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Effect of fouling reduction by ozone backwashing in a microfiltration system with advanced new membrane material

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Abstract

The effect of ozone back washing for membrane fouling reduction was experimentally investigated in a submerged metal membrane microfiltration system. A cleaning by intermittent ozone gas backwashing was effective in recovering the permeation flux. Intermittent ozone backwashing was highly effective than the air or permeates backwashing for flux recovery. Regarding the operational parameters, the increase of ozone gas flow rate was more effective than the increase of injection time under the conditions of same ozone dose. However, the backwashing cycle was longer, the effect of flux recovery by ozone backwashing decreased. Therefore, it is favorable to operate membrane cleaning before the foulant was consolidated on membrane surface.

Keywords: Submerged microfiltration; Fouling; Ozone backwashing; Gas flow rate; Injection time

1. Introduction

For several years now, pressure-driven membrane processes such as microfiltration and ultrafiltration are predominantly applied in drinking water and process water production [1] as well as in the treatment of industrial wastewater [2]. Compared to conventional separation processes, the most significant advantage of these processes, besides the reliable separation of suspended and colloidal organic and inorganic substances, is the retention of pathogenic bacteria and every type of microorganism to a great extent.

However, one of the major disadvantages of these membrane processes is fouling of the membrane induced by deposits of inorganic,

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organic and microbiological substances of both the membrane surface and inside the membrane pores. Membrane fouling is characterized in general as a reduction of permeate flux through the membrane, as a result of increased flow resistance due to pore blocking, concentration polarization and cake formation [3]. Fouling often associated with accumulation of substances on the membrane surface or within the membrane pore structure worsens membrane filtration performance and ultimately shortens membrane life. To maintain the economic viability of a membrane process, membrane fouling has to be kept to a minimum.

For the improvement of membrane permeability, many remedial actions have been tried such as increasing fluid velocity, backwashing with air, permeates or chemicals, multiphase flowing, controlling the membrane surface charge and the injection of nitrogen gas or polymeric particles [4,5]. Usually fouling may be improved by membrane cleaning; however, some irreversible fouling may also occur and the membrane replacement takes time. Therefore, it is necessary to develop some progressive membrane fouling reduction techniques that can overcome these problems. It is reported that intermittent ozonation is effective in preventing membrane fouling caused by particle accumulation on the membrane surface [6]. In addition, ceramic membranes, which are ozone-resistant, in combination with ozonation achieved a high permeate flux without membrane damage [7,8]. Relatively, few studies using ozone have been conducted for the enhancement of permeation flux in the membrane process.

As a method for membrane fouling reduction, we applied the intermittent backwashing using ozone gas in microfiltration system with metal membrane. The purpose of this research is to investigate the effect of ozone backwashing for permeation flux recovery.

2. Materials and methods

Metal membrane microfiltration system, as shown in Fig. 1(a), was used for filtration experiments. Metal membrane supplied by Fibertech Co., Ltd, Korea, was used in this study. Nominal pore size of metal membrane used in filtration is 1 μm. It has an effective filtration area of 97 cm^2 and a diameter of 1.4 cm and a length of 22 cm.

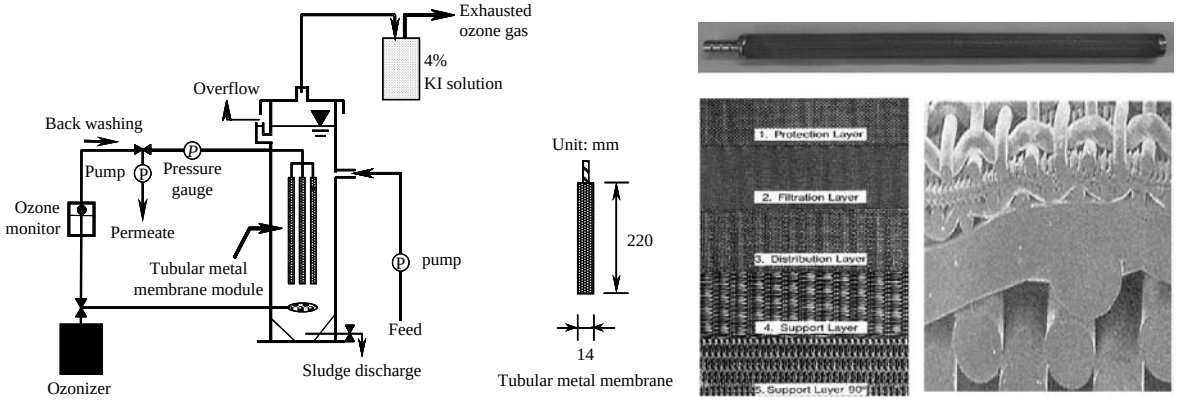

Fig. 1. Schematic diagram of metal membrane microfiltration system (a) and an outward and a cross-section of metal membrane.