Isolation of filamentous fungi *Penicillium simplicissimum* for improved sludge filterability and dewaterability

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1. Introduction

A huge quantity of sewage sludge produced from the wastewater treatment plants (WWTPs) has attracted wide concerns as large volumes and high water content of excess sludge (Mowla et al., 2013; He et al., 2015). In China, for example, production of 80% moisture content sewage sludge is estimated to close to about 3.50×10^7 tons per year (Liu et al., 2012). Usually, thickened sludge is conditioned through physical disruption and chemical addition (e.g., acid, ferric chloride, and lime), followed by mechanical dewatering techniques (e.g., press filters and centrifuges). However, high cost, complicated operation and hazardous reagents significantly limit these traditional conditioning methods. Therefore, environmental-friendly methods for the dewatering of sludge have been main focus of many researchers. Isolated filamentous fungi entraps on the solids particles from sludge and compresses the sludge with its filamentous (hyphae) mycelia that modify the porosity structure of biosolids and enhance the dewaterability and filterability of the fungal treated sludge (Alam and Fakhru'l-Razi, 2003). In this study, filamentous fungi capable of enhancing sludge dewaterability were isolated from sewage sludge and the related mechanisms responsible for the sludge dewaterability enhancement were investigated.

2. Materials and methods

2.1. Municipal sewage sludge sample

The municipal sewage sludge used in this study was obtained from the sludge thickening-pond of the Taihu New City Wastewater Treatment Plant in Wuxi City, Jiangsu Province, China. Prior to usage, sludge was stored in polypropylene bottles at 4 °C. The characteristics of municipal sewage sludge are listed in Table 1.

Table 1 Characteristic of municipal sewage sludge.

Indicator	Moisture content (%)	pH	SRF (m/kg)	CST (s)	VS (%)
Value	97.20	7.16	1.97×10^{13}	20.50	51.70

2.2. Microorganisms and the preparation of inoculums

The strain *Penicillium simplicissimum* NAU12 (CGMCC No. 10990) isolated from sewage sludge (collected from Taihu New City Wastewater Treatment Plant in Wuxi City, Jiangsu Province, China), using potato dextrose agar (PDA) medium by serial dilution techniques.

2.3. Changes of sludge properties during the fungal treatment of sludge

The selected fungus *P. simplicissimum* NAU12 obtained from the sewage sludge was cultured in Czapek-dox medium for further study. Four sets of experiments were performed, to achieve the optimal factors influencing sludge dewaterability for the fungal mediated process. During the incubation, 100 mL sludge samples were collected from each flask at 0, 1, 2, 3, 4, 6, 8, and 10 d and then determined for sludge SRF and CST.

3. Results and discussion

3.1. Isolation and identification of filamentous fungi

A filamentous fungal strain with the ability of enhancing sludge dewaterability was isolated from waste activated sludge. This identification was based on fungal-colony morphology on PDA (Figure 1a). Neighbor-joining tree depicting the phylogenetic relationship of the isolated strain with related species based on the 18S rRNA gene sequence is shown in Figure 1b.

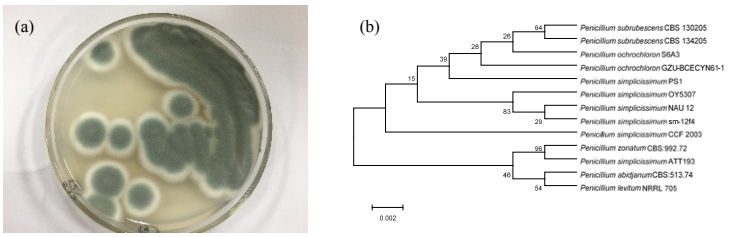

Fig. 1. (a) Colony morphology of fungal strain grown on potato dextrose agar (PDA) plates after 5 days; (b) Phylogenetic tree of *P. simplicissimum* NAU12 and related strains based on ITS sequence.

3.2. Effects of *P. simplicissimum* NAU12 on sludge dewaterability

The changes of SRF and CST of sludge treated with *P. simplicissimum* NAU12 at the inoculum size of 5%, 10% and 20% were shown in Fig. 2a and b. It can be seen that the SRF and CST values of sludge decreased obviously in the first 3 days, and then the sludge SRF and CST values increased slightly. These findings are consistent with previous studies in that the sludge dewaterability in the aerobic digestion system was firstly improved and then deteriorated (Wang et al., 2015).

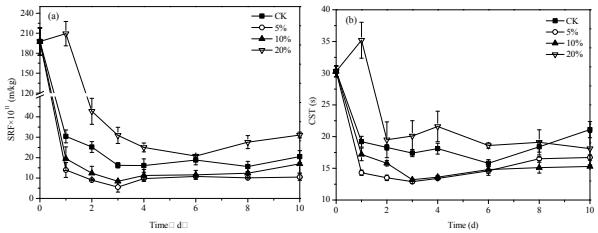

Fig. 2. Changes of sludge SRF (a) and CST (b) during the fungal treatment of sludge using *P. simplicissimum* NAU12 at the inoculum size of 5%, 10%, or 20%.

4. Conclusions

The filamentous fungus *P. simplicissimum* NAU12 capable of enhancing sludge dewaterability was isolated from waste activated sludge for the fungal treatment of sludge. But the economic viability of large-scale cultivation needs to be evaluated.

5. Reference

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