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Complementary Methods for the Determination of Dissolved Oxygen Content in Perfluorocarbon Emulsions and Other Solutions

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Abstract:

Perfluorocarbons (PFCs) are compounds with increased oxygen solubility and effective diffusivity, making them ideal candidates for improving oxygen mass transfer in numerous biological applications. Historically, quantification of the mass transfer characteristics of these liquids has relied on the use of elaborate laboratory equipment and complicated methodologies, such as in-line gas chromatography coupled with temperature-controlled glass fritted diffusion cells. In this work, we present an alternative method for the determination of dissolved oxygen content in PFC emulsions and, by extrapolation, pure PFCs. We implemented a simple stirred oxygen consumption microchamber coupled with an enzymatic reaction for the quantitative determination of oxygen by optical density measurements. Chambers were also custom fitted with lifetime oxygen sensors to permit simultaneous measurement of internal chamber oxygen levels. Analysing the consumption of oxygen during the enzymatic reaction via recorded oxygen depletion traces, we found a strong degree of correlation between the zero-order reaction rate and the total measured oxygen concentrations, relative to control solutions. The values obtained were in close agreement with published values in the literature, establishing the accuracy of this method. Overall, this method allows for easy, reliable, and reproducible measurements of oxygen content in aqueous solutions, including, but not limited to PFC emulsions.

Key-words: Perfluorocarbons; oxygen solubility & diffusivity; oxygen mass transfer; oxygen consumption chamber; Trinder Reaction