

Sequential-injection Analysis

AFRICA

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by

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Synopsis

Process Analytical Science (PAS) is a rapidly developing sub-discipline of Analytical Science. Tried and tested analytical principles are applied in modified instrumental architectures that enable the real-time monitoring of key process constituents.

Process Analyzers are becoming vital and valuable components of sophisticated distributed control strategies. Their acceptance and usefulness is resulting in ever increasing demands on the process analysis researcher. Chemical sensors, first believed to be the ultimate solution for the process controller, have not enjoyed the wide spread application initially predicted. Their long term reliability has not materialized in all but a few cases. An intermediate or alternative approach is required which will incorporate the conceptual simplicity and size of sensors and the predictable and controlled environment of well established flow-based sample

manipulation procedures such as flow-injection analysis (FIA) and the various branches of chromatography.

This study describes the development of such a technique which has been called Sequential-injection Analysis (SIA). The theoretical basis on which the technique is founded is outlined together with the progression of thinking which lead to its conceptualisation. Its successful implementation depends entirely on microprocessor controlled flow programming. The development of a device control and data acquisition package was mandatory and is described. The study then focuses on establishing the operational parameters affecting the design of a SIA manifold.

Having established the manifold design principles, SIA is evaluated as an approach to sample manipulation. The wet chemical unit operation of trace enrichment is applied to SIA. Although the use of SIA for many traditional FIA applications is envisaged, the use of SIA principles with chemical sensors as the means of detection is seen as the ultimate application of this flow-based analytical technique. Some would be so bold as to claim that it is possibly the basis of successful implementation of chemical sensors. Its usefulness and advantages over FIA in such an application is demonstrated. The hardware requirements for the future optimum development of this approach to process analysis as well as some future areas of work conclude the study.

Sequential-injection Analysis

deur

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Samevatting

Die wetenskap van prosesanalise is 'n snelontwikkelende subdissipline van die Analitiese Wetenskap. Beproefde analitiese beginsels word aangewend in gewysigde instrumentasie wat die monitering van hoof prosesbestanddele in reële tyd moontlik maak. Prosesanaliseerders word steeds belangriker en waardevoller komponente in gesofistikeerde verspreide-beheer strategieë. Hulle aanvaarding en nuttigheid bring eskalerende eise mee vir die prosesanalitiesenavorser. Chemiese sensors wat eers beskou is as die eindoplossing vir prosesbeheer, geniet nie die wydverspreide toepassing wat oorspronklik voorspel is nie omdat hulle langtermyn betroubaarheid net in 'n paar gevalle bewys is. 'n Tussentydse of alternatiewe benadering, wat die konseptuele eenvoud en grootte van die sensors kombineer met die voorspelbare en beheerde milieu van goed gevestigde vloeigebaseerde monsterhanteringsprosedures, soos vloeï-inspuitanalise (VIA) en chromatografie, word benodig.

Hierdie studie beskryf die ontwikkeling van so 'n tegniek wat sekvensiële-inspuitanalise (SIA) genoem word. Die teoretiese basis waarop die tegniek berus, word geskets saam met die vooruitgang in denke wat gelei het tot sy totstandkoming. Die suksesvolle implementering van die tegniek maak volkome staat op vloeibeheer deur middel van 'n mikroverwerker. Die ontwikkeling van 'n apparaatbeheer- en dataverkrygingsprogram was daarom noodsaaklik en word beskryf. Daarna fokus die studie op die bepaling van bedryfsparameters wat die ontwerp van 'n SIA vloeisistiem beïnvloed.

Nadat die ontwerpbeginsels vir die vloeisistiem vasgestel is, word SIA geëvalueer as 'n benadering tot monster-manipulasie. Spoorverryking as eenheidsbewerking word aangewend ten opsigte van SIA. Al word die gebruik van SIA beoog vir sommige tradisionele VIA toepassings, word die gebruik van SIA beginsels met chemiese sensors as metingswyse beskou as die uiteindelijke toepassing van hierdie vloeigebaseerde analitiese tegniek. Sommige sal hulle verstout om te sê dat dit moontlik die basis vir die suksesvolle implementering van chemiese sensors is. Die nut en voordele bo VIA in so 'n toepassing word aangetoon. Die studie word afgesluit met die hardeware behoeftes vir die toekomstige optimum ontwikkeling van hierdie benadering tot prosesanalise, en 'n aantal toekomstige studieveldde.

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Here I stand on the edge of an ocean of truth. I have picked up a few grains of sand, but the whole ocean lies beyond me, unknown.

– Isaac Newton