Polyhydroxyalkanoate production from yeast industry wastewater using mixed microbial culture

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1. INTRODUCTION

Bioplastics have recently become increasingly popular as an environmentally friendly alternative to petroleum-derived plastics. Polyhydroxybutyrates (PHBs) as a kind of biopolymer are preferred because of their biological production and degradation and very low environmental impact (Majone et al., 2006).

PHB can be obtained from pure cultures as well as mixed cultures such as activated sludge. Studies have been carried out with different industrial wastewater to produce PHA from wastewater and substrates used to increase and enrich PHB accumulation in sludge mainly consist of organic acids such as acetate, valerate, propionate, butyrate, or lactate(Serafim et al., 2008).

In this study, two steps PHB production from yeast industry wastewater in activated sludge was investigated: 1) feeding of activated sludge with anaerobically pre-treated yeast industry wastewater (enrichment reactor) 2) PHB accumulation by pulse addition in the excess sludge of enrichment reactor.

2. MATERIAL AND METHOD

The sludge was acquired from the aeration tank in a wastewater treatment plant of a yeast industry in Kocaeli-Turkey. Anaerobically pre-treated wastewater was used as substrate which was also obtained from the same treatment plant. Wastewater composition is summarized in Table 1.

Table 1 Anaerobically pre-treated yeast production wastewater composition

Parameter	Value
pH	7.5
COD (mg/L)	1770
∑N (mg/L)	100
∑P (mg/L)	6.7
Suspended solids (SS) (mg/L)	247
Total volatile fatty acids (VFA) (mg/L)	1540

The experiments were carried out in a 5 L Sequencing batch reactor (SBR) which was was operated at sludge retention times (SRT) 4 day, organic loading rate (OLR) 2 g COD/ L.d and under the feast-famine regime. The pH and dissolved oxygen (DO) were monitored in real-time using pH and DO probes. Chemical oxygen demand (COD), total suspended solid (TSS) and volatile suspended solids (VSS) determined according to standard methods. PHB production was quantified with gas chromatography with flame ionization detector (GC-FID Agilent) as mg PHB per mg cell dry weight (CDW).

3. RESULTS AND DISCUSSION

Figure 1 shows the concentrations of COD, TSS and VSS in first 20 days of SBR. COD value of wastewater was increased step by step to increase the PHA accumulated microorganisms. End of the 20 days operation while SBR still continues for the enrichment stage, excees sludge was used for the accumulation stage.

The wastewater was fed by pulse addition (4 pulses) controlled by the DO concentration. Figure 2 shows the COD and PHB concentrations and DO profile in the accumulation reactor. PHB storage was increased to 0.31 mg PHB/mg CDW at the end of 4 pulses which was 0.14 mg PHB/mg CDW at begining of the accumulation. In literature there are few reports which are used industrial wastewater for PHA accumulation: (Bhalerao et al., 2019). and Tamang et al. reported respectively %72 and %43.7 PHA accumulation yields by using yeast industry and brewery wastewaters. Figure 3 shows that FTIR and TGA analysis of biopolymer which are highly similar comparison with standard PHB.

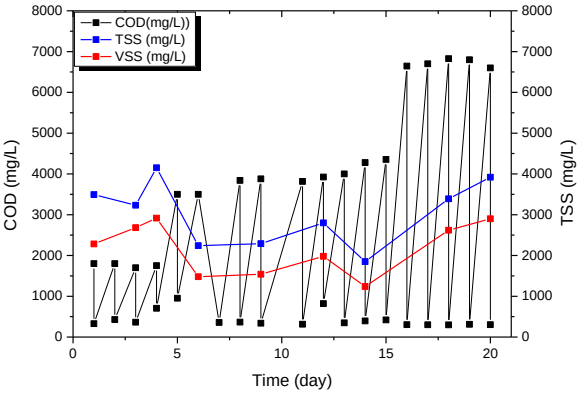

Figure 1 Concentration profiles of COD, TSS and VSS in 20 days SBR

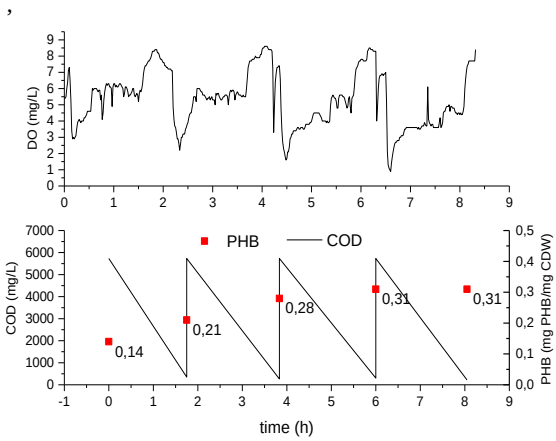

Figure 2 Concentrations of COD and PHB in the accumulation reactor with pulse addition of wastewater (bottom) controlled by DO concentration (top)

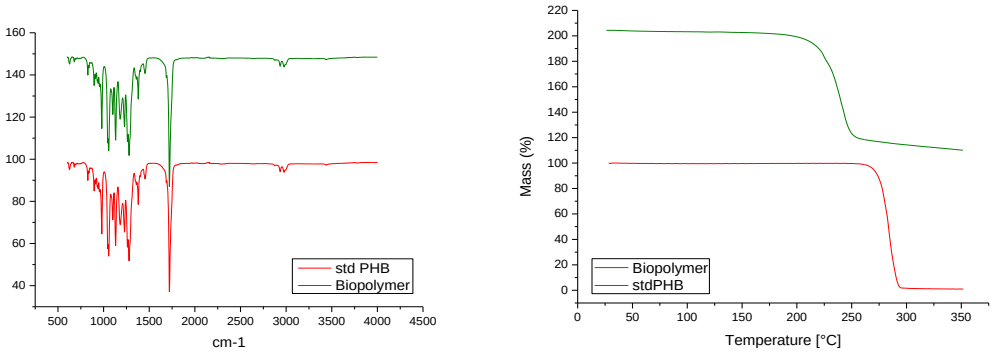

Figure 3 FTIR and TGA analysis of biopolymer comparison with standard PHB

4. CONCLUSION

In this study, PHB yield of 0.31 mg per mg CDW was obtained by pulse feeding in mixed microbial culture using yeast industry wastewater. This yield, which was obtained during short-term enrichment, is expected to be increased with long-term enrichment. Thus, the process of converting wastewater and waste sludge into a bio-based and biodegradable new product will be developed.

5. REFERENCES

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6. ACKNOWLEDGEMENT

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