Professur für Chemische und Thermische Verfahrenstechnik
Campus Straubing für Biotechnologie und Nachhaltigkeit
Technische Universität München

Experimental bachelor‘s thesis, research internship

Determination of the Temperature-Dependent Protonation Equilibria of Neutral Red and Nicotinamide

Description

Global warming continues to be one of the most alarming threats to humanity. As fossil fuels continue to dominate global energy production, large-scale carbon dioxide removal (CDR) technologies will become essential. The Laboratory for Chemical Process Engineering is actively researching Negative Emission Technologies (NET) and assessing their feasibility.
Electrochemically driven CDR methods offer promise due to their potentially lower energy requirements. To avoid the high voltage (min. 1.23 V) typically required in aqueous systems and thereby reduce energy consumption, alternative redox systems such as neutral red have been proposed. This system theoretically requires a fraction of the usual voltage, making it highly energy-efficient. However, critical physicochemical properties, such as protonation equilibria, remain insufficiently characterized, limiting accurate process simulation.
This study aims to determine the protonation equilibria of neutral red, nicotinamide, and selected reference compounds in aqueous solutions at varying temperatures. To achieve this, a laboratory setup and a standardized operating procedure will be developed. A systematic parameter study will then be conducted to analyze the temperature dependence of protonation equilibria. The resulting data will be used to derive temperature-dependent equilibrium constants.

Requirements

- Interest and experience in laboratory analytical techniques (preferred)
- Background in chemical thermodynamics, physical chemistry, or reaction engineering (desirable)
- Motivation and ability to work independently while collaborating with advisors

Tasks

- Familiarization with electrochemical CO_2 removal and temperature-dependent chemical equilibria
- Planning and performing titration experiments
- Data analysis, consolidation, and parameter estimation

The focus and scope of the work will be agreed upon in a personal interview.

Start date

- immediately

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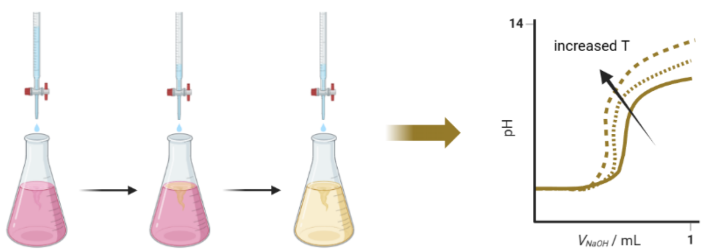

$$\ln(K_{a,j}) = A_j - B_j \cdot (RT)^{-1}$$