Biodegradation of diethylketone by *S. equisimilis*

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Problems related to the presence of organic solvents in the aquatic environment, especially in industrial effluents are well known. These substances are regulated under severe restrictions with regard to their levels in the environment due to their hazardous effects in life and natural ecosystems. Ketones are commonly employed in numerous industries (e.g. food, chemicals, electronics, pharmaceutical) where they may act as a substrate or as a solvent in the production of drugs, vitamins and cosmetics. One common example is diethylketone, which despite being used in many anthropogenic activities as a solvent and as an intermediate in the synthesis of pharmaceuticals, flavors and pesticides among others, has had few studies regarding its biodegradability.

This work aims the development of a technology that may decontaminate aqueous solutions containing diethylketone. Batch studies were made aiming to investigate the biodegradation ability of concentrated *Streptococcus equisimilis* (5g/L) for the treatment of aqueous solutions containing diethylketone. The effect of the initial concentration of diethylketone (0 - 7.5g/L) and the effect of stirring speed (100-200 rpm) on the growth of the bacteria as well as the percentage of diethylketone biodegraded were evaluated. The effects of pH variation along each assay were also analysed. Control experiments without diethylketone and with only diethylketone were also performed.

The kinetic paramenters were estimated using five growth kinetic models for biodegradation of organic compounds: Monod, Haldane, Powell, Luong and Edward (Table 1) and four biodegradation kinetic models: zero order, pseudo-first, pseudo-second and three-half order.

Table 1- Growth kinetic paramenters obtained from different growth models

Stirring spedd (rpm)	Model	μ max (h^{-1})	K_s (g/L)	K_1(g/L)	S_m(g/L)	S_{crit}(g/L	K	m	n	R^2
100	Monod	-0.00651	0.3496	-	-	-	-	-	-	0.9246
	Powell	-0.00556	0.2712	-	-	-	-	7.990E-4	-	0.9931
	Haldane	5.384	0.0087	-1179	-	3.209	-	-	-	0.9574
	Luong	-0.016	2.262	-	13.950	-	-	-	1.111	0.9684

	Edward	-0.005	0.030	-3E20	-	-	1	-	-	0.9434
150	Monod	0.0166	0.5719	-	-	-	-	-	-	0.9323
	Powell	0.0190	0.899	-	-	-	-	1.610E-6	-	0.9759
	Haldane	0.0283	1.838	19.220	-	5.944	-	-	-	1
	Luong	0.0203	1.056	-	7.501	-	-	-	0.0312	0.9728
	Edward	0.0166	0.5719	9.643E15	-	-	2.520	-	-	0.9323
200	Monod	0.006	0.593	-	-	-	-	-	-	0.9624
	Powell	0.006	0.655	-	-	-	-	-3.770E-4	-	0.9717
	Haldane	44.17	10512	0.001	-	2.370	-	-	-	0.9794
	Luong	0.036	6.051	-	4.830E7	-	-	-	1.340E7	0.9666
	Edward	0.0053	0.4607	2.163E14	-	-	6.260E11	-	-	0.9139

For all the assays conducted at 100 rpm the biodegradation of diethylketone reaches values higher than 95% and followed the pseudo-second order kinetics. For all the assays with higher stirring speeds the biodegradation of diethylketone was equal to 100% and followed the pseudo-second order for 150 rpm stirring speed and the pseudo-first order for 200 rpm stirring speed.

The study showed that the concentrated culture of *S. equisimilis* is capable of efficiently biodegrade an aqueous solution containing diethylketone. It is also possible to conclude that

1- The stirring speed influences a) the growth of the biomass since it will limit the ability of the biomass to consume the carbon source; b) the biodegradation kinetics, since for agitation speed above 200 rpm the obtained results are best described by the pseudo-first order, suggesting that under these conditions the process depends on time and sorption sites and not on the concentration of biomass or substrate; c) the period of time required to achieve biodegradation of over 90%. The initial concentration of diethylketone and the stirring speed used do not influence the pH variation (initial and final pH ±5 to 8.5, respectively).

2- The culture is inhibited by substrate in assays with a stirring speed equal or higher than 150 rpm and the critical substrate concentration was determinate to be circa 6g/L and 2.4 g/L, respectively for the assays conducted at 150 and 200 rpm.