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Polyhydroxyalkanoate production from yeast industry wastewater using mixed microbial culture

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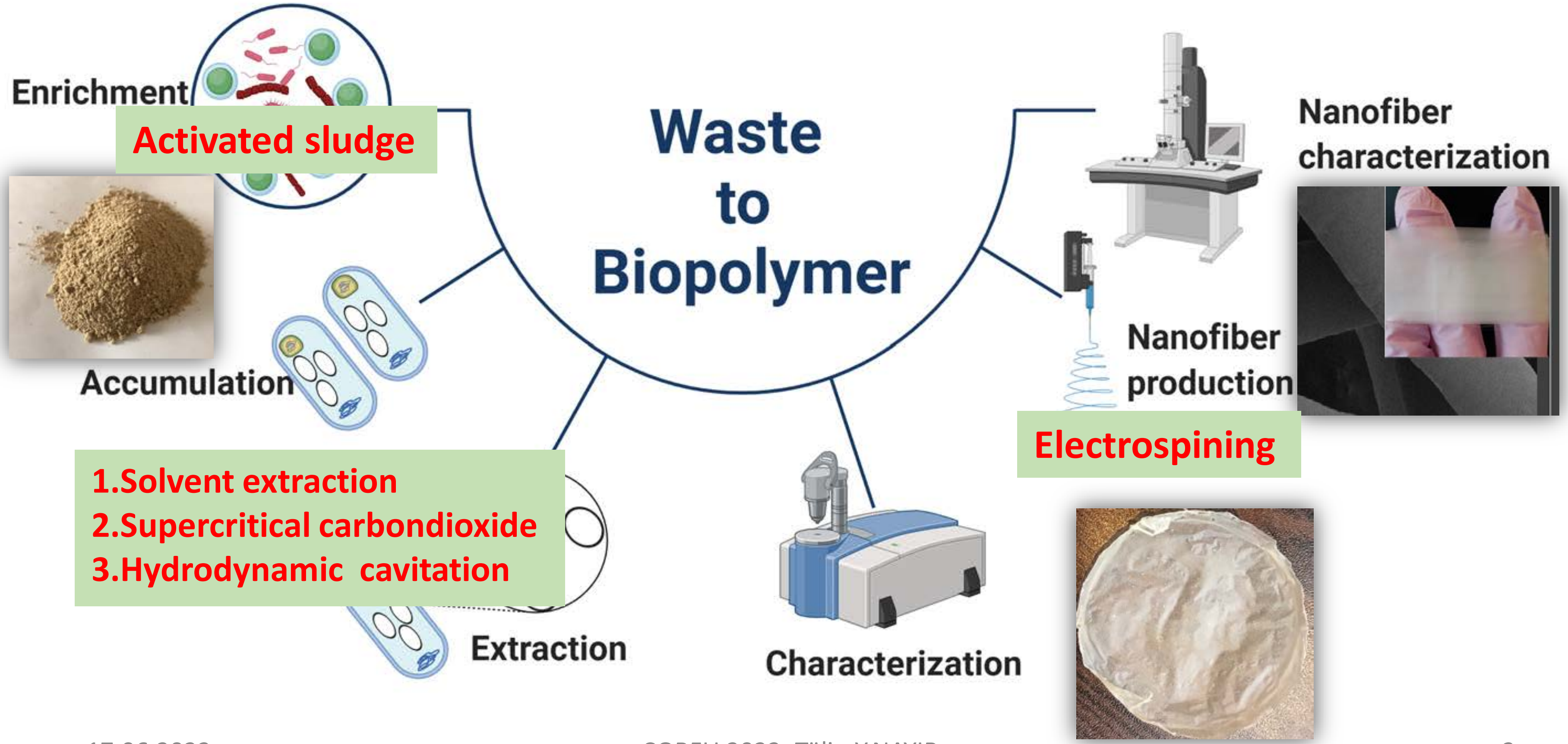
PROJECT OVERVİEW

The Project steps are :

1. PHA production in activated sludge with using yeast industry wastewater (YWW) as a feeding stream,

2. PHA extraction with using different extraction methods,

3. Nanofiber production



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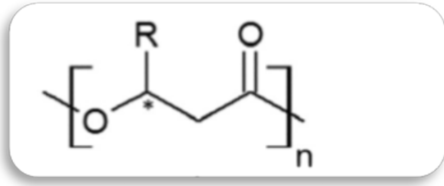

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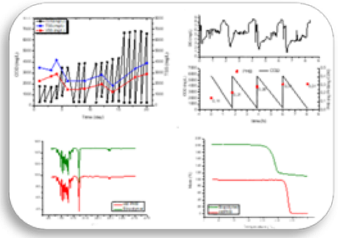
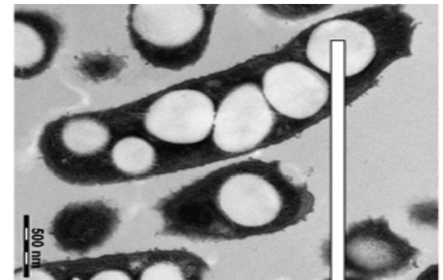


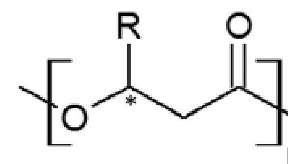
V. Conclusion and Future Work

I. Introduction to PHB

BIOPLASTIC

Bio-based and non biodegradable	Petro-based and biodegradable	Bio-based and biodegradable
Bio-based PP, PET	PBA	PLA and PHA





R	PHA
$C_1 - C_2$	scl-PHA
$C_3 - C_{11}$	mcl-PHA
$-CH_3$	P(3HB)
$-C_2H_5$	P(3HV)

n=1, R=metil =>
poli-3-hidroksibütirat (PHB)

- PHB was the first PHA to be identified in 1926 by in the bacterium Bacillus megaterium.
- PHB is the most widely studied and best-characterized member of PHAs.

II. PHB produced microorganisms and substrates

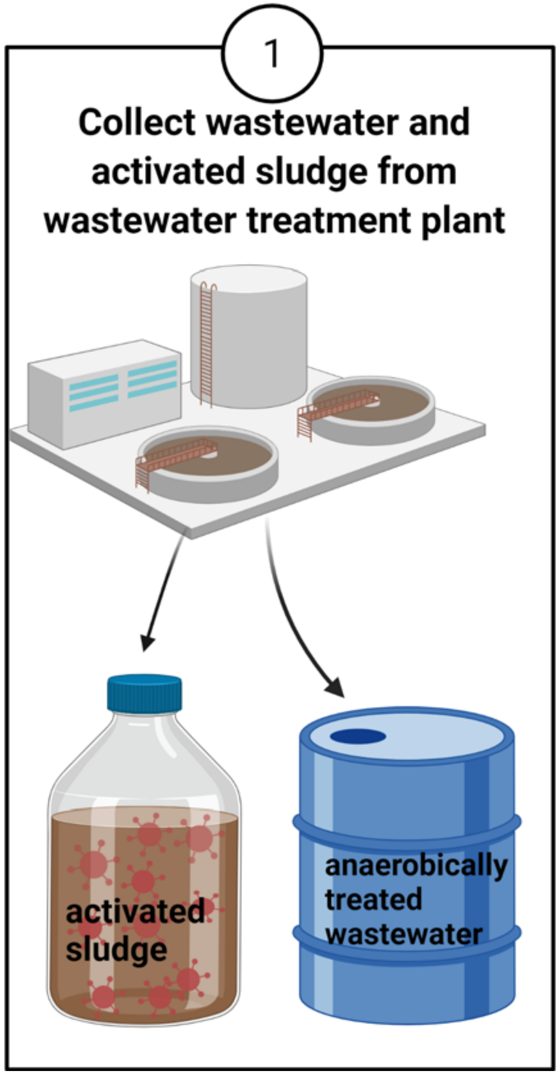
Food waste source	Microorganisms(s)	PHA polymer type	Cultivation	Dry cell weight (g l^{-1})	Maximum PHA production reported (g PHA g^{-1} dcw)	References
Spent coffee grounds oil	*Cupriavidus necator* DSM 428	PHB	Fermenter, fed-batch	16.7	78.40%	Cruz *et al.* (2014)
Starch	*Azotobacter chroococcum*	PHB	Fermenter, batch	54	46%	Kim (2000)
Sugarcane molasses	*Bacillus megaterium*	PHB	Fermenter, fed-	72.2	42%	Kulpreecha *et al.*
Rice straw	*Bacillus firmus* NII	PHB	Fermenter, batch	1.9	89%	Sindhu *et al.* (2013)
Molasses	*Psuedomonas*	PHA	Flask, batch	10.54	20.63%	Chaudhry *et al.*

Table 3. Production of PHAs from anaerobically digested food waste.

Food scraps from cafeteria	*C. necator*	PHBV	Fermenter, batch	22.7	72.60%	Du and Yu (2002)
Kitchen waste	*C. necator*	PHB	Fermenter, batch	4.6	52.79%	Omar *et al.* (2011)
Fermented molasses	Mixed microbial culture	PHBV	Fermenter, pulse feed		56%	Albuquerque *et al.* (2011)
Olive oil mill pomace	Activated sludge consortia	PHBV	SBR		39%	Waller *et al.* (2012)
Restaurant waste	Recombinant *E. coli* pnDTM2	PHB	Fermenter, batch	2.9	45%	Eshtaya *et al.* (2013)
Restaurant waste	*C. necator* H16	PHB	Fermenter, continuous feeding	1.4	87%	Hafuka *et al.* (2011)

Nielsen, C., Rahman, A., Rehman, A. U., Walsh, M. K., & Miller, C. D. (2017). Food waste conversion to microbial polyhydroxyalkanoates. In *Microbial Biotechnology* (Vol. 10, Issue 6, pp. 1338–1352). John Wiley and Sons Ltd. https://doi.org/10.1111/1751-7915.12776

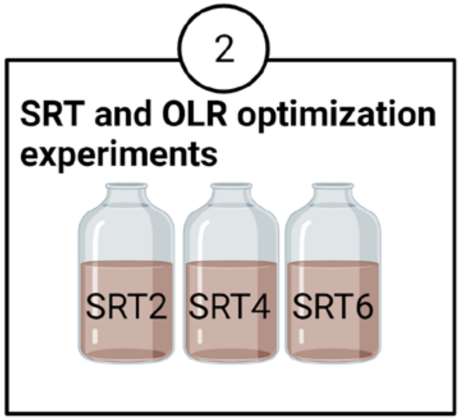
III. Experimental Procedure



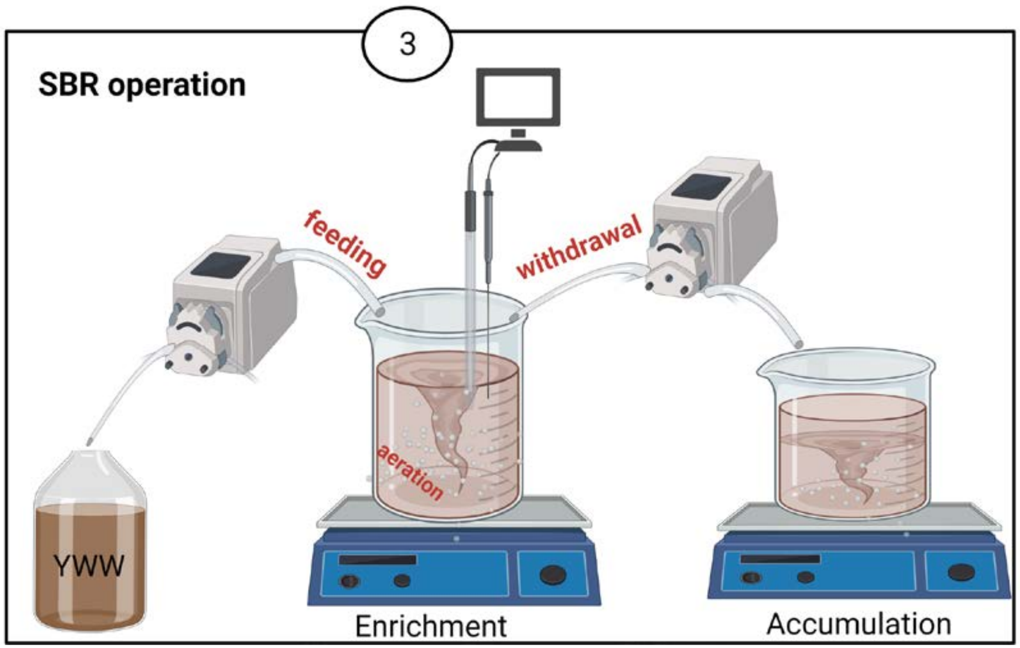
Parameter	Value
pH	7.5-7.88
COD (mg/L)	2500-3430
∑N (mg/L)	100-200
∑P (mg/L)	6.7-21.9
Suspended solids (SS) (mg/L)	450-500
Total volatile fatty acids (VFA) (mg/L)	950-3000

Acetic acid: %90
Propionic acid:%3
Butyric acid: %3
Isobutyric acid: %2
i-valeric acid:%1
Valeric acid:%1

III. Experimental Procedure



Operating conditions: SBR's in different sludge retention times (SRT), feast/famine regime, one cycle/day well aerated and stirred



- ***Inoculum:*** activated sludge
- ***Feeding stream:*** anaerobically pre-treated yeast industry wastewater (YWW)
- two steps PHB production from yeast industry wastewater in activated sludge was investigated:

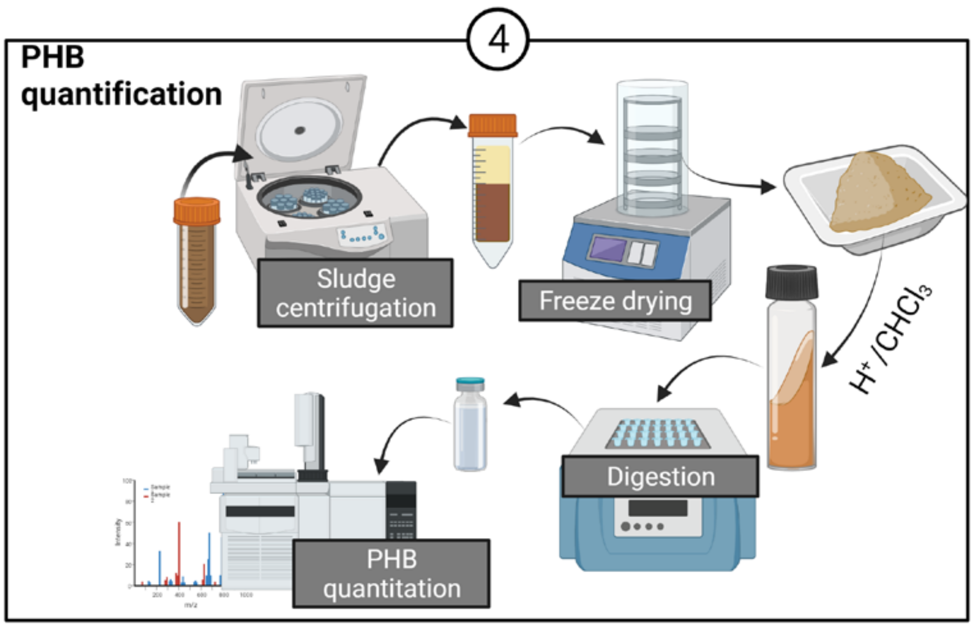
1) feeding of activated sludge with anaerobically pre-treated yeast industry wastewater (enrichment reactor)

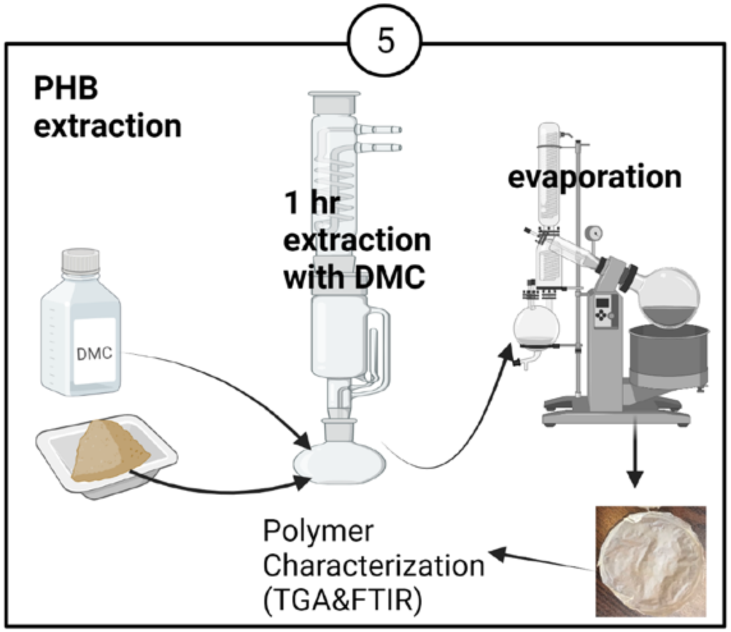
2) PHB accumulation by pulse addition in the excess sludge of enrichment reactor.

III. Experimental Procedure

Analytical methods:

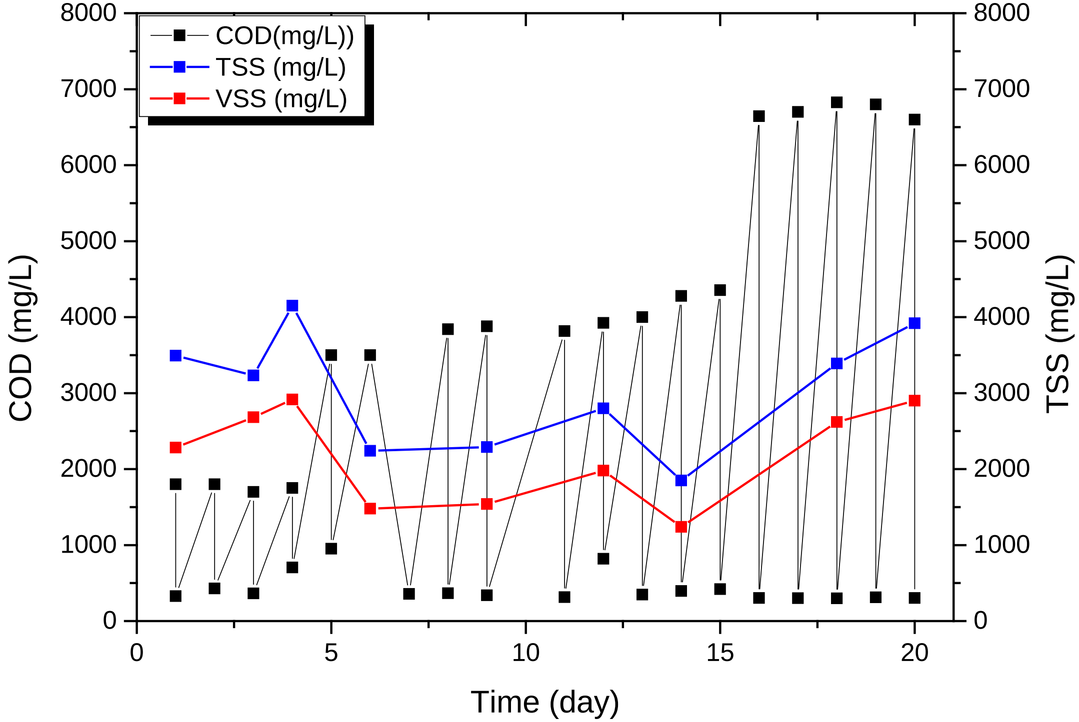
- Chemical oxygen demand (COD),
- Total suspended solids (TSS),
- Volatile suspended solids (VSS),
- PHB content (%cell dry weight (CDW)
- Dissolved oxygen (DO),
- PHB extraction





IV. RESULTS

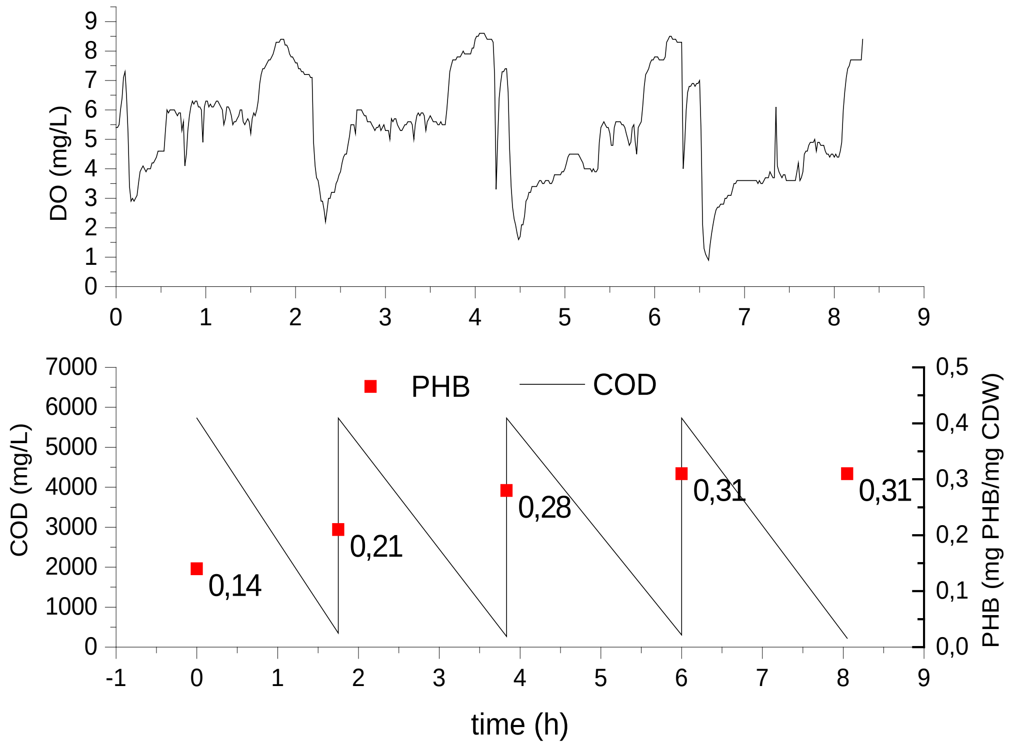
Concentration profiles of COD, TSS and VSS



- COD value of wastewater was increased step by step to increase the TSS.
- End of the 20 days operation while SBR still continues for the enrichment stage, excees sludge was used for the accumulation stage.

IV. RESULTS

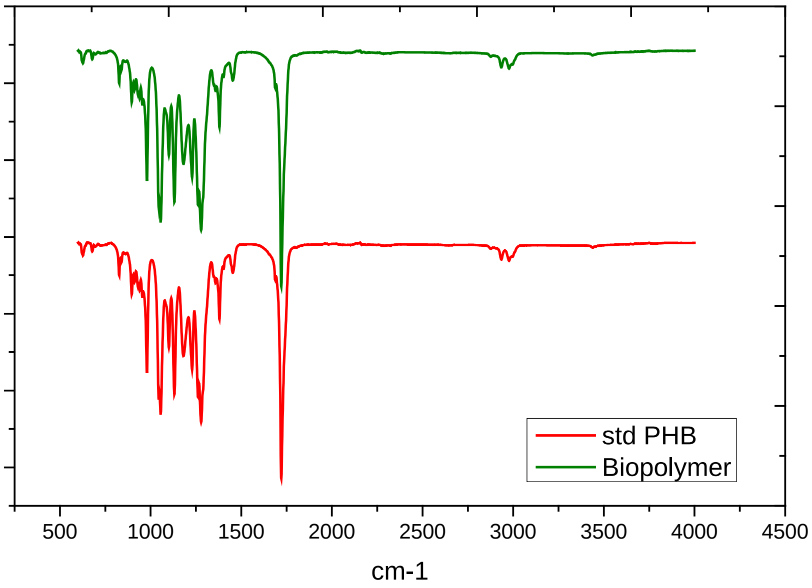
Concentrations of COD and PHB in the accumulation reactor with pulse addition of the substrate

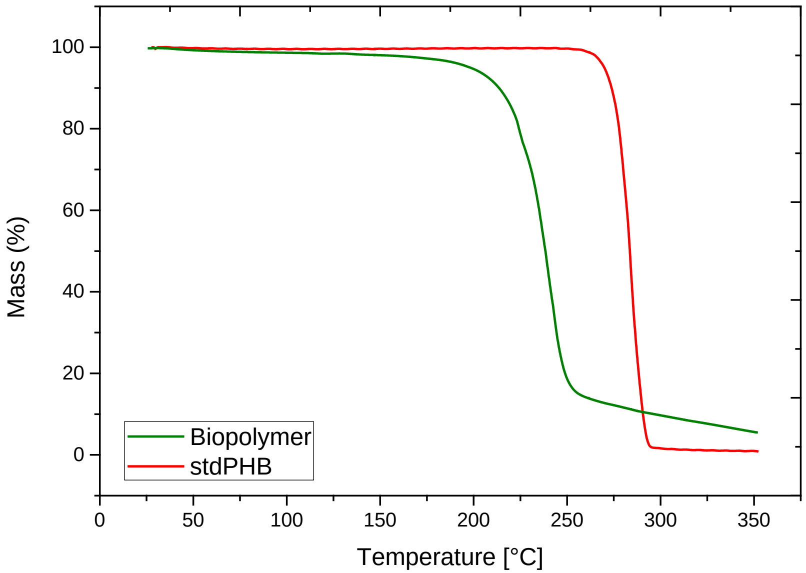


- The wastewater was fed by pulse addition (4 pulses) controlled by the DO concentration.
- PHB storage was increased to 0.31 mg PHB/mg CDW at the end of 4 pulses which was 0.14 mg PHB/mg CDW at begining of the accumulation.

IV. RESULTS

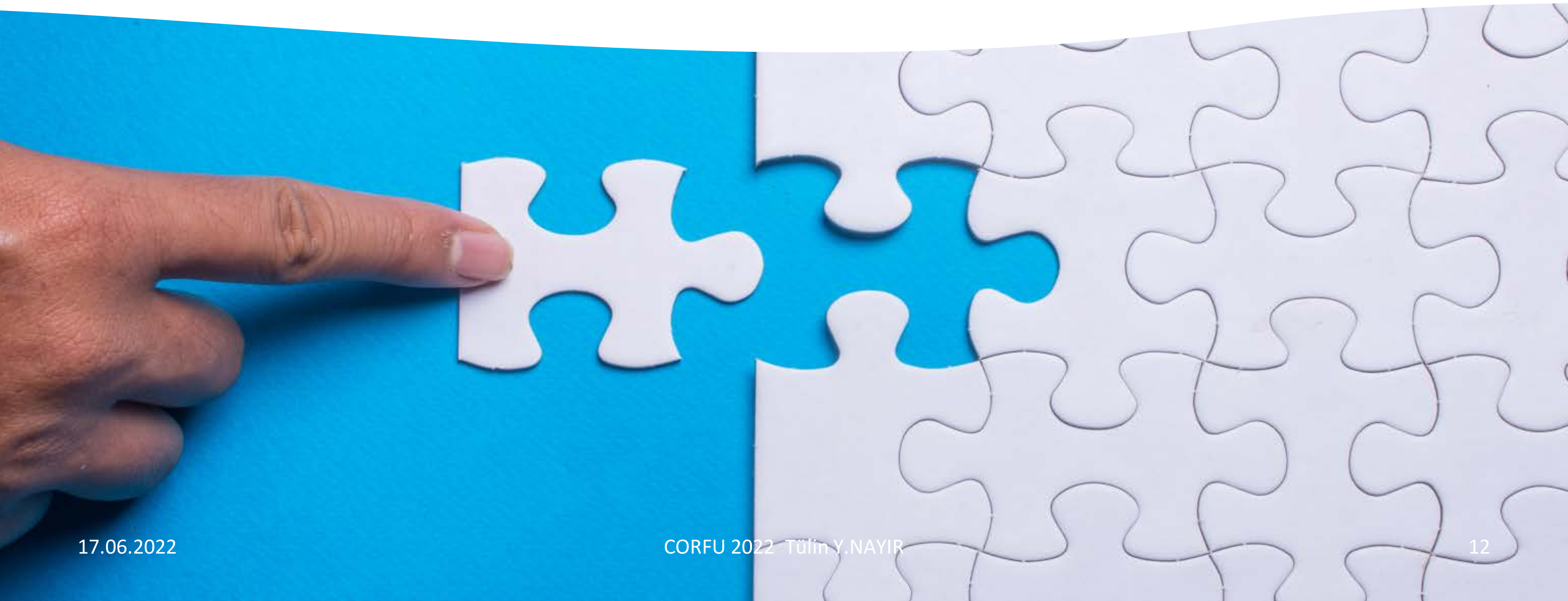
FTIR and TGA analysis of biopolymer comparison with commercial PHB sample





VI. CONCLUSION and FUTURE WORK

- ***There are few study which are feeded to enrichment reactor with wastewater stream instead of synthetic acetate and mineral solution. In this study, the culture was able to accumulate 30% PHB (for CDW).***
- Study is still going on with the accumulation experiments to increase the PHB content in the (MMC).
- Extraction experiments continue in parallel with the accumulation.
- Extracted polymers are going to be used for the nanofiber production
- End of this project, we will have developed new methods for the production of biopolymer by evaluating waste and extracting this polymer using environmentally friendly methods.



VI. ACKNOWLEDGEMENT

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