Diffusion Effects in Heterogenously Catalyzed Enzymatic Rearrangement

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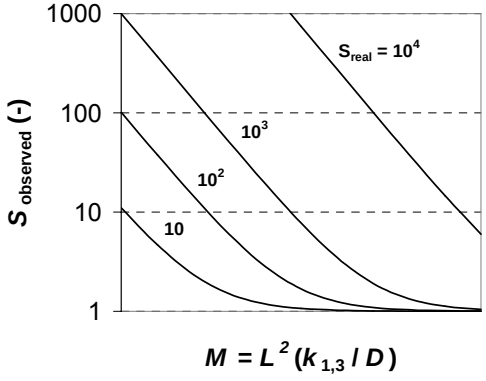
Enzymatic processes for the modification of oils and fats are of increasing interest, as they allow manufacture of fats with tailored properties that cannot be made by conventional processes.

The selectivity S_{real} of a native enzyme used in such a process may be expressed as the ratio of the rate of fatty acid interchange between (sn-1↔sn-3) and (sn-2↔sn-3). This selectivity is enzyme dependend and can even be different for different fatty acids. It is well known that immobilization of an enzyme on a substrate can decrease the selectivity. Currently available commercial catalysts consist of immobilized enzymes inside of a porous substrate, size typically on the order of 1 mm.

As a result another source of decreased (observed) selectivity can be the severity of diffusion limitations that occure inside this porous particle. The observed selectivity S_{obs} can be expressed as a function of the diffusion modulus M, which is a function of catalyst size L, effective diffusivity of the fat molecules D_{eff} and the rate of interchange $k_{1\leftrightarrow3}$

$$M = L^2\left(\frac{k_{1\leftrightarrow3}}{D_{eff}}\right)$$

It will be shown that for commercial catalysts the conditions are such that diffusion effects cannot be excluded and will influence the final triglyceride mix.



Influence of increasing diffusion modulus M on the observed selectivity S_{obs}