Effects of Failure of Aeration during Continuous Biomass Production on Sulfite Liquor

J. PACA* and P. KUJAN*

*Department of Fermentation Chemistry and Bioengineering, Institute of Chemical Technology, 166 28 Prague 6

bInstitute of Microbiology, 142 20 Prague 4

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ABSTRACT. The effect of the length of the failure in stoppage aeration on the changes in the growth and physiological characteristics of a Candida utilis population grown in the chemostat was observed. During the interruption of air supply, the temporary surface aeration was used. The transient change to the oxygen-limited growth conditions induced different values and courses of the growth and physiological parameters in the transition states.

Abbreviations and symbols

\( D \) dilution rate, 1/h
\( \dot{q}_o^* \) actual cell respiration rate, mmol g\(^{-1}\) h\(^{-1}\)
\( \dot{q}_o^e \) endogenous cell respiration rate, mmol g\(^{-1}\) h\(^{-1}\)
\( R_S \) concentration of reducing compounds in the medium, g/L
\( R_{S_0} \) concentration of reducing compounds in the feed, g/L
\( \text{RNA} \) intracellular content of ribonucleic acid, % (W/W)
\( t \) time, h
\( t_p \) time of air supply interruption, h
\( X \) biomass concentration in the medium, g/L
\( Y_{X/R_S} \) biomass yield related to the reducing compounds consumed, g/g
\( \tau \) time necessary to reach the original RS value for the steady state after the failure of aeration, h
\( \mu \) specific growth rate, 1/h

Sulfite liquors represent a waste product used for the production of microbial biomass. They are continuously manufactured during the production of cellulose and due to their large amounts they cannot be stored for a long time. Consequently, any failure in the continuous biomass production process using those liquors results in major losses of the biomass produced.
In our previous paper, the effects of the failure of mixing, fermenter cooling and electrical power supply were described (Páca et al. 1985).

This study is focused on the changes resulting from the failure of aeration for various lengths of time during the continuous microbial growth on sulfite liquors.

**MATERIAL AND METHODS**

The experiments were conducted using the industrial strain of *Candida utilis* (*North Moravian Cellulose Factories, Paskov, Czechoslovakia*). The microorganism was grown in a medium containing a magnesium hydrogensulfite liquor from the same factory. The nutrient content in the liquor was adjusted by the addition of (g/L): KCl 0.35, NH₄Cl 5.7, concentrated molasses foots 2.8, and 85 % H₃PO₄ 1 mL. The pH of the medium was adjusted by adding 26 % NH₄OH. The content of the carbon and energy source estimated as the reducing compounds in the medium was 27.9 g/L. The levels of the inhibitors detected in the medium were as follows (g/L): free SO₂ 0.45, acetic acid 6.1, formic acid 1.5, furaldehyde 0.2; pH 2.3.

A LF 2 laboratory fermenter (*Workshops of the Czechoslovak Academy of Sciences, Prague, Czechoslovakia*) was employed for the cultivations. The fermenter was equipped with a temperature, pH and foam control that was operating throughout the cultivation. The cultivation conditions were as follows: temperature 34 °C, dilution rate 0.3/h, pH 5.4. At the steady states, the aeration was interrupted for various lengths of time. After the aeration was resumed, the following parameters were measured in the transition state until the original steady state was reached: the biomass concentration, the content of the reducing compounds in the medium, the intracellular content of RNA and protein and the respiration activity of the yeast population. Once the culture resumed the steady state, the cultivation was kept under the chemostat conditions for the next 24 h to be sure that a stable and not a pseudostable steady state was reached. After those 24 h, an aeration stoppage of the same or a longer time length was simulated. The results shown in Figs. 1 to 5 are the means of two experiments.

Biomass concentration was estimated gravimetrically after separation, washing and drying at 70 °C for 1 h or 105 °C for 2.5 h.

The content of reducing compounds in the medium was determined by the method of Somogyi (1952).

The content of RNA was measured by using orcinol (Herbert et al. 1971).

The content of cellular protein was estimated by Lowry method. The cell respiration was measured in a vessel containing a freshly-removed yeast suspension at 34 °C. A Pt–Ag/AgCl oxygen electrode covered with a polypropylene membrane (thickness 12 μm) was employed, connected to a dissolved-oxygen Oxymetr analyzer (*Workshops of the Czechoslovak Academy of Sciences, Prague*). The signal was registered by an OH-814/1 recorder (*Radelkis, Hungary*).

The endogenous respiration was estimated after the cells were separated by