# Multi-component Determinations using Sequential Injection Analysis

by

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## SYNOPSIS

The need to measure several parameters rapidly in the same sample in areas such as clinical chemistry, environmental pollution and industrial control has urged the development of automated methods of analysis. Multiple determinations are feasible, not only because it is more cost-effective, but also because it shortens or eliminates separation steps needed to remove interferences due to closely related species. This results in less sample preparation and eliminates loss of analyte due to long and sometimes ineffective pretreatment methods.

Several multi-component sequential injection systems are proposed. These include a novel tandem application of SIA, which is based on an optimised sequence of samples and reagents in the holding coil, as well as the kinetics of the reactions involved, to determine sulphate and iron sequentially or simultaneously in aqueous samples. The same analytes were used to evaluate a sandwich technique based on the introduction of a very large sample volume, sandwiched between two different reagents. A method based on differential kinetics was used to determine nickel and cobalt with the same reagent (PAR) without prior separation. Three sequential extraction systems were developed for the determination of two up to seven metal ions in the same samples.

Compared to flow injection extraction, the sequential injection extraction manifold is much simpler to design, since no phase segmenters or separators are needed.

For all of these determinations, SIA manifolds with only a single detector were used. The usefulness, cost-effectiveness and advantages of multi-component sequential injection analysis over convential (multi-component) flow injection analysis are demonstrated.

**Multi-komponent Bepalings met behulp van Sekwensiële-inspuitanalise**

**deur**

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# SAMEVATTING

Die behoefte om verskeie parameters in dieselfde monster vinnig en effektief te bepaal, het die ontwikkeling van geoutomatiseerde analitiese metodes versnel. Hierdie behoefte het veral op die gebied van kliniese chemie, besoedelingsbeheer asook industriële kwaliteitsbeheer ontstaan. Veelvuldige bepalings is wenslik, nie alleen omdat dit goedkoper is nie, maar ook weens die feit dat die skeidingstap benodig om steurings weens soortgelyke spesies te verwyder, verkort of heeltemal weggelaat kan word. Die resultaat hiervan is dat minder monstervoorbereiding benodig word. Dit opsigself verminder die verlies aan analiet as gevolg van lang en soms oneffektiewe monstervoorbereidingsmetodes.

Verskeie multi-komponent sekwensiële-inspuitanalise sisteme is voorgestel tydens hierdie studie, onder andere 'n nuwe tandem toepassing van SIA vir die agtereenvolgende of gelyktydige bepaling van yster en sulfaat in waterige monsters. Die bepaling is gebaseer op 'n geoptimiseerde volgorde van monsters en reagense in die deurvloeispiraal asook die kinetika van die betrokke reaksies. Dieselfde analiete is gebruik in die evaluering van 'n "toebroodjie-tegniek". Die tegniek is gebaseer op die

gebruik van 'n baie groot monstervolume wat geleë is tussen twee verskillende reagens oplossings. 'n Metode gebaseer op differensiële kinetika is aangewend vir die bepaling van nikkel en kobalt met dieselfde reagens (PAR), sonder die vooraf skeiding van die analiete. Drie sekwensiële-inspuitekstraksie sisteme is ontwikkel vir die bepaling van twee tot en met sewe metaalione in monsters. In vergelyking met vloei-inspuitekstrasie is die sisteemontwerp van die sekwensiële-inspuitekstraksie eenhede baie eenvoudig, aangesien geen fasesegmenteerders of -skeiers benodig word nie.

Al die voorgestelde bepalings het van SIA sisteme met slegs een detektor gebruik gemaak. Die aanwending, ekonomiese en ander voordele van hierdie veelvuldige tegniek bo konvensionele vloei-inspuitanalise (VIA) is aangetoon.

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*To Him who by means of His power working in us is able to do so much more than we can ever asks for, or even think of: to God be the glory.*

Ephesians 3 : 20 - 21.

# Table of Contents