DEVELOPMENT AND CHARACTERIZATION OF A SYSTEM FOR THE ON-LINE DETERMINATION OF THE POWER INPUT IN SHAKEN FLASKS

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Key words: power consumption, shaken flasks, alginate

Introduction. The specific power consumption (P/V) is one of the most important operational parameters and it is regarded as one of the determining factors in shaken flasks performance. Thanks to experimental techniques developed by Büchs et al. [1], it has been possible the accurate measurement of P/V in shaken flasks. These studies have shown that power input values in shaken flasks, using low and high viscosity fluids, are equal to or even higher than, the values typically found in stirred bioreactors [2]. However, the data available are restricted to a very narrow set of conditions and therefore more studies are necessary. The aim of this work was to build and to characterize a device for the on-line measurement of the power consumption in shake flasks. This system is based on an equipment developed at the Technical University of Aachen, Germany [1].

Methods. The power input device was assembled as described by Büchs et al. [1]. Accuracy and reproducibility tests were performed with three different liquids of low, medium and high viscosity, using distilled water, solutions of algae alginate (5 g/L) and carboxymethylcellulose (CMC) (5 g/L), respectively. All tests were performed in 500 mL unbaffled flasks at constant temperature (25°C), filling volume of 100 mL and shaking speed from 80 to 300 rpm. A culture of *Azotobacter vinelandii* was characterized as described by Peña et al. [2].

Results. As expected, an exponential increase was observed with increasing shaking speed (between 80 and 300 rpm) and the values depended on the viscosity of the fluid (Figure 1a). The statistical analysis of 5 independent tests showed a high reproducibility of the system, with no significant differences according to an ANOVA test. The data were also compared with those obtained in a twin equipment available in Germany, showing very good agreement (Figure 1b). The evolution of the specific power input evaluated in cultures of *A. vinelandii* showed the same behavior reported previously by Peña et al. using a twin equipment [2] (Figure 1c).

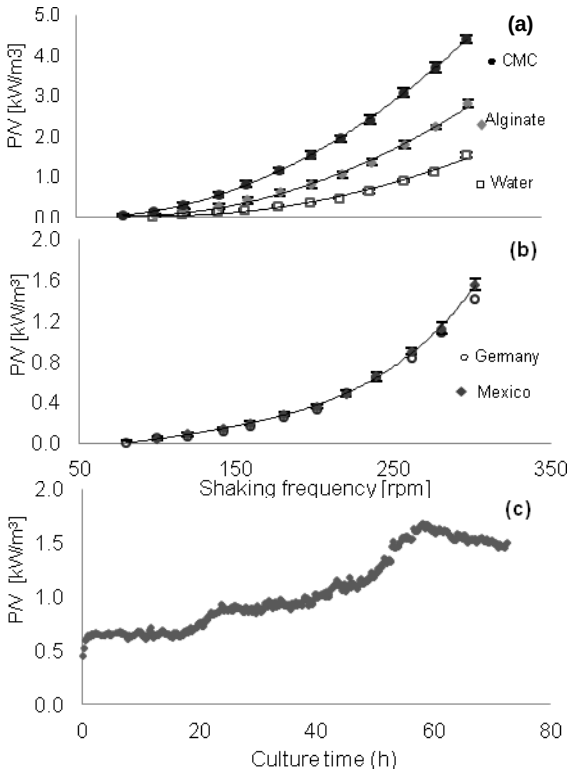

Fig.1 (a) Reproducibility tests performed with different fluids; **(b)** agreement with results from a twin equipment available in Germany (with water); **(c)** evolution of power consumption in a culture of *A. vinelandii*.

Conclusions. The equipment assembled in Mexico (unique in Latin America) is capable of measuring the power input with a high reproducibility and accuracy, comparable with the device originally developed in Germany.

Acknowledgements. Financial support of DGAPA/UNAM (grant IT200212) is gratefully acknowledged.

References.

1. Büchs J., Maier U., Milbradt C., Zoels B., (2000). *Biotechnol. Bioeng.* 68: 589-593.
2. Peña C., Peter C., Büchs J., Galindo E., (2007). *Biochem Eng*. 33: 73-80.