TECHNIQUE TO EVALUATE HEXADECANE TRANSFER VOLUMETRIC COEFICIENT IN A THREE- PHASE AIRLIFT BIORREACTOR: MASS TRANSFER AREA EFFECT

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Introduction. Airlift bioreactors (ALB) have been used in various biotechnological processes. However, ALBs are hard to design due to their flow patterns, therefore, recent studies claim it is necessary to investigate the hydrodynamic and the mass transfer phenomenon, with the purpose to enhance their efficiency in the degradation of hydrocarbons (1). The hexadecane ($C_{16}H_{34}$) is widely used as a model for oil degradation. The $C_{16}H_{34}$ transfer volumetric coefficient (k_La_{HXD}) is an important parameter of mass transference, implicated in a three–phase bioreactor. A new technique to evaluate k_La_{HXD} was proposed (1); however the mass transfer area effect over technique has not been evaluated.

The aim of this work is to evaluate the mass transfer area effect in a new technique to determine k_La_{HXD} in a three–phase ALB (H_2O, air and $C_{16}H_{34}$).

Methods. The (k_La_{HXD}) was evaluated as follows: In an ALB made out of Pyrex glass (0.14m diameter and 0.10 m height) with 10 L mineral milieu (1). Three stainless steel capsules (1 cm diameter and 3.5 cm height) filled with $C_{16}H_{34}$ were placed in the downcomer and the same was done in the riser. The air was injected with superficial gas velocity (Ug) of 1.76 cm/s. Once the aeration was stabilized, samples of 5 mL were taken every two hours, the free $C_{16}H_{34}$ was extracted with 1:1 v/v C_6H_{14} and it was analyzed in a gas chromatography. The specific area of $C_{16}H_{34}$ (a_{HXD}) was estimated by means of photographic technique (1) and analyzed by software (Image – Pro Plus 7). The diameter of the droplets of $C_{16}H_{34}$ was weighted using the Sauter mean diameter (d32). The experiments were performed by triplicate. The k_La_{HXD} was obtained like a product of $k_La_{HXD\ per}$ a_{HXD}.

Results. Table 1 shows the effect of the amount of capsules on the k_La_{HXD}. For one and two capsules on the downcomer zone the k_La_{HXD} is the same, with a little decrease in the time of the experiment with two capsules. Otherwise, for three capsules the k_La_{HXD} value is higher than for one and two capsules, indicating that the technique is susceptible to the increase of two or more capsules, probably because of perturbations in the hydrodynamic, given the increased flow obstacles in the liquid phase. The value of k_La_{HXD} for one capsule placed on the riser zone was slightly lower than the one on the downcomer zone, due to a possibly higher turbulence on the riser zone.

Table 1. Area where capsule was placed on the bioreactor, amount of capsules, runtime, k_{LHXD} y k_La_{HXD}.

Area where capsule was placed	Amount of capsules	Runtime	K_{LHXD} (cm. h^{-1})	k_La_{HXD} (h^{-1})
Downcomer	3	29	0.0969±0.002	1.559±0.02
Downcomer	2	48	0.0167±0.006	0.259±0.10
Downcomer	1	68	0.0188±0.001	0.302±0.02
Riser	1	51	0.0791±0.025	1.274±0.23

The specific area of hexadecane (a_{HXD}) is 17.17 cm^2.

Conclusions. The technique to determine the mass coefficient of transference of $C_{16}H_{34}$ is ratified for two and three capsules; however it is more susceptible for three. The area (downcomer or riser) where the capsule was placed does matter.

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References.

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