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ORIGINAL RESEARCH PAPER

Domestic sewage improvement Purification under long sewer line situation in a lab system by Aspergillus Niger bio augmentation

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A B S T R A C T

The Aspergillus Niger bio augmentation influence on COD and protein disposal in domestic effluent under wastewater requirements have been considered. The sewage simulation bioreactor has been operating at a hydraulic retention time of 17-hour, 20°C, and PH 7.8 beneath aerobic circumstances. While A. Niger has been bio augmented, forty-five percent to seventy-two percent of COD has been released in comparison with twenty-eight percent to forty-eight percent disposal of COD in the controlling in the identical time. Whole protein disposal of sixty-six percent co while A. Niger has been bio-augmented in comparison by 29.7 percent in the controlling. Concerning enzymatic actions, we have attended which since the bio augmented strategy biomass attention has been more than the controlling the enzymatic actions have been high. This investigation is a primary study on swage transfer underneath transient situations by A. Niger and displayed the capability of A. Niger for removing both COD and protein underneath real situations. A. Niger bio augmentation underneath sewage situations can be an alternative for wastewater therapy by a valorization of fungal waste biomass.

Introduction

Today, the treatment of wastewater needs considerable budgets and this is regarded to strengthen in the future. In growing countries, water source contamination would attain an essential level if substitute procedures aren't evolved and adjusted to a real strategy in treating of wastewater. Treatment of wastewater in swage line by bio augmentation with well-selected microorganisms or the swage development biofilm can be substituted procedures for preventing this issue (Koch and Zandi, 1973; Green et al., 1985; Hvitved-Jacobsen et al., 1998; Warith et al., 1998; Coulibaly et al., 2002; Coulibaly and Agathos, 2003). Green et al. (1985) have presented bio augmentation of indigenous bacteria, whereas it hasn't been accomplished and developed. The reason for this interest deficiency can be the increased attention to needed blended liquor. Aspergillus and Trichoderma have been extensively utilized in industries for producing enzymes. These fermentation's remaining biomasses are usually reserved in the dump.

In other ways, Aspergillus active fungal biomass has an appropriate possibility in contaminant decay (Coulibaly et al., 2003). We have utilized A. niger through the transitory situation for degrading starch as a model polysaccharide layer and a mix of this layer and bovine serum albumin (Coulibaly et al., 2002; Coulibaly and Agathos, 2003). The fungus has been able of converting biopolymers to easily degradable layers by coincidental enzyme secretion in its growth medium.

this study proposes are assessing the capability of A. Niger in pulling chemical oxygen demand and proteins in natural wastewater through long sewage line situation at a hydraulic retention time of seventeen hours (Ozer and Kasirga, 1995). The other purpose of this study is investigating the

valorization in wastewater treatment field of waste biomass of A. niger and also verifying the secretion of extracellular enzymes. The strain A. niger has been selected after the screening some strains of Trichoderma and Aspergillus for the capability for excreting hydrolases whenever rising in domestic wastewater. The fungal biomass has been simply constructed in the lab and a sewage simulation bioreactor has been developed for performing the biodegradation examination.

Methodologies

Microorganisms and culturing situations

Aspergillus niger. MUCL 28817 has been gained from the fungal collection of the Catholic University of Louvain (MUCL). The fungus has been cultivated on tryptic soy agar (TSA) from Difco labs (Detroit, Mich., USA) in 260 ml flat bottle (Nunc, Roskilde, Denmark) including 40 ml of TSA at 28°C for seven days previous for using in the reactor system. A. niger has been pre-cultured in the medium defined by Garcia et al. (1997) including 40 g l^{-1} glucose, 5 g l^{-1} meal peptone and 5 g l^{-1} casein peptone. 2 milliliters of fungal spores gathered from 2 bottles of TSA with 20 ml of pre-culture medium including 0.1percent Tween eighty have been immunized in a 250 ml baffled flask including 100 ml of pre-culture medium. The fungus has been grown for three days at 20°C on a rotary shaker at 150 rpm. After three days, the biomass has been re-covered by vacancy filtration through sterile situations on a Whatman N°4 filter paper. The biomass has been suspended and washed in sterile water.

The filtration and washing phases have been repeated 3 times. After the third filtration, the recovered fungal biomass has been suspended in a 250 ml flask including 100 ml of sterile water. The biomass has been homogenized for five minutes by a tissue homogenizer (Ultra-Turrax, Stanfen, Germany). 50 ml aliquot has been cleaned and recovered as mentioned before and the biomass has been utilized for inoculating the reactor.

The reactor system

The swage simulation system utilized in this study had been formerly represented in Coulibaly et al. (2002). It has been comprised of 5 mixed tanks in series. The system contained a membrane pump (Prominent, CfG, Heidelberg, Germany), that fed the first reactor, and 4 peristaltic pumps (Gilson, Manupilus 2, Namur, Belgium) connecting every reactor to its neighboring unit. Magnetic stirrers (Ika-Combimag RCO, Namur, Belgium) have concerned the reactors and the feeding reservoir. The reactor system has been worked at a general hydraulic residence time (HRT) of fourteen hours that is located in long seage lines (Özer and Kasirga, 1995).

Reactor inoculation and sampling

The reactor system has been immunized and sampled in the identical method as demonstrated in the prior study (Coulibaly et al., 2002). It has been loaded by 500 ml of raw wastewater. The first reactor has been then immunized by biomass organized as demonstrated. The sampling duration specification has been characterized in a study (Coulibaly et al., 2002).

Wastewater

Wastewater has been derived from a Louvain-la-Neuve collector. The natural wastewater has been filtered in site on a 500 µm sieve and derived for feeding the SEWAP. Around 30 liters have been maintained at 4°C no more than a week for the controlling, for avoid changing in wastewater features.

Analyses

Fungal biomass has been specified with dry cell weight (oven drying at 105°C for one day) and COD has been specified with the dichromate approach NBN-T 91-201. Proteins have been specified by multiplying the organic nitrogen portion by 6.25 (Sridhar and Pillai, 1973). The organic nitrogen portion has been specified with the varience amonge the whole nitrogen (Kjeldahl method, NBN-T 91-255) and ammonium (NBNT- 91 255). The API ZYM kit from bioMerieux (Marcy-l'Etoile, France) has chosen enzymatic profiles and the manufacturer's instructions have been observed completely. The API ZYM kit is a standardized semi-quantitative micro technique can discover nineteen various kinds of enzymes. It has been utilized for screening enzyme profiles in the environmental investigation (McKellar, 1986; Boczar et al., 1992; Morgan and Pickup, 1993; Cicek et al., 1998).

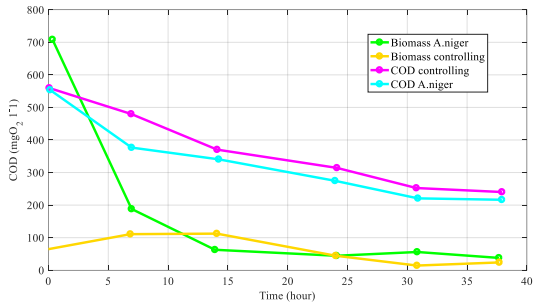
Discussion and results

Investigations have been conducted in a hydraulic retention time (HRT) of 17 hours, pH 7.8 and 20°C. Fig.1 demonstrates the kinetics of COD reduction in the sub-reactors R1, R3 and R5. The kinetics for sub-reactors R2 and R4 aren't notified since the similitudes between R2 and R1, and also between R4 and R5. As can be seen that COD reduction improved from reactor R1 to R5 (fig 1) in both the bio-augmented system and the controlling. Nevertheless, for every reactor, COD reduction in the bio augmentation investigation has been greatest in comparison with controlling.

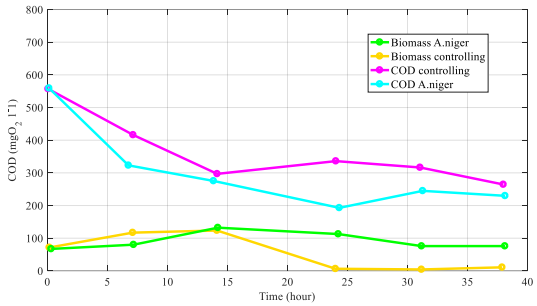
The growth in COD reduction parallel by the reactor demand can be described by the enlargement of the communication time between the contaminants and the biomass. The HRT in R1, R3, and R5 have been respectively 3.4, 10.2, and 17 hours. In R5 (Fig.1. C), 70 percent of COD and approximately 66percent of proteins according to table 1, have been terminated in the bio-augmented procedure whenever in the identical time and in the identical reactor in the controlling, Just 48 percent of COD and 30 percent of proteins have been terminated according to table 1. The residual protein engagements in the sewage of the bio augmented reactor and the controlling have been orderly, 22 mg l^{-1} and 48 mg l^{-1}. The analogous COD of these proteins are 35.2 mg O_2 l^{-1} and 76.8 mg O_2 l^{-1}, orderly, in the bio augmented reactor effluent and in the controlling.

Table. 1. Protein reduction Kinetics in domestic sewage by A. niger and the controlling under transient situations

Time (hour)	Controlling Run			Bio augmentation Run		
	Feed (Protein, mg l^{-1})	Sewage (Protein, mg l^{-1})	Eliminated (%)	Feed (Protein, mg l^{-1})	Sewage (Protein, mg l^{-1})	Eliminated (%)
0	67.5			65		
7	67.5	57.5	14.8	75	47.5	26.9
14	67.5	37	45.2	75	48.7	35.1
24	63.7	55	13.6	75	52.5	30
31	63.7	39.4	38.1	75	31	58.7
38	87	48	44.8	75	22	70.7



(a)



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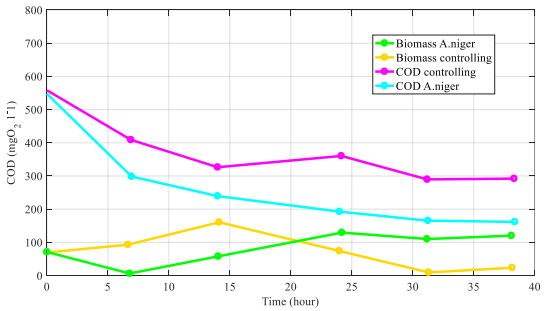

(c)

Fig. 1. Soluble COD reduction kinetics in domestic sewage by *A. niger* and the control under transitory situation. In reactor R1 (A), R3 (B) and R5 (C).

As can be seen, proteins included the fundamental residual COD in the effluent of reactor R5. The high attention of proteins seen in the reactors effluents can be described by their low biodegradability and the reduction in proteases actions (Lotter and Van der Merwe, 1987; Coulibaly and Agathos, 2003). The kinetic in terms of COD uptake rate in the sub-system (R1 to R3; HRT = 10.2 hours) can be in comparison by the experimentation of Green et al. (1985) conducted on Tel-Aviv drainage system (HRT = 9.8 hours). While A. niger has been bio augmented, the primary biomass in the sub-system (R1 to R3) has been 503 mg l^{-1}. In this bio-mass engagement, the rate of COD uptake has been 1.84 g COD (g SS)-1 at 31 h wherase it has been 0.43 g COD $(gSS)^{-1}$ that Green et al. (1985) bio augmented 538 mg l^{-1} of activated sludge. As can be seen, A. niger bioaugmentation improved the rate of COD uptake 4 times in comparison with activated swage bio augmentation.

The bio-degradation system underlying the bio augmented reactor mechanism has been further characterized by investigating enzymatic profiles in the swage feed and in R1, R3 and R5 waste water utilizing API ZYM kit at 7 hours, 14 hours and 31 hours, orderly.

These periods have been chosen for verifying if fungal biomass had an influence on the enzymes actions in their development medium. It can be seen that at 7, 14, and 31 hours, the suspended solid concentration in the bio-augmented reactor has been orderly, greatest, identical, and lower than the controlling (Fig. 1). The wastewater preservation at 4°C affected the enzymatic profiles. The principal enzymes in the swage feed have been phosphatase (alkaline, acid, and phosphohydrolase), cellulase (α glucosidase, β-galactosidase, and α-mannosidase), esterase (C4 and lipase C8) and protease (leucine aminopeptidase).

The enzymatic actions of the sewage preserved at 4°C have been typically greatest in comparison to those not preserved in this temperature. The enzymes specified in this study are specified for sewage (Hankin and Sands, 1974; Verstraete et al., 1976; Lotter and Van der Merwe, 1987; Nybroe et al., 1992; Lemmer et al., 1994) and might not have just bacterial source, while human waste source (Nybroe et al., 1992). The most heightened activity of alkaline phosphatase in the start of the investigation can have been derived from human excreta (Verstraete et al., 1976). They can have some influences on the fungus upon enzyme creation in the growth medium.

As can be seen, while the bio-mass engagements of the bio-augmented technique have been greatest or identical to the controlling bio-mass (7 hours in R1 and 14 in R3), the enzymatic actions in the past technique have been basically greatest to the latter. Furthermore, while the bio-mass concentrations in the bio-augmented strategy in a sub-reactor have been inferior to the controlling bio-mass, the enzymatic actions have been effectively inversed. The higher phosphatase action considered at 38 hours for the controlling in R5 can be the feed action obtained by dilution.

Conclusion

This investigation revealed the potential of enhancing soluble COD and protein reduction with wastewater augmentation by A. niger in a sewage simulation strategy running at a HRT of 17 hours. COD and proteins have been terminated twice as high in the bio-augmentation reactor strategy in comparison with the controlling. According to this study, the A. niger is relevant in complicated media like sewer.

Bio-augmentation of sewer by A. niger through transitory situation can be regarded for wastewater pretreatment as there is less bio-mass immunized. Additional analyses are required for assessing both nutrient removal and bio-augmentation procedure modeling for giving a precise mechanism for sanitary engineers. This can be so economic for sewage treatment and for the management of A. niger waste bio-mass deriving from fermentation industries.

Conflict of interest

The authors declare that they have no conflict of interest.

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