CHARACTERIZATION OF AN ELECTROCHEMICAL PILOT PLANT FILTERPRESS REACTOR BY HYDRODYNAMIC AND MASS TRANSPORT STUDIES

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This work deals with the study of the influence of turbulence promoters in hydrodynamic and mass transport behaviour of a filter-press type electrolyser with 3250 cm2 electrode area (model REIM 3300 supplied by "I.D. Electroquímica") in undivided configuration.

Experimental set-up

Figure 1. Electrochemical cell REIM 3300 supplied by "I.D. Electroquimica"

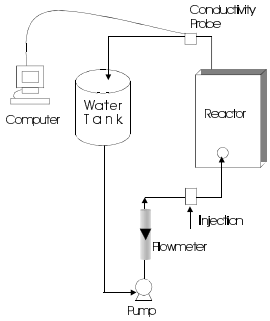

Figure 2. Diagram of experimental set-up

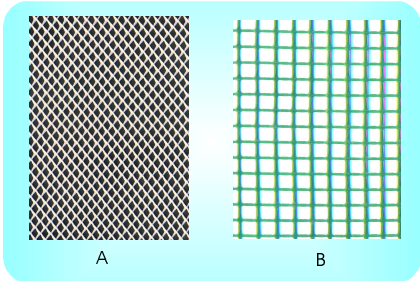

Figure 3. Turbulence promoters grids

Model

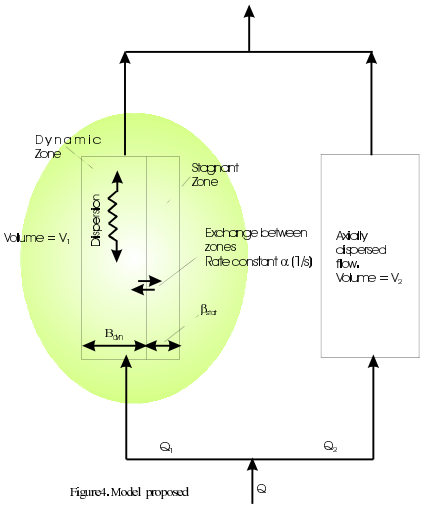

Figure 4. Model proposed

Local rate of exchange:

$J = \alpha_m (c_{dyn} - c_{sta})$

α_m = exchange coefficient

Parameters: Pe_1, Pe_2, θ_β, N_α (Normalized rate), τ_1, τ_2

Pe is the Peclet number and the subscripts 1 and 2 make reference to the stream considered (stream 1 takes into account dead volumes), N_α characterizes the rate of exchange between the stagnant zones and the dispersed plug flow. θ_β is the ratio between volume in dispersed plug flow/total volume in stream 1 and τ is the mean residence time. The $N_\alpha\theta_\beta$ product has been considered as a turbulence factor measuring the turbulence promoter effectiveness.

Results

The optimized values of the parameters provided by the model give a plug flow hydrodynamic behaviour with low axial dispersion for the reactor with turbulence promoters (higher Pe and θ_β values than empty configuration) and more mixing for the empty configuration. It is also very interesting to highlight that the turbulence factor (see Table) decreases as Re increases, showing the same behaviour that the mass transport enhancement coefficient obtained from electrochemical studies using the limiting current technique.

The classification obtained by electrochemical method for the turbulence promoters (plastic nets) A and B is the same than that obtained from hydrodynamic study: B > A > empty.

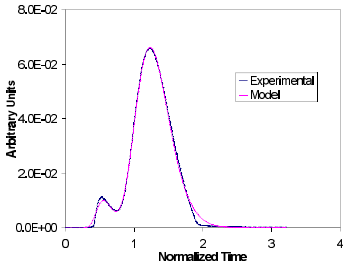

Figure 5. Example of a experimental and model curves for the reactor working at Re=847 and promoter B.

	Promoter A			Promoter B			Empty		
Re	θ_β	N_α	$N_\alpha\cdot\theta_\beta$	θ_β	N_α	$N_\alpha\cdot\theta_\beta$	θ_β	N_α	$N_\alpha\cdot\theta_\beta$
317	0.81	0.38	0.31	0.78	3.35	2.61	0.86	0.31	0.27
423	0.79	0.32	0.25	0.79	3.07	2.43	0.76	0.2	0.15
529	0.8	0.23	0.18	0.83	2.35	1.95	0.85	0.27	0.23
635	0,82	0,14	0,11	0,86	2,20	1,89	0,92	0,17	0,16
741	0,82	0,16	0,13	0,83	2,06	1,71	0,84	0,12	0,10
847	0.9	0.11	0.10	0.99	1.06	1.06	0.83	0.10	0.08

References

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[2] José González-García, Angel Frías, Eduardo Expósito, Vicente Montiel, Juan A. Conesa and Antonio Aldaz, *Characterization of an electrochemical pilot-plant filter-press reactor by hydrodynamic and mass transport studies*, Ind. Eng. Chem. Res. 39 (2000), 1132-1142.

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