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IMPELLER FLOODING CONDITIONS IN AN INDUSTRIAL BIOREACTOR FOR ANIMAL CELL CULTURE

Jordan Raffo[1], Alvio Figueredo[1], Julio Dustet[2]; José L. Martínez[3],[1]Industrial Operation Group, Center of Molecular Immunology (CIM), Havana 11600, Cuba; [2]Chemical Engineering Faculty, Cujae,Cuba; [3]Chemical Sciences Faculty, Coahuila University, México; jordan@cim.sld.cu

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Introduction. The bioreactor performance is influenced, among other factors, by the agitation and aeration conditions imposed, as well as by their geometrical characteristics. Aeration and agitation are two important operations for culturing animal cells. An ineffective aeration by impeller flooding can bring unnecessary cell damage compared to the damage caused by the agitation (*1, 2*).
The aim of this work is to determine the operating conditions that cause the phenomenon of impeller flooding by experimental correlation and Computational Fluid Dynamic (CFD).

Methods. The studies were performed in a stirred-tank bioreactor (Bioengineering AG) with a1100L capacity, equipped with two impellers coupled to the same shaft (lower Rushton turbine and a marine propeller top) both with a diameter of 0,3 m, and four baffles at 90º angles. The aeration is performed through a distributor type perforated tube under the lower impeller. To determine the operating conditions that cause the phenomenon of flooding experimental correlations of Froude number (Fr) and aeration number (Fl_G)(*3*) were employed. We propose a mathematical model of 3D bioreactor geometry using the CFD tool (CFX, ANSYS).

Results. From Figure 1, it is verified that most of the operational conditions imposed on the handling of the bioreactor are under the curves taken from the literature to represent the boundary between flooding conditions and dispersion.

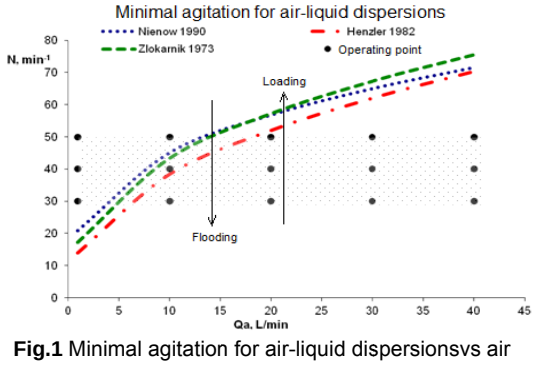

Fig.1 Minimal agitation for air-liquid dispersionsvs air flow.

The flooding condition consisting of an excess of air in correspondence with the handling capacity of the impeller causes an abrupt decrease in the gassed power (*4*).

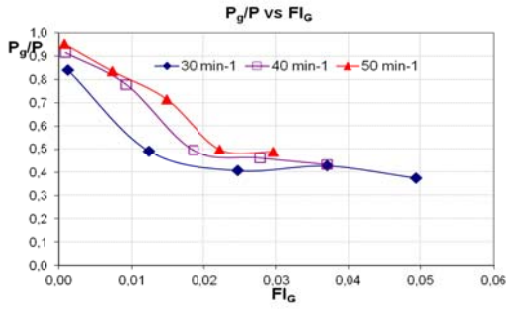

Fig.2 Relation between the gassed power/no-gassed power (P_g/P) and the gas flow number (Fl_G) for different agitation rate obtained by CFD.

Figure 2 shows the decreases of gas power as the flow number increases due to the accumulation of gas in the back of the blades of the turbine.

Conclusions. According to the comparison of the results with those published by other cases studied, the current condition of operation of the bioreactor evaluated in this study corresponds to the flooded condition of the impeller. In addition, the prediction of the phenomenon of flooding obtained by CFD is similar to the results obtained using the correlations published.

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