Kinetic Evaluation of Oxygen-Dependent Enzymes Converting Poorly Water-Soluble Substrates

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Reaction kinetics: a generic approach

- Accurate analytics are key at all scales.
- Online, non-intrusive methods are preferred to overcome sampling challenges brought about by heterogeneous reaction mixtures.
- Oxygen mass balance for kinetic estimations applied in the fields of respirometry (wastewater treatment) & solid state fermentations.

Theory and model system

Glucose oxidase (GOx) used as a model system for validation

\[
\frac{1}{2}O_2 + \text{Glucose} \xrightarrow{\text{GOx catalysis}} \text{Gluconic acid} + H_2O
\]

\( \text{mmol.min}^{-1} \) in gas outlet stream found by ideal gas law:

\[
V_{\text{out}} = \frac{P_{\text{out}}\,V}{RT}
\]

Initially when no reaction is taking place (at steady state):

\[
R_{O_2,\text{in}} = R_{O_2,\text{out}}
\]

\( R_{O_2} (= \frac{1}{2}R_{\text{Glucose}}) \) [mmol.L\(^{-1}\).min\(^{-1}\)]:

\[
\frac{dC_{O_2}}{dt} = \frac{(n_{0,\text{in}} - n_{0,\text{out}})}{V}
\]

Conclusions

Accurate kinetic predictions by off-gas oxygen mass balance hold potential for any oxygen-dependent reactions where representative sampling is challenging (e.g. heterogeneous reactions).

Key References:

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