm Freundlich model was the largest.

Kinetics adsorption

Kinetics adsorption describe the rate of adsorbate mass transfer surfacing adsorbent along with increase the time contact, the time is one of parameter could be describe the efficiency of adsorption process. Kinetics model adsorption used in this research was pseudo first order and pseudo second order.

The Leachate Process TPA Cahaya Kencana with Ultrafiltasi Membrane after Adsopsi Process Treatment

The Influence of Carbon Active Doses in Pre-treatment Adsorption to Permeability UF Membrane

The UF membrane process will be conducted variation of pre-treatment doses to the adsorbent process. The previous adsorption process have obtained the best condition of adsorbent doses 4 g/L, so to the UF adsorbent membrane process being varied of doses 1 g/L; 2 g/L; 3 g/L; to 4 g/L.

According to Fachrozi (2013) in his research, if the flux levels of education show decreasing, which is the event was expected to be fouling that occurs will rise up significantly. The UF Membrane was passed on to a curling pass leachate garbage without having treatment being handed out fouling the greatest of them all. While UF membrane was passed with the variation of a dose carbon active that was given to them. Hence it can be said that the process of pre-treatment adsorption can reduce the possibility of the formation of fouling on UF membrane.

The Effect of Carbon Active Doses to the Adsorption Pre-Treatment Permselektivitas Membrane Ultrafiltrate

The qualifying of UV_{254} was used adsorption pre-treatment that produce better allowance percentage, however the qualifying of percentage became higher with the UF membrane combination process.

4. Conclusions

Isotherm and kinetics adsorption model suitable with UV_{254} KAB was a isotherm Freundlich model and kinetics pseudo-second order, where as the rate of reaction adsorption dominated by chemically adsorption. The combination process of pre-treatment adsorption with UF membrane are able to aside UV_{254} of 93,91%. The best conditions operating process to the combination pre-treatment process adsorption and UF membrane was pH 6, contact time 120 minutes, and 4 g/L dosage of KAB. The pre-treatment adsorption process can reduce the fouling UF membrane, 1- 4 g/L KAB, the greater KAB dose the smaller establishment the potential of the fouling on the membrane.

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