

# START-UP OF A SEQUENCING BATCH REACTOR FOR THE SELECTION OF POLYHYDROXYALKANOATES ACCUMULATING CULTURES BY MEANS OF A CARBON AND NITROGEN DECOUPLING STRATEGY

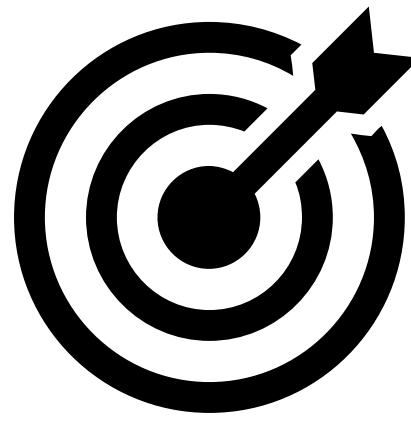
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## Introduction and objectives

Wastewater treatment plants (WWTPs) are being transformed into resource recovery facilities (RRF). These plants are also known as biorefineries being a network of facilities that integrate biomass into bioproducts as polyhydroxyalkanoates (PHA) [1] [2] [3].



This study is focused on the start-up of a SBR reactor to select PHA accumulating microorganisms and determine their PHA accumulation capacity in aerobic batch tests.

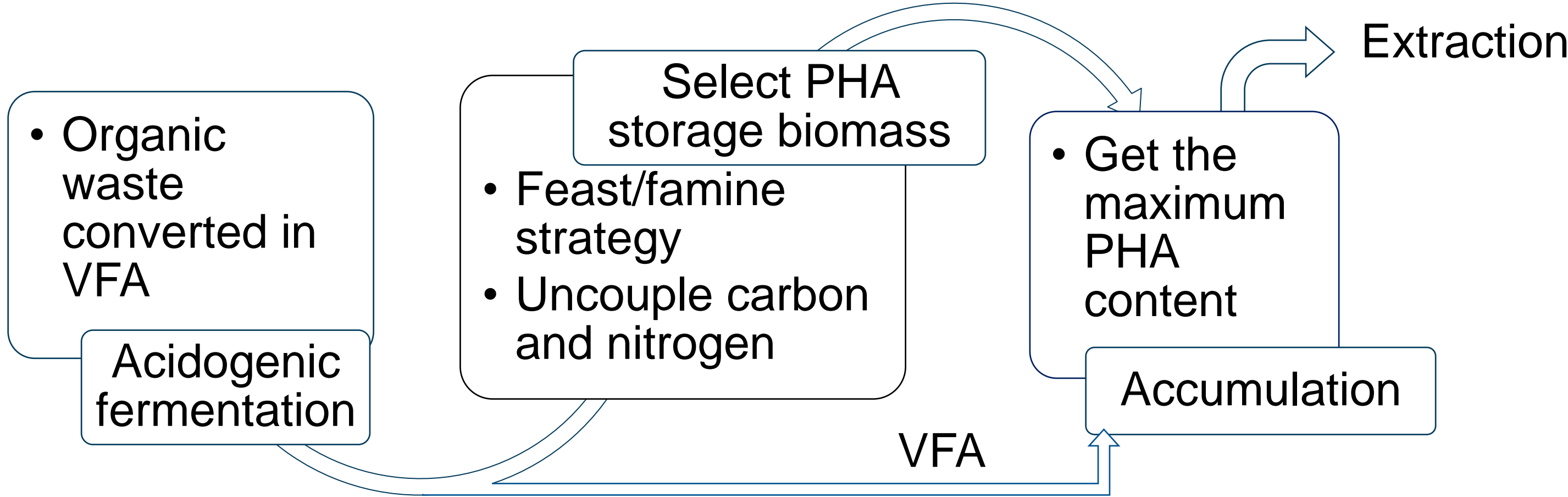


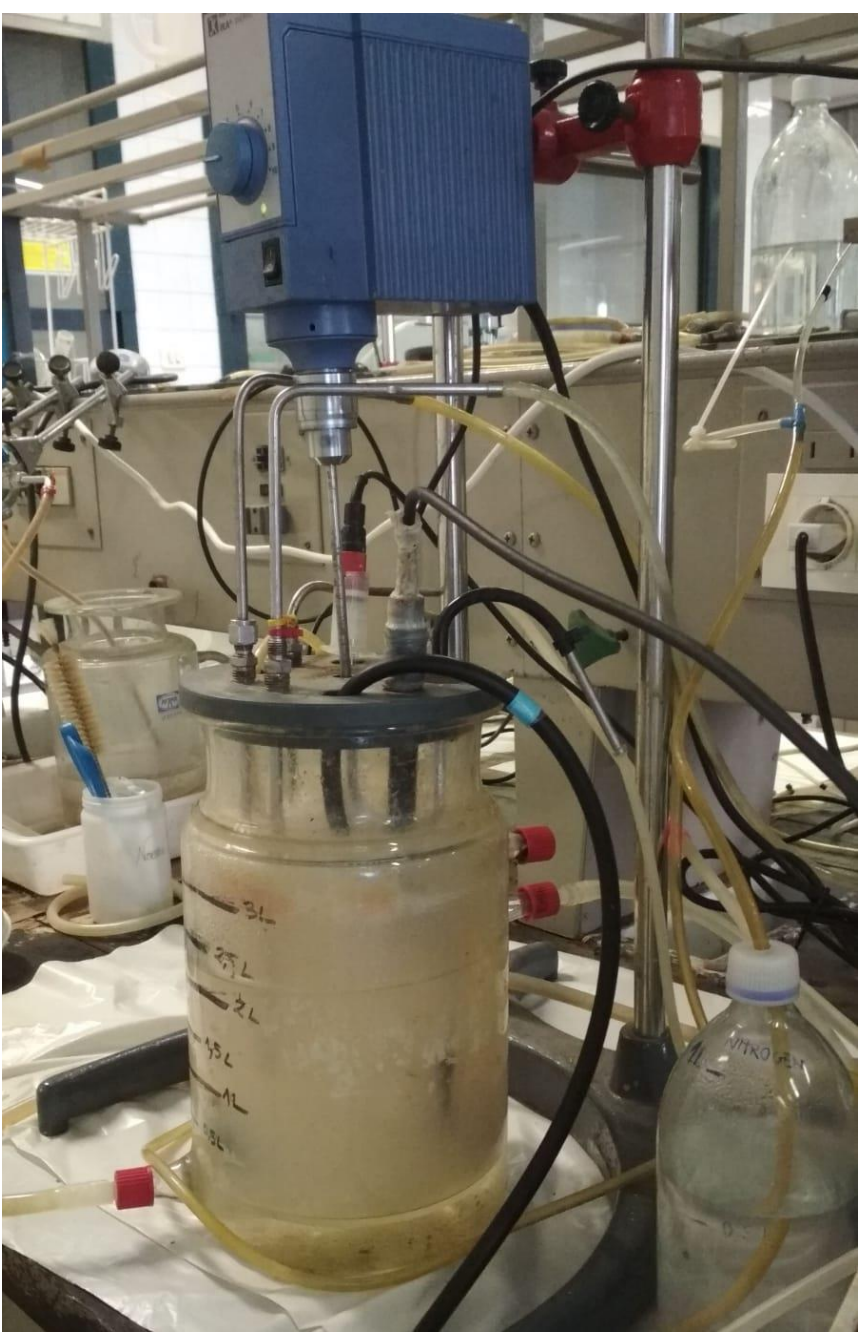
Figure 1. General scheme of the process

## Materials and methods

### Selection SBR

A sequencing batch reactor (SBR) at 30 °C was used to select PHA accumulating microorganisms. The SBR was inoculated with waste activated sludge (WAS) with 12.3 g TSS · L<sup>-1</sup> and 9.1 g VSS · L<sup>-1</sup>.

Table 1. Operating parameters of SBR



Parameter	Units	Stage I	Stage II	Stage II
Days of operation	-	1-117	118-169	170-209
HRT	days	1.25	1.25	1.25
SRT	days	4.8	4.8	4.8
Feast/total cycle ratio	% time	>20%	<17%	<17%
Organic loading rate	g COD · L <sup>-1</sup> · day <sup>-1</sup>	2.0	2.0	2.8
VFA feed	g COD · L <sup>-1</sup>	2.5	2.5	3.5
Influent acetic acid	% COD	53.1	53.1	53.1
Influent propionic acid	% COD	21.3	21.3	21.3
Influent butyric acid	% COD	25.6	25.6	25.6
NH <sub>4</sub> <sup>+</sup> -N loading rate	mg NH <sub>4</sub> <sup>+</sup> -N · L <sup>-1</sup> · day <sup>-1</sup>	72	96	96

### Accumulation SBR

A reactor of 1.5 L at 30 °C was used for accumulation tests, where the PHA content of the purged biomass of the selection SBR increased following a feed-on-demand strategy.



Table 2. Operating conditions of accumulation test

Parameter	Units
SBR purge (inoculum)	800 mL
Duration	7 h
VFA <sub>feed</sub>	5 gCOD · L <sup>-1</sup>
Number of VFA <sub>feed</sub> spikes	5
Volume of VFA <sub>feed</sub> /spike	100 mL
N concentration in VFA <sub>feed</sub>	0 mg N · L <sup>-1</sup>

## Results and discussion

### Selection SBR performance

In Stage III, the DO in the feast phase (A-B) was nearly 0 mg · L<sup>-1</sup> which means that **microorganism consumed the carbon source supplied (VFA)**. VFA were totally depleted in the purge. Feast phase was much shorter than famine phase (0.17). During the **second aerobic phase (C-D) microorganisms consumed the stored PHA together with the NH<sub>4</sub><sup>+</sup>-N supplied for biomass growth**. The PHA concentration measured in the purge had **7% in SS basis** in majority as PHB whereas at the beginning was less than 4% in SS. Stage II provided similar results.

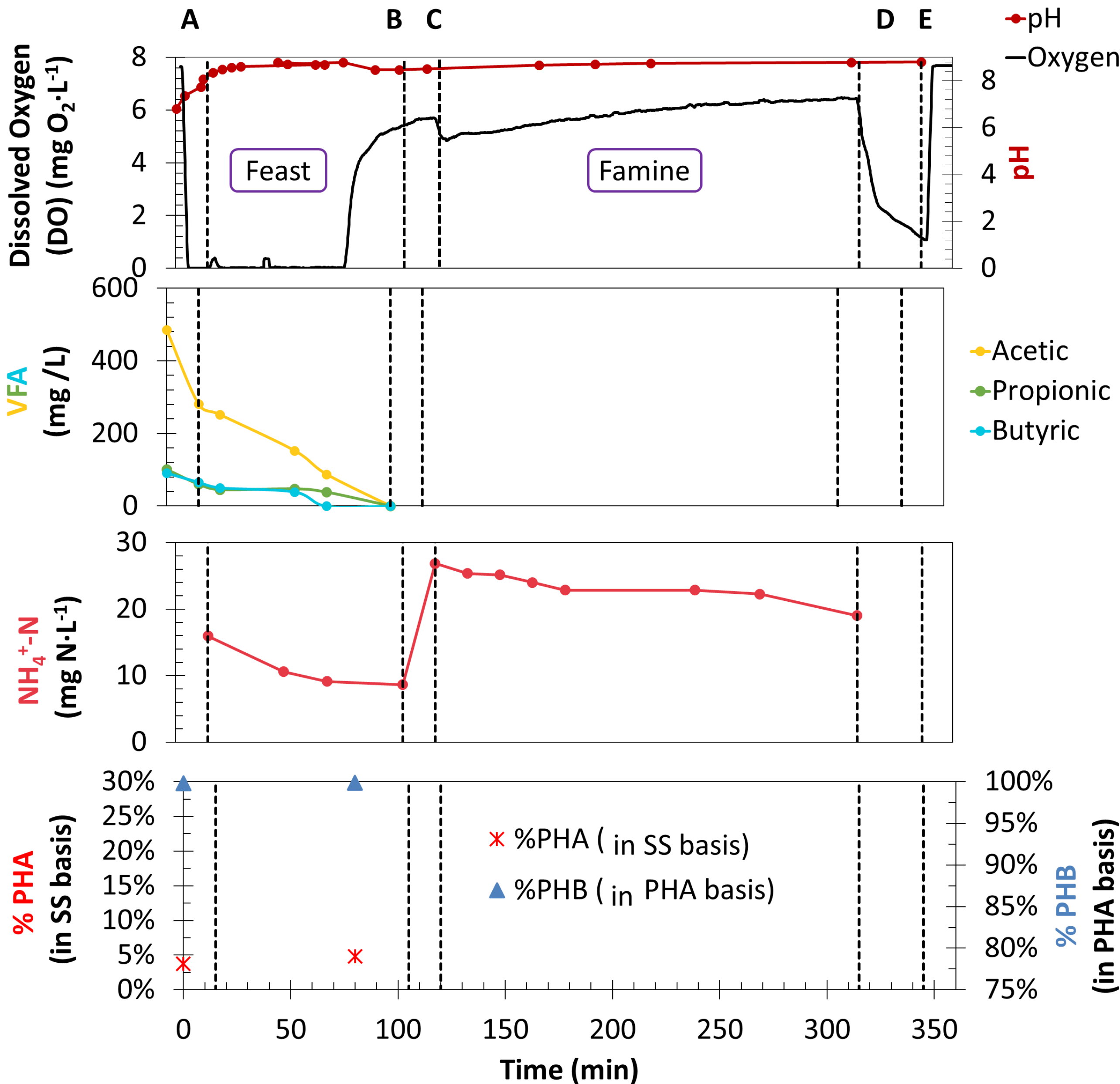


Figure 2. DO, pH, VFA, NH<sub>4</sub><sup>+</sup>-N, profiles of Stage III (A = feed addition; B = purge; C = ammonia addition; D = sedimentation; E = effluent discharge) – (Stage III results)

### PHA Accumulation

The purged biomass obtained in Stage II has a TSS and VSS concentration of 1.59 and 1.45 g · L<sup>-1</sup>, respectively. Although the VFA dosage was the same in each spike, over time, **microorganisms become more satiated and took longer to consume the acids**. Microorganisms had an **initial intracellular PHA** with concentration of **309 ± 134 mg PHA · L<sup>-1</sup>** (~9% PHA in SS basis) **arriving to 1363 ± 8 mg PHA · L<sup>-1</sup>** (~44% PHA in SS basis) in the last sample of the assay. At Stage III, 46% PHA in SS basis was obtained after accumulation assays.

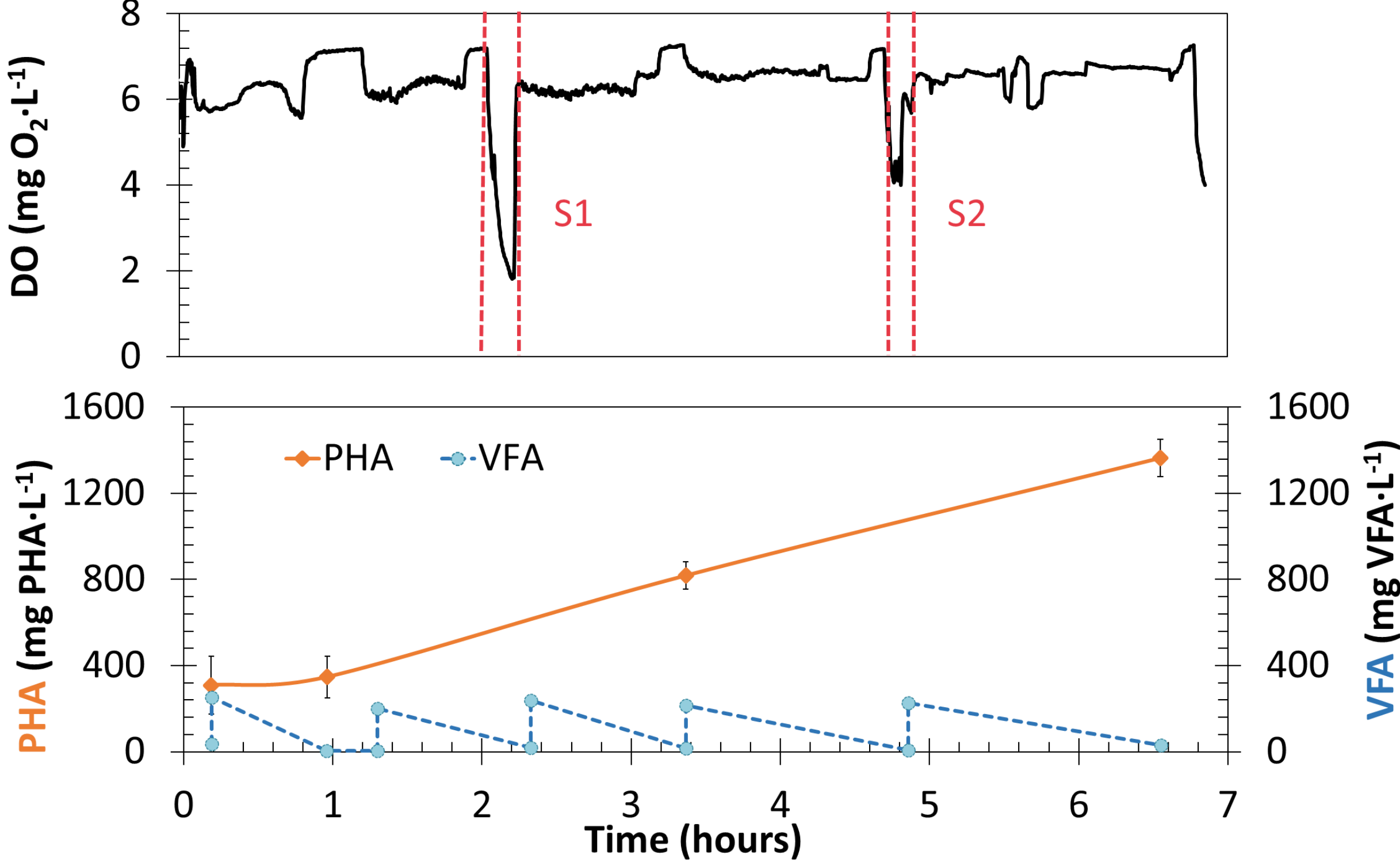


Figure 3. Accumulation of Stage II of the selective reactor with COD of 5 g COD · L<sup>-1</sup> (Stage II results). S1 and S2 represent settling phase.

## Conclusions

- ✓ The **SBR working conditions at both 2.0 and 2.8 gCOD · L<sup>-1</sup>** were **beneficial** for a proper **microorganism selection**.
- ✓ Accumulation assays showed that **PHA-storing bacteria were successfully selected** in the SBR.
- ✓ The **percentage of PHA was above 40% in SS basis**, a value that could lead to **commercially viable PHA recovery**.

### Acknowledgment

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