일반강연 B-4

활성슬러지 여과시 여러 가지 인자들이 투과유속 감소에 미치는 영향

배태현, 한성수, 박형규, 탁태문
서울대학교 생물자원공학부

Influence of various components on flux decline during activated sludge filtration.

Tae-Hyun Bae, Sung-Soo Han, Hyung-Kyu Park and Tae-Moon Tak
School of biological resources & materials engineering,
Seoul National University

1. Introduction

A membrane bioreactor (MBR) has been widely used as an advanced treatment system and its advantages have been illustrated by several researchers. However, the development of MBR has been limited by membrane fouling, which decreases permeate flux during filtration of activated sludge. Membrane fouling is a result of the interaction between membrane and various constituents of activated sludge mixed liquor. Since activated sludge is a living microorganism, interpretation of fouling mechanism are more difficult than that of conventional membrane separation process.

A number of studies about fouling mechanism in crossflow MBR system have been reported. Recently, several studies have quantified the fouling caused by each fraction of the sludge, i.e. suspended solid, colloids, and soluble fraction. But there are large differences among the results. So further studies are needed in order to elucidate the flux decline mechanism.

The aim of the study was to quantify the fouling contributions of each activated sludge fraction at various condition.

2. Experimental

Membranes used in this study were prepared using phase inversion methods. Membrane material was cellulose acetate (CA) and solvent was n-methyl-2-pyrrolidone (NMP), and aceton was used as cosolvent. In order to acquire various membranes which having different pore size, polymer concentration, cosolvent/solvent ratio were adjusted. The casting solution was kept at room temperature for 24 hour and then cast on a polyester nonwoven fabric with a doctor knife having 200㎛ thickness. The nascent membrane was evaporated at 25±1℃, 65±5% relative humidity for 30s and then immersed in a 18±1℃ deionized water coagulation bath.

Membrane performance and flux decline behavior was measured using filtration cells which having 18.1cm^2 of membrane surface area. Transmembrane pressure and flow rate were 100Kpa and 2.5L/min, respectively. Pore sizes were measured by solute passage methods using 1,000mg/L polyethylene glycol (PEG) aqueous solution.

Activated sludge used in this study was cultivated in submersed type MBR plant and synthetic wastewater was used as substrate. To quantify the influence of the different fractions of sludge, two fractions were separated from a sludge sample. Colloid and soluble fraction were separated from a sludge sample after removing of settlable solids by 3 hours of sedimentation. And soluble fraction was obtained by flocculation and filtration method, i.e. after the sedimentation, supernatant was flocculated with $FeCl_3$ at 400mg/l and filtered using 0.45㎛ membrane filter.

'Resistance in series model' was used in order to quantify the amount of flux decline.

3. Result and discussion

Various CA membranes which have different pore size was prepared by phase inversion method. Flux was reached almost constant level after 5 hours of activated sludge filtration. Cake layer formed more severely in case of large pore membrane due to the higher permeation drag.

Settlable solids have the largest effect on flux decline of CA membranes. Influence of colloid and soluble fraction on fouling was not significant in case of small pore size. But its influence increased with membrane pore size. Especially, colloid resistance to sludge resistance ratio (R_{coll}/R_{sludge}) was increased with pore size.

4. References

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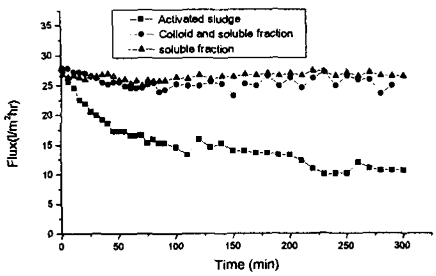
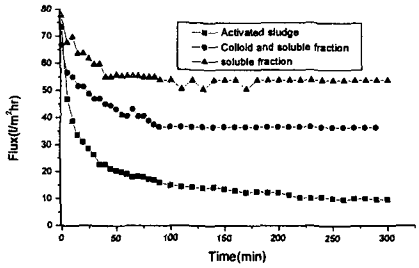


(a)



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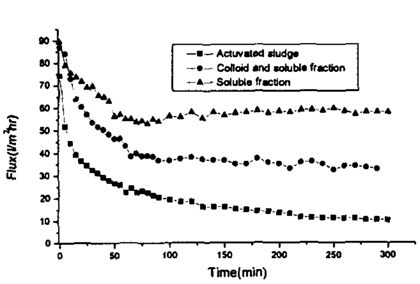

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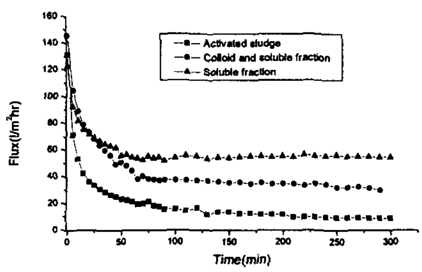

(d)

Figure. Influence of each component of activated sludge on flux decline of various CA membranes:
(a) CA-1, (b) CA-2, (c) CA-3, and (d) CA-4.