OBTAINING MECHANICAL FORCE USING GAS PRESSURE GENERATED BY MICROORGANISMS IN A SELFPRESURIZED MEMBRANE BIOREACTOR

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REZUMAT. Lucrarea prezintă o posibilitate de a utiliza activitatea metabolică a microorganismelor producătoare de gaze, în special drojdia, pentru a obţine o presiune înaltă în gazul produs într-un mediu închis, pe de o parte, şi separarea celuilalt produs al metabolismului prin membrană, pe de altă parte, cu ajutorul presiunii gazului ca o forta conducatoare. Este cunoscut faptul că mai multe tulpini de drojdie rezistă la presiune hidrostatică foarte mare având activitate bună. Acest fapt dă posibilitatea de a folosi energia lor pentru alte scopuri, cum ar fi producerea lucrului mecanic. Combinaţia între cele două, presiune gaz şi arderea de alcool, creşte eficienţa procesului.

Cuvinte cheie: bioreactor cu membrana auto-presurizata, drojdie, bioreactor cu membrana modulara

ABSTRACT. This paper present a possibility to use metabolic activity of gas producing microorganisms, especially yeast, to obtain high pressure from gas produced in closed medium on the one hand and separation of the other product of metabolism through membrane on the other hand using gas pressure as driving force. Is known that several strains of yeast resist on very high hydrostatic pressure heaving good activity. This fact give the possibility to use their energy for other proposes like the producing mechanical work. Combination of both, gas pressure and alcohol burning, increase the process efficiency.

Keywords: self pressurized membrane bioreactor, yeast, modular membrane bioreactor

1. INTRODUCTION

This study proposes the use of metabolic activity of microorganisms for getting a high pressure generator. This is possible through the accumulation of gas resulting from metabolism in a closed environment. As a result, the pressure created can be used both as a driving force in membrane separation of the product of metabolism and as a potential energy gained for other processes that use pressure.

The yeasts have been extensively studied over time, being involved in important branches of food industry based on fermentation and wine-making technology, beer and bakery technology. The same principles that are based on fermentation, production of ethanol as biofuel is another area whose importance increases with the price of crude oil through alternative energy and environmentally friendly that it offers[1,2].

2. MATERIALS AND METHODS

In closed environment, can be easily obtained as the limit pressure, metabolic activity is not affected by the condition to eliminate the constant-products of metabolism and nutrient medium composition remains constant. Certainly one factor is the strength of the membranes involved in limiting the accumulation of pressure separation to the nominal level required by the manufacturer. P.M.B. Fernandes have found in conditions which apply hydraulic pressure above 50 MPa yeast cell morphology is affected, Some wild yeast survived at 220 Mpa [3].

We must to consider two variables that permit the design and build a bioreactor that work on this conditions: mechanical pressure resistance of the membrane (P_M) and the maximum pressure that the yeast cell has its own metabolic activity ($P_{max\ yeast}$).

Considering Pf the maximum final pressure generated by fermentation in bioreactor than if $P_f = P_{max\ yeast}$ and $P_{max\ yeast} < P_M$ membrane applied pressure is insufficient to allow separation.

Observing the condition of equation (1) we can say there is the possibility of using gas pressure generated during alcoholic fermentation for the purpose of getting high hydraulic pressure.

Process description

We aim to obtain practically useful for both separation pressure product of metabolism found in the biomass - ethanol - and in order to build upon mechanical excess gas accumulated at the top of the bioreactor. Constant supply of nutrient media and culture, the culture of constant discharge and the separation constant dead maintain constant ethanol production of carbon dioxide and thus obtain the entire system working pressure. Also, always maintaining the optimal level of nutrient concentrations, metabolic activity during which a culture of microorganisms is used will be constant at the value obtained previously in the literature or by testing and allows adjustment of the exhaust flow yeast culture. Therefore, defining the tasks assigned

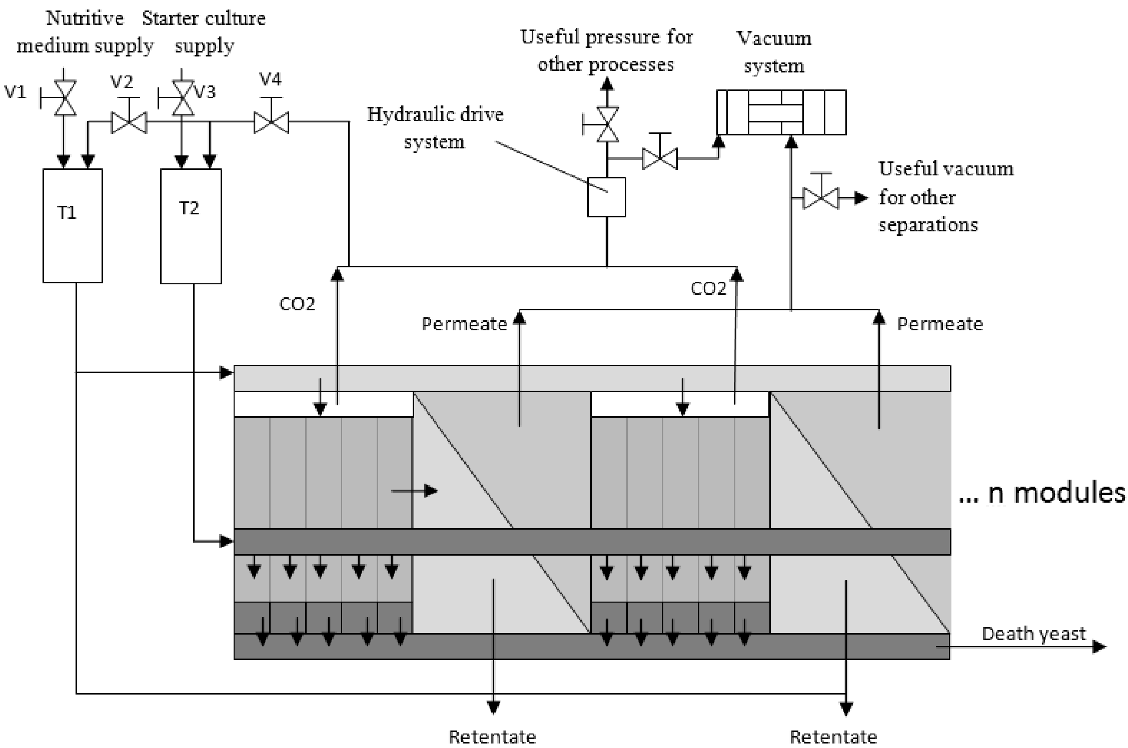

Fig.1 *Block diagram for obtaining hydraulic pressure using biotechnological methods*

it by adjusting the mass flow to achieve a balance in supply and exhaust.

In figure 1 is presented the block diagram for obtaining hydraulic pressure using biotechnological methods.

The installation is composed of membrane bioreactor directly connected to it, culture medium supply tank (T1), starter culture supply tank (T2), hydraulic drive system and optionally can be attached a high pressure storage container of carbon dioxide or other gases [4] depending on hydraulic drive system design.

The main segment of the system is the membrane bioreactor. Operation in a closed system is ensured by valves located on the supply and drain paths thereof with which to regulate flows. It consists of the bioreactor itself directly coupled to the membrane separation module.

Starter culture membrane bioreactor supply is provided by the T1 buffer tank and the nutrient medium through the buffer tank T2. They are kept at working pressure of the membrane bioreactor with open positions that the valves V2 and V4, respectively closed position of valves V1 and V3. The circulation of culture, the medium and recycle of it into the system is provided by pumps corresponding to T1 and T2 tanks.

In turn, buffer tanks, for maintain the constant pressure in bioreactor, are supplied with material up to maximum level at atmospheric pressure by closing valves V2 and V4 and opening valves V1 and V3. As a result, we have two circuits which supply a buffer tank at atmospheric pressure and the other, constantly feeding the bioreactor on its working pressure.

Feeding the bioreactor with starter culture is achieved by a uniform distribution in the vicinity of the sediment layer at the base of the machine. In this way at the top of the layer will be always deposited yeast with maximum metabolic activity that will cover the full yeast whose activity decreases as they move towards the drain at the bottom.

Recycling the nutrient medium must be made over the dispenser order not to disrupt the yeast sedimentation. It will make successive passes in front of the membrane separation module that removes constant the dissolved ethanol using pervaporation membrane process [5] from nutritive medium using just the driving force the pressure of carbon dioxide resulted from fermentation.

Due to the limitation of useful work pressure of the membrane, obtaining a useful high and very high pressures can be done by a hydraulic pressure transformer. Consequently, the use of lower pressures to obtain a high pressure leads to a slowing of the overall process of obtaining energy.

The solution to the problem mentioned above is the modular design of the bioreactor so that it will present a mass and thus high energy efficiency. In the figure below is illustrated a part o this type of bioreactor consisting in serial plates that create a cavity along the device. The plates presented are from bioreactor region in zone of supply with microorganisms.

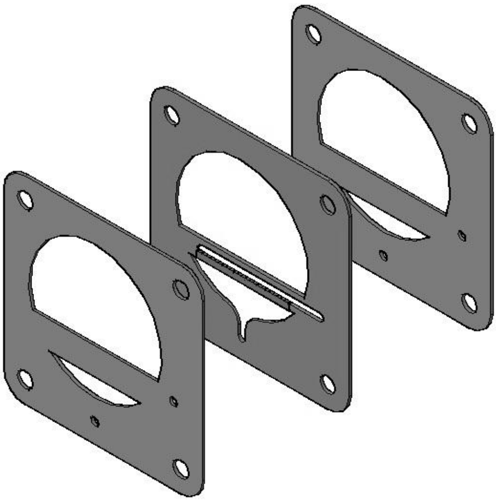

Fig.2 *Plates from zone of the system that make the repartition of starter culture at the botom of he bioreactor*

3. CONCLUSIONS

The driving force by using pressure provided by bacterial metabolism resulting gases can be used to separate and obtain useful compounds in food and pharmaceutical industries. Obtaining energy by the method presented in this work may have wide applicability in various fields such as energy and mechanical.

The modularity given by the possibility of multiple configurations lead to increase the productivity.

It also can reduce the emissions of CO_2 by storage storage in the form of ice. At high pressure, 70 atm, the carbon dioxide used can be saved by decompression in the form of dry ice and then use of this form.

4. ACKNOWLEDGEMENTS

This research is supported by the European Social Fund, through the Human Resources Development Operational Programme 2007-2013, the project POSDRU/89/1.5/S/63258 Postdoc School for Zootechnical Biodiversity and Food Biotechnology based on Ecoeconomy and Bioeconomy Required by Ecosanogenesis.

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