UNIVERSITEIT VAN PRETORIA
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YUNIBESITHI YA PRETORIA

Electrodialysis in flow injection systems

by

Cornelius Johannes Hattingh

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Summary

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Cornelius Johannes Hattingh

Supervisor: Professor JF van Staden

Department of Chemistry

University of Pretoria

Degree: Philosophiae Doctor

Flow injection analysis (FIA) is a continuous flow technique developed in the early 1970's. FIA is based on reproducible sample injection, accurate timing and controlled dispersion. This technique is very versatile due to the control of the variables and can easily be automated. This technique is very suitable for routine laboratory analysis. By introducing various sample modifying techniques in tandem with the FIA system, samples can easily be modified. Some modifying techniques are analyte pre-concentration, sample dilution and sample cleanup. Passive dialysis can be used very successfully for sample dilution and cleanup. Problems arise when samples with low analyte concentration have to be analysed. For this reason an electrodialyser unit, equipped with a passive membrane, was developed. The history, development and theory of membranes and membrane processes are discussed. A study of the movement of ions, in solution and across a passive membrane, under the influence of an applied d.c. electrical potential is given. Passive

membranes were evaluated for use in the proposed system. The following factors influencing the efficiency of electrodialysis in the FI system were studied: The flow rate of the donor and acceptor channels; the applied d.c. electrical potential; injection loop volumes; flow direction in the electrodialyser unit. An investigation was done into on-line analyte pre-concentration and regulated dilution probabilities of the electrodialysis system. Systems that were evaluated are the following: The determination of chloride in water effluents; The determination of copper and zinc in pharmaceuticals; The direct and indirect determination of phosphate in fertilisers. A comparative study between the advantages and disadvantages of the passive dialysis and electrodialysis system is given.

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Elektrodialise in vloei inspuit sisteme

deur

Cornelius Johannes Hattingh

Voorgelê ter vervulling van 'n deel van die vereistes vir die graad

Philosophiae Doctor

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Samevatting

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Cornelius Johannes Hattingh

Studieleier: Professor JF van Staden

Departement Chemie

Universiteit van Pretoria

Graad: Philosophiae Doctor

Vloei inspuit analise (VIA) is 'n kontinue vloeitegniek wat aan die begin van die 1970's ontwikkel is. VIA is gebaseer op herhaaldelike monsterinspuiting, akkurate tydmeting en gekontroleerde dispersie. Hierdie tegniek is baie veelsydig weens die beheer van veranderlikes. Hierdie tegniek kan ook maklik ge-outomatiseer word. Hierdie tegniek is verder baie toepaslik vir gebruik in roetine laboratoria. Deur verskeie monstermodifikasie tegnieke in die VIA sisteem in te sluit kan monsters verander word om die sisteem se toepassing te optimiseer. Somige modifikasietegnieke sluit in die analiet prekonsentrasie, monster verdunning en suiwering van monsters. Passiewe dialise kan met sukses vir monster verdunning en suiwering aangewend word. Probleme onstaan egter indien die analiet konsentrasie reeds laag is. Om hierdie rede is 'n elektrodialiseerder, wat toegerus is met 'n passiewe membraan, ontwikkel. 'n Kort inleiding rakende die onwikkeling van die analitiese proses word gegee. Die geskiedenis, onwikkeling en teorie van membrane en membraanprosesse is bespreek. 'n Studie van die beweging van ione, in 'n oplossing en oor 'n passiewe membraan, onder die invloed van 'n toegepaste direkte stroom elektriese potensiaal is gedoen. Passiewe membrane vir gebruik in die voorgestelde elektrodialiseerder is ge-evalueer. Die volgende faktore wat die effektiwiteit van elektrodialise in die VI sisteem beïnvloed, is bestudeer: die vloeitempo van die skenker- en ontvangerstrome; die toegepaste direkte stroom spanning; die inspuit volumes; vloeirigting in die elektrodialiseerdereënheid. 'n Ondersoek na analiet prekonsentrasie en beheerbare aanlynverdunnings deur die elektrodialise sisteem is uitgevoer. Die volgende sisteme is ge-evalueer: Die bepaling van chloried in afvloeiwater; die bepaling van koper en sink in farmaseutiese produkte; die direkte en indirekte bepaling van fosfaat in kunsmis. 'n Verglykende studie van voor- en nadele van passiewe en elektrodialise word gegee.

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