



UNDERSTANDING THE NON-CONSERVATIVE
BEHAVIOUR OF FLUORESCHEIN

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By Simon Alastair Smith

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by

Simon Alastair Smith

Promoter: Prof. W.A. Pretorius

Department: Chemical Engineering, Water Utilisation Division

Degree: MSc (Water Utilisation)

Summary

Fluorescein is a widely used tracer because it is easy to detect. Unfortunately its non-conservative character restricts its use to qualitative analysis. This study investigates the possible causes of fluorescein's non-conservative behaviour so that it can also be used for quantitative analysis.

The different ionic forms of fluorescein have markedly different physical characteristics but it is possible to predict exactly when these ionic changes occur if the ionisation constants (pK_a) are known. Unfortunately there is little agreement between the published pK_a or absorptivity constants of fluorescein. A new pK_a determination method was developed and activity corrections were found to play an important role in this process. When these activity corrections were also applied to other published pK_a there was agreement between the corrected values and the pK_a values found in this study.

A series of elution trials showed that the pK_a and absorptivity factors determined using the new pK_a determination method yielded consistent results and that these results were that same as those of a much simpler fluorescein detection technique. A separate experiment confirmed that intense sunlight does degrade fluorescein quickly but that even hot samples are stable if kept in the dark.

Keywords

Fluorescein, disodium fluorescein, tracer, non-conservative, ionisation constants, pK_a determination, absorptivity, absorbance.



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Opsomming

Fluorescein word algemeen as spoorder gebruik omdat dit maklik bepaalbaar is. Ongelukkig word dié gebruik tot kwalitatiewe ondersoek beperk omdat fluorescein nie-konserwatief van aard is. Hierdie studie ondersoek moontlike redes vir die nie-konserwatiewe gedrag van fluorescein sodat dit moontlik ook vir kwantitatiewe analise gebruik kan word.

Die fisiese eienskappe van die onderskeie ioniese vorms van fluorescein verskil merkbaar, maar dit is moontlik om presies te voorspel wanneer die ionise veranderings plaasvind as die dissosiasiekonstantes (pK_a) bekend is. Ongelukkig verskil die gepubliseerde pK_a waardes en absorpsie konstantes van fluorescein grootliks. 'n Nuwe metode om pK_a te bepaal, is ontwikkel en daar is ook gevind dat aktiwiteitregstellings 'n belangrike rol speel. As dié aktiwiteitregstellings op gepubliseerde pK_a waardes toegepas word, is daar ooreenstemming tussen die aangepaste waardes en dié wat in die studie bepaal is.

'n Reeks kolom eleuringstoetse het bevestig dat die pK_a waardes en absorptiwiteit faktore wat met die nuwe pK_a metode gedoen is, herhaalbare resultate lewer en dat dié resultate ooreenstem met 'n eenvoudige fluorescein bepalingmetode. Afsonderlike eksperimente het bevestig dat sterk sonlig fluorescein vinnig kan afbreek terwyl warm fluorescein oplossings stabiel is as dit in die donker bewaar word.