SA waterbulletin

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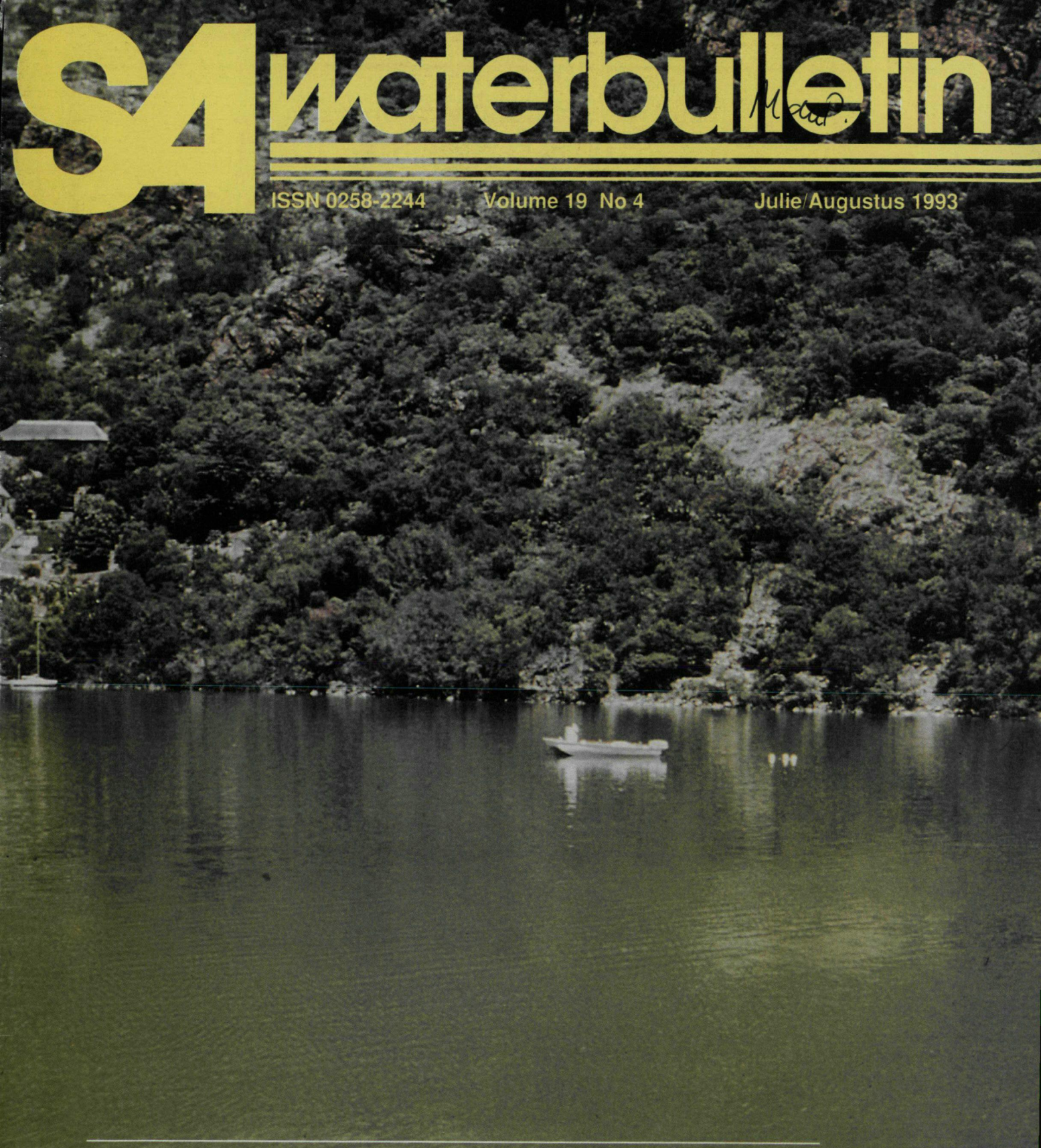

NATSURV
WRC Guide to assist textile industry with water problems

AFVALWATER
Navorsers evalueer fosfaatverwyderingsmodelle

GROUND WATER
New computer software makes SA's National Ground-water Data Base facilities more user friendly

00010035

FAKULTEIT NATUURWETENSKAPPE
TECHNIKON PRETORIA

Departement Waterversorging

KORTKURSUSSE 1993

❑ Wateranalisedataverwerking

November 1 - 5 Koste: R500

Die kursus behels monsterneming, statistiese verwerking van analise, kwaliteitskontrole, interpretasie van data versamel vanaf drinkwatersuiweringswerke, biologiese filters, geaktiveerde slyk, nutriëntverwydering en anaerobiese vertering.

Sluitingsdatum: 15 Oktober 1993

❑ Fosfaatverwydering uit afvalwater

November 15 - 19 Koste: R500

Die kursus behels die teorie en bedryf van chemiese en biologiese prosesse asook slykhantering.

Sluitingsdatum: 29 Oktober 1993

❑ Chemiese Wateranalise

November 22 - 26 Koste R1 000

Die kursus dek inleidende laboratoriumtegnieke, monsterneming, dataverwerking, chemiese berekeninge, analitiese prosedures, gravimetrie, titrimetrie, elektroanalise, spektrofotometrie, atoomabsorpsie- en emissiespektrometrie, chromatografie, distilleringsprosedures en praktiese werk.

Sluitingsdatum: 5 November 1993

Die meeste kursusse is ontwerp vir persone met of sonder enige vorige opleiding in die tegnieke. Omdat basiese sowel as gespesialiseerde aspekte in beide die teorie en praktiese opleiding aandag sal geniet, sal die kursusganger met baie meer selfvertroue en inisiatief die kursus verlaat.

Let wel:

- ❑ 'n Volledige stel lesings asook 'n praktiese handleiding, waar van toepassing, word in enigeen van die twee landstale voorsien.
- ❑ 'n Maksimum aantal kandidate kan per kursus geakkomodeer word. Die aansoeke vir elke kursus wat eerste ontvang word, sal voorkeur geniet. "n Minimum aantal deelnemers word ook benodig voordat 'n kursus aangebied sal word.
- ❑ Beide amptelike tale sal gebruik word vir die aanbieding van die kursusse.
- ❑ 'n Eksamen sal aan die einde van elke kursus afgeneem word. Punte sal ook vir praktiese werk toegeken word, waar van toepassing. Amptelike sertifikate sal slegs aan kandidate uitgereik word wat die teoretiese en praktiese gedeeltes slaag. Kandidate wat nie slaag nie, ontvang slegs 'n bywoningsertifikaat.

Inligting en besprekings

Die Hoof: Departement Waterversorging, Skool vir Natuurwetenskappe, Technikon Pretoria, Privaatsak X680, Pretoria 0001

Tel (Sieg Schwarzer) (012) 28-3811 x 262 of (Marthie Coetzee) (012) 28-3811 x228.

Faksnommer (Vermeulenstraatkampus) (012) 325-8529

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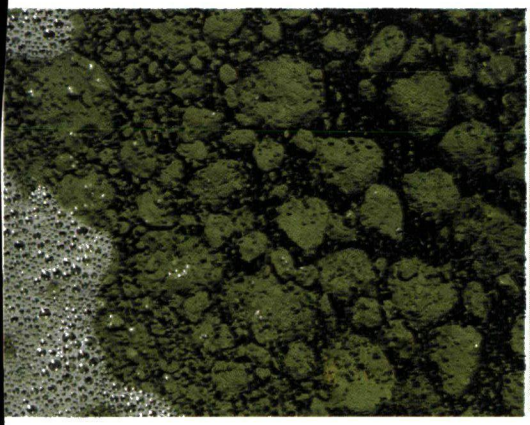
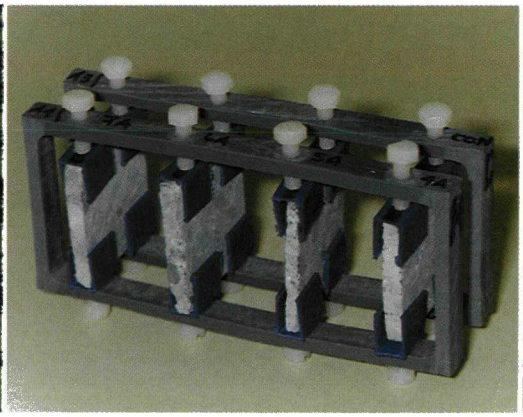


p 12



p 16

p 18

Inhoud

Voorblad: Hartbeespoortdam, die mees nutrient verrykte dam in Suid-Afrika.

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Water & Hydraulics Specialists Confer at Victoria Falls

A symposium on water and river management for developing countries was recently held in Zimbabwe. Dr JM Jordaan from the Department of Water Affairs and Forestry who attended the event, reports.

A very successful symposium on "Water the Lifeblood of Africa" was held in Zimbabwe (11-15 July) under the auspices of the International Association for Hydraulic Research (IAHR). The venue was the Elephant Hills Hotel at Victoria Falls and the host was the African Division's Southern African Interest Group under the leadership of Professor David Stephenson of the Witwatersrand University.

Forty scientific papers on water aspects, mainly of the African continent, were presented as well as some twenty poster papers and three working exhibits of water supply related subjects.

More than one hundred delegates attended the symposium, some from as far away as Australia, Taiwan, Turkey, Norway, United States and the West Bank (Israel/Jordan). African countries represented were Egypt, Sudan, Malawi, Lesotho, Mozambique, Namibia and South Africa. Two post-conference tours were arranged, one to Lake Kariba and one to the Okavango Delta in Botswana.

The symposium dealt with water and river management aspects for developing countries, sustainable growth and technology relating to water, system analysis, research on hydraulic devices and problem solving and solution finding in water recovery, conveyance, storage and distribution projects.

The opening remarks by Professor Torkild Carstens, Secretary-General of IAHR: "Water both divides and unites", referred to rivers often being political boundaries between neighbouring states but also bringing them together in multinational projects and inter-basin water transfer schemes. (A paper in a similar vein on water and energy interrelationships was presented by Mr A van Tonder of EMATEK.)

The keynote speaker was Professor Margaret Peterson, formerly USACE engineer and now working at the University of Arizona. Her lecture was entitled "Water and Africa - the Human Dimension" and dealt in a very precise and detailed way with the water developments in various African regions, and the continent as a whole, emphasising the vast, untapped

Victoria Falls - an ideal setting for a water symposium.

Two delegates from South Africa arriving at the conference. Mr A van Tonder (left) and Dr M Shand.

potential and the rising social needs for coordinated development around the available resources.

Professor John S McNown gave a lecture on the use of international rivers in Africa, noting the serious political problems faced in Africa and the key role that water plays in establishing a more reliable social network in most countries.

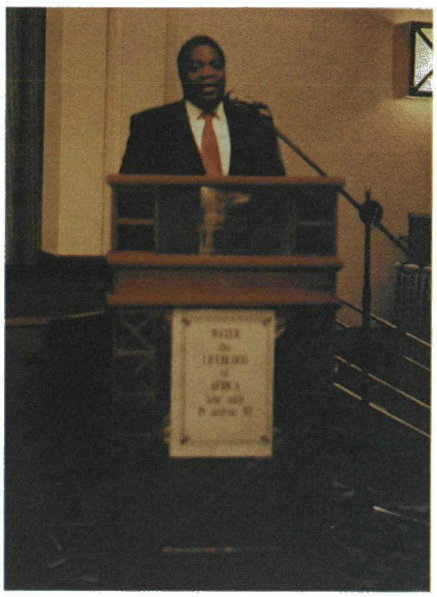
On the research side a number of innovations were described among others the "Serpent" sedimentation tank desalter, the Matthews gate to control and schedule releases of water in canals, the Aquatan pond-lining and reservoir-cover system and the use of greenhouses to raise four crops per annum in the West Bank area of Jordan (under Israeli occupation).

Papers by Yilmaz on water supply in Istanbul, Turkey, and Gasser and Saad on the management of the Nile River and Aswan Dam water respectively gave new firsthand information.

Professor Abdin Salih, the Chairman of the African Division of IAHR emphasised in his opening address the need for international cooperation on the African continent, among at times, many diverse nationalities and interests developing along parallel lines. IAHR can perform such a liaison function in technology transfer through symposia, conferences and congresses, he suggested. Zimbabwe's Minister of Land, Agriculture and Water presided at the banquet and announced several new water engineering projects recently approved there.

At the conclusion of the symposium the new "Southern Region of the African Division of the IAHR" was duly formed with Professor Stephenson elected as chairman. The other nine southern African countries were represented on the nominating panel and each will be allowed one member to be elected at the next meeting, scheduled for later this year. The next notable event will be the IAHR African Regional Congress in Khartoum, Sudan, in February 1994 with the theme "Water Project Development". In August 1993 the International Congress of the IAHR is taking place in Tokyo, Japan, with the theme: "Water and Natural Disasters".

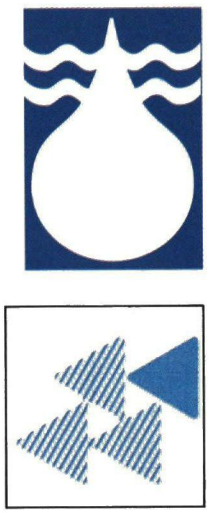
The symposium in Zimbabwe also covered fields like unconventional water sources (JP Kriel), remote sensing (A Howman) and the Vaal River system quality modelling (G Quibell). Transkei water projects were featured (A McLellan). One of the demonstrations was of the Mike 11 water flow model (K Blake, EMATEK). American author Prasuhn gave a vivid account of what can go wrong with inadequate project management while another American, Clark, discussed the water resources of the North West United States. Solar energy for ground-water recovery in remote areas was another novel application announced by Mailu from Kenia and Chen from Taipei explained the details of a water resource project in the semi-arid south west quarter of Taiwan.



The Zimbabwean Minister of Lands, Agriculture and Water development, Mr KM Kangai.

The proceedings are available as an A4-size bound volume from Professor Stephenson, Water Research Group, Private Bag X3, WITS 2050.

The Victoria Falls as seen from the conference venue.



Phosphate fixed with controlled struvite formation

In 1988, as a result of work done by the CSIR's Division of Water Technology (DWT) on phosphate crystallization in activated sludge systems, the Water Reseach Commission again appointed the DWT to investigate the fixation of phosphate in waste water by means of controlled struvite formation.

In a final report to the Water Research Commission, the researcher, Miss GA Momberg, says the primary objective of this new project was to investigate the feasibility of immobilising dissolved orthophosphate, arising from biological removal from municipal effluents, by means of magnesium ammonium phosphate (or struvite) formation.

"The uncontrolled precipitation of the mineral struvite, which essentially consists of magnesium ammonium phosphate, is a major problem in many waste water conveyance and treatment systems. Heat exchanger surfaces in digester systems and pipe networks utilised in treatment plants employing such processes are particularly prone to scaling and clogging as a result of struvite precipitation when ammonium, magnesium and phosphate are present in sufficient quantities."

The premise of the investigation, the researcher says, is that struvite formation, which is normally experienced as a serious operational problem, can be turned into an effective method of phosphate immobilisation, provided the process is properly engineered and controlled. While the process can be used directly to treat raw or settled domestic sewage in activated sludge or other plants, the most promising applications pertain to enhanced phosphate removal plants and particularly the treatment of anaerobic digester effluents.

In the case of direct application, struvite crystallisation could be used to immobilise part or all of the phosphate which is primarily concentrated and then released by the microbial biomass in the anaerobic stage of nutrient removal plants, thus enabling consistently lower effluent phosphate concentrations to be obtained.

In addition, stoichiometry shows that the ammonium load on the nitrification stage, and hence also the aeration requirement, would be proportionately reduced.

FINDINGS

The report says a literature survey indicated that in addition to inorganic formation or precipitation of struvite, a large number of bacteria are responsible for struvite formation in microbial environments.

Laboratory scale and pilot scale tests have indicated struvite formation in anaerobic digester effluents after dosing with magnesium chloride and adjusting the pH to more than 8. Phosphorus fixing of up to 90 per cent was obtained.

Struvite crystallisation was studied on a laboratory scale in fluidised bed reactors. Supplementation of anaerobic digester effluents with both magnesium sulphate and potassium hydrogen phosphate enhanced struvite formation. With pH adjustment to 9,5 almost 99 per cent of phosphate could be removed in a continuous flow reactor as a result of both struvite and hydroxyapatite formation.

The report says effective struvite formation can contribute significantly to phosphate removal and will depend on four major parameters, namely:

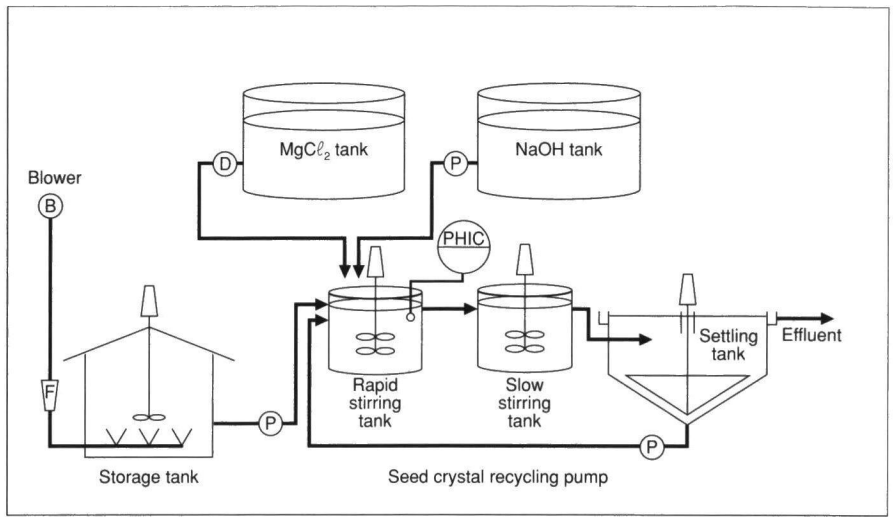
- ❑ The presence of sufficient magnesium and ammonia
- ❑ The presence of sufficient phosphate
- ❑ An alkaline environment
- ❑ Suitable seed material

The report says the required mass ratio (complying with the 1:1:1 molar ratio) for effective and efficient struvite formation is 1,71 Mg : 1 N : 2,21 P. While most sewage effluents contain large amounts of ammonia, there is usually a deficiency of magnesium and phosphate. Supplementation with these components was necessary to establish conditions in the effluent which were conducive to struvite formation.

The use of quartz sand as a seed material proved to be suitable as it did not interfere with the struvite formation and provided an inert surface on which crystallisation could take place.

Precipitation patterns can be complex in liquors or effluents with many components, but it is possible to predict the types of precipitates that may be expected from chemical modelling.

Potentially the most rewarding application of struvite formation, however, is to be found in the treatment of effluents arising from the anaerobic digestion of excess phosphate accumulating sludge withdrawn from nutrient removal plants. These liquors contain high concentrations of ammonia and phosphate. Recycling such effluents to the head-of-works would simply create a closed loop and thus another means of phosphate disposal or elimination needs to be found. Harnessing struvite formation in a controlled environment presents itself as one of the best ways to immobilise not only the dissolved phosphate but also an equivalent mass of ammonia. The troublesome problems of disposing phosphate and ammonium rich effluents and the indiscriminate precipitation of struvite on surfaces where it is highly detrimental, can both be solved if the precipitation and crystallisation can be made to occur under controlled conditions in a reactor designed for that purpose.



Flow schematic of pilot plant magnesium ammonium phosphate crystallization process – Phase 1 (Fujimoto et al., 1991)

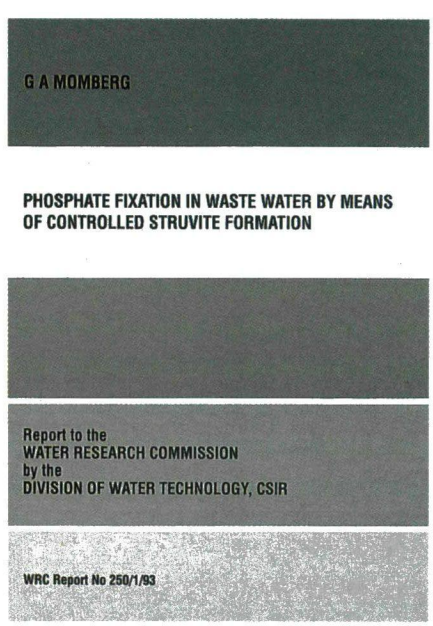
ADVANTAGES

According to the report the controlled formation of struvite by means of crystallisation in effluents from anaerobic digesters will have the following advantages:

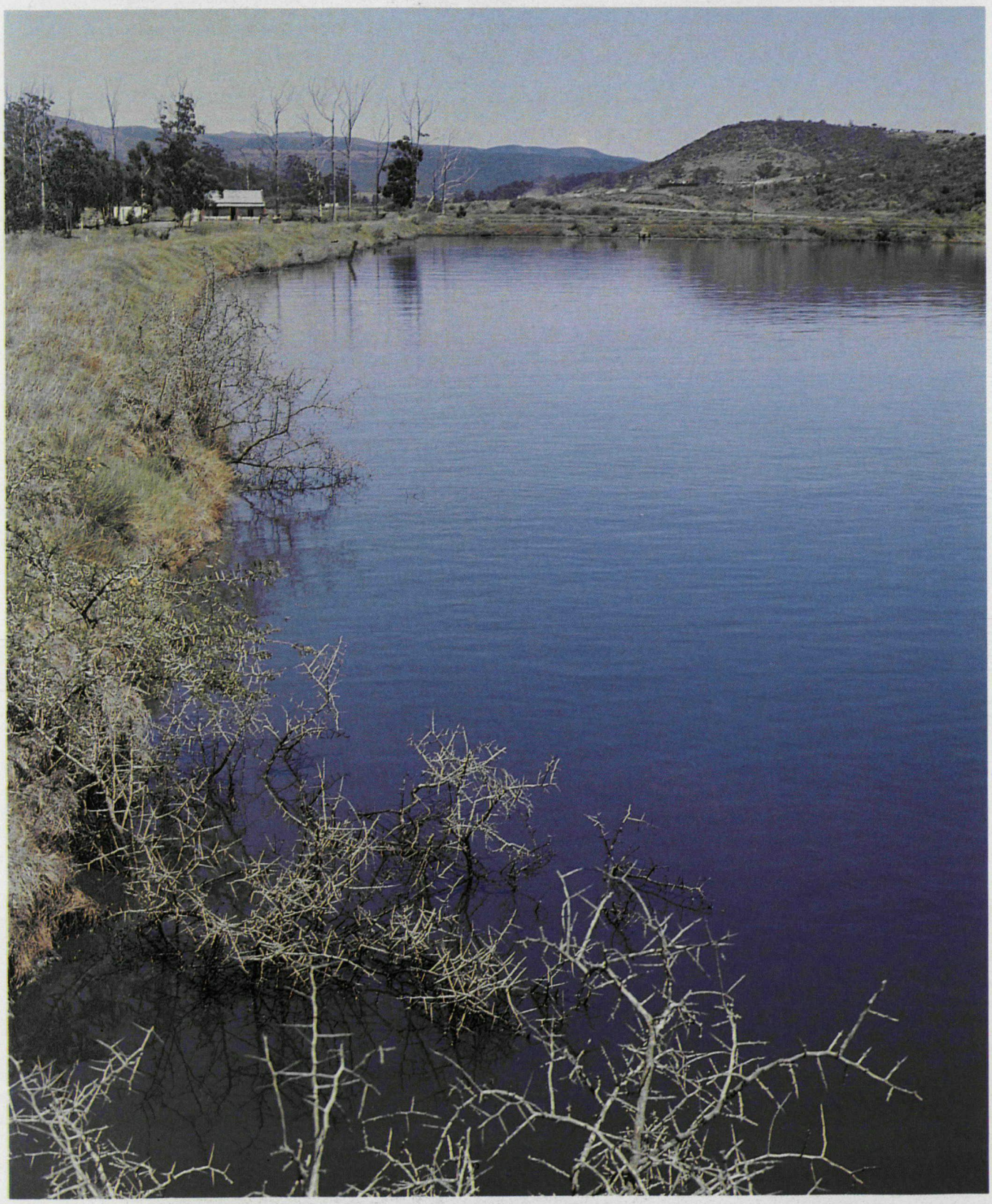
- ❑ It will enhance biological phosphate removal in activated sludge plants;
- ❑ It will reduce anaerobic digester maintenance costs by reducing scaling problems in pipelines and pumps;
- ❑ It will quantitatively reduce phosphate concentrations in effluents to levels which are more compatible with the environment;
- ❑ It will make phosphates, ammonia and magnesium available to the agricultural sector as a slow release fertiliser for plant growth.

This study did not go into design or operating criteria for a struvite crystallisation and precipitation system, since these aspects have been dealt with in a companion report to the Water Research Commission entitled "Phosphate crystallisation in activated sludge systems". Struvite formation is nevertheless seen as a potentially useful method for phosphate reduction as part of a side-stream process in sewage treatment plants.

Copies of this report called "Phosphate fixation in waste water by means of controlled struvite formation" (WRC Report 250/1/93) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Please note: Orders received from outside South Africa will be charged the list price of $20.



New Guide to assist textile

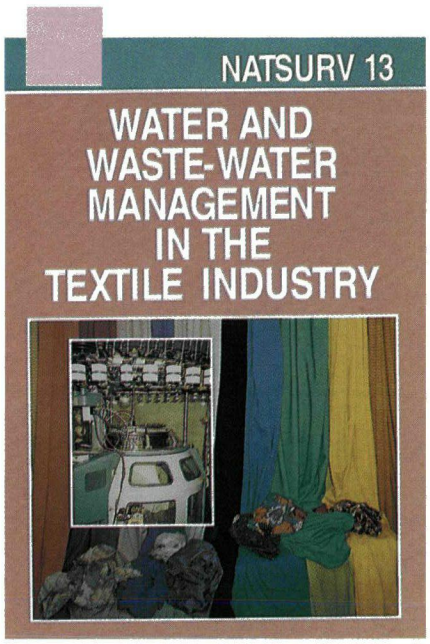


industry with water problems

The Water Research Commission has released a Guide for water and waste-water management in the textile industry. The aim of the Guide is to establish norms for water intake and waste-water disposal in this industry and forms part of the National Industrial Water and Waste-water survey (NATSURV) which is currently being conducted by a team of consulting engineers under contract to the Water Research Commission.

The Guide will be of value, not only to the industry itself, but also to other interested parties such as municipalities, legislators, researchers and consultants in the water and effluent fields.

The Guide entitled Water and wastewater management in the textile industry (NATSURV 13) is available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001.



The textile industry in South Africa comprises a group of related industrial operations which use various natural and synthetic fibres as raw materials to produce a wide variety of end-products, ranging from processed fibres to woven materials, finished garments or piece goods.

This Guide is addressed primarily at the sector of the industry which uses water extensively in its processing operations.

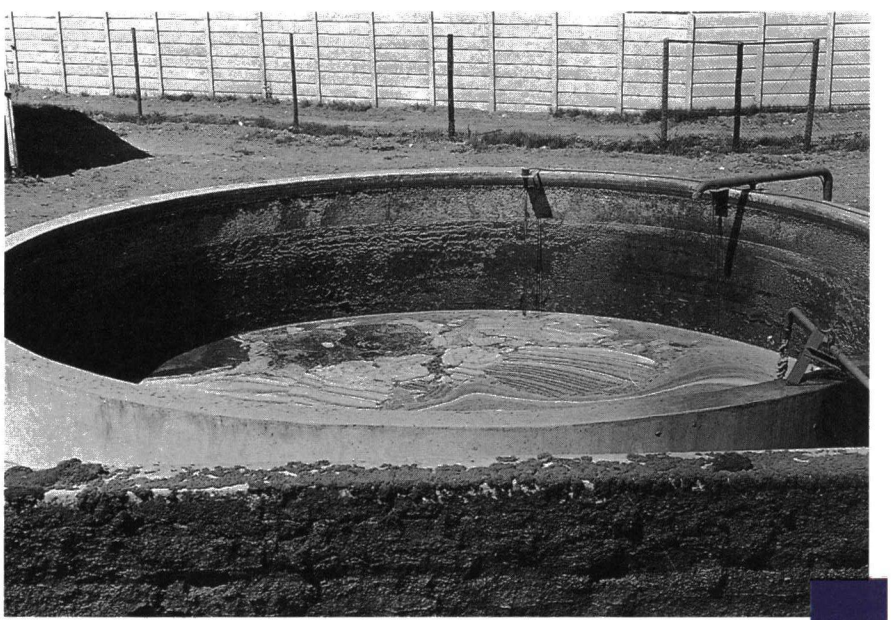
According to the Guide, most of the field data collected is from the Western Cape area, although major textile plants in the Eastern Cape and Natal have also been surveyed. The data obtained has been correlated with other data available on water intake and effluent generation in the textile industry.

Overall water intake by the industry is estimated to be around 30 million m^3 per year of which 70 to 80 per cent is returned as industrial effluent.

Specific water intake was found to vary from 95 to 400 ℓ/kg of material processed. The wide range in specific water intake values observed is partly due to the diverse nature of the industry, for example in terms of the types and proportions of different fibres processed, but also reflects a relative lack of water efficiency at some factories compared to others with similar processing operations. The latter factor, the Guide says, indicates that significant reductions in water intake and improvements in water management can be achieved in the industry.

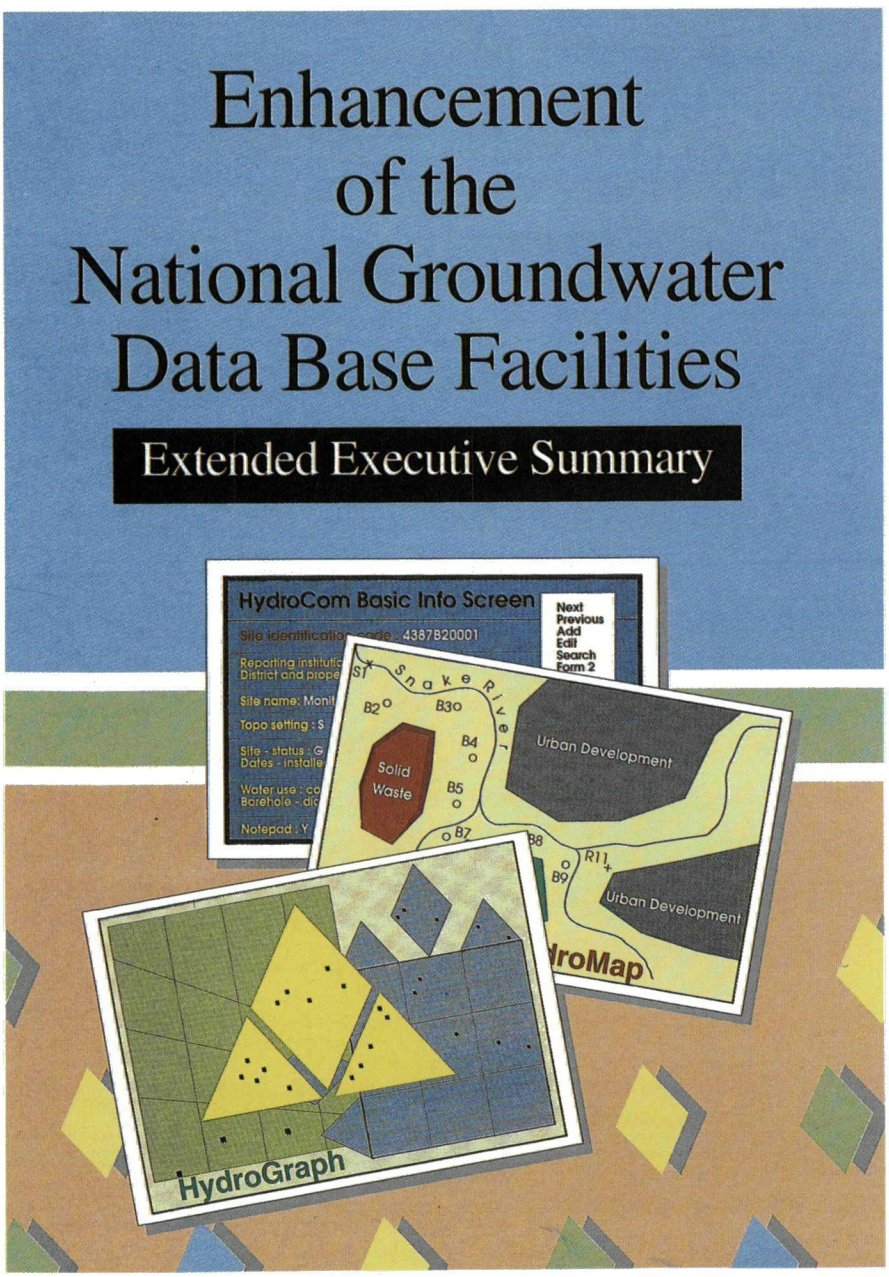
Specific pollution load values were found to vary considerably depending on the type of processing involved, which in turn is affected by the material handled and the type of equipment employed. In general, the waste waters from the textile industry have high salinity and range widely in terms of pH values and, in some cases, have high heavy metal concentrations, colour and relatively non-biodegradable organic content.

The Guide says the strategic approach consequently recommended for reducing overall specific water intake and specific pollution load values in the industry is for individual factories to implement water-saving and pollution-reducing measures, using their individual water intake and pollution load values as targets against which to measure improvement. Generally applicable measures for reducing water use (i.e. improving water efficiency), for reducing pollutant loads at source and for providing on-site pretreatment of the effluents arising, are identified in the Guide. However, these measures should be implemented selectively on a site-specific basis to further the factory's strategic approach.



Waste-water and effluent treatment at a wool scouring plant in the Eastern Cape.

WRC sponsored study enhances SA's National Ground-water Data Base facilities



IGS, the Institute for Ground-water Studies at the University of the Orange Free State, in 1987 completed the development of the first South African National Ground-water Data Base facility on the Department of Water Affairs and Forestry's mainframe computer in Pretoria.

Upon completion of this three-year research contract between the IGS, the Department and the Water Research Commission, it was felt that additional software would be required to enable geohydrologists to enter and process the data within the data base and to display this information in the form of graphs and tables.

Experts in the field decided that the existing G-base software, which had been developed in-house at the IGS, could serve as a basis for enhancing the new National Ground-water Data Base. The Water Research Commission subsequently contracted the Institute and funded a follow-up research project with the following aims:

- The enhancement of the National Ground-water Data Base facilities by providing suitable software for the interpretation of data in the data base.
- The identification of needs amongst data base users and accommodating these needs within the present research project.
- Active promotion of the use of the data base facilities amongst geohydrologists and others interested in ground water and related data.

The researchers, FDI Hodgson, JOG Kirchner, E Lukas and G Fourie, say that in the follow-up project, the original data base on the Department's mainframe was not altered in any significant way from the original which was established in 1987.

Since its establishment, the number of sites in the data base have increased from approximately 35 000 to more than 100 000. The Department of Water Affairs and Forestry, in particular, has been entering vast amounts of data into the data base. Water levels as digitised monthly from continuous strip chart recorders, comprise a large portion of the data presently in the data base.

At this stage only the Department has

direct access to the data base. Others may request information on diskette.

It is envisaged that this situation will continue to exist, because:

- Very few organisations, institutions or individuals are linked to the mainframe.
- Ground water is regarded as private water under present South African legislation and not everybody may have direct access to the data base facility.
- The system whereby data are requested through the Director of the Directorate of Geohydrology at the Department is presently functioning satisfactorily, and
- Not everybody has the technical expertise to interact with the data base via a terminal.

The National Ground-water Data Base, in its present form, is primarily intended to store data into an organised structure from where this data can be accessed and withdrawn with the provision of certain variable specifications. A large range of specifications is possible. The most important are:

- Extraction of data by area
- Extraction of data by date
- Extraction of data by site numbers

The data base unfortunately does not allow processing of data in any way. It merely writes data, which fall within the specified range, to a file that can later be accessed for visual inspection, or which can be processed by the HydroCom package.

HydroCom is the name for a collection of programs that has been written during the course of the project. In total it comprises more than 300 different programs, all linked together, so that passing from one program to another becomes transparent to the user. In size, these programs constitute about four megabytes. The software is currently available on four high-density diskettes and can only be run after installation of the software onto a hard disk in an IBM compatible computer.

The HydroCom software consists of two basic units, namely HydroBase and HydroCad. HydroBase is the equivalent of the National Ground-water Data Base and all variables that may presently be entered into the National Data Base may also be entered into the HydroBase module. The HydroCad section is used to display the data as various graphs and maps.

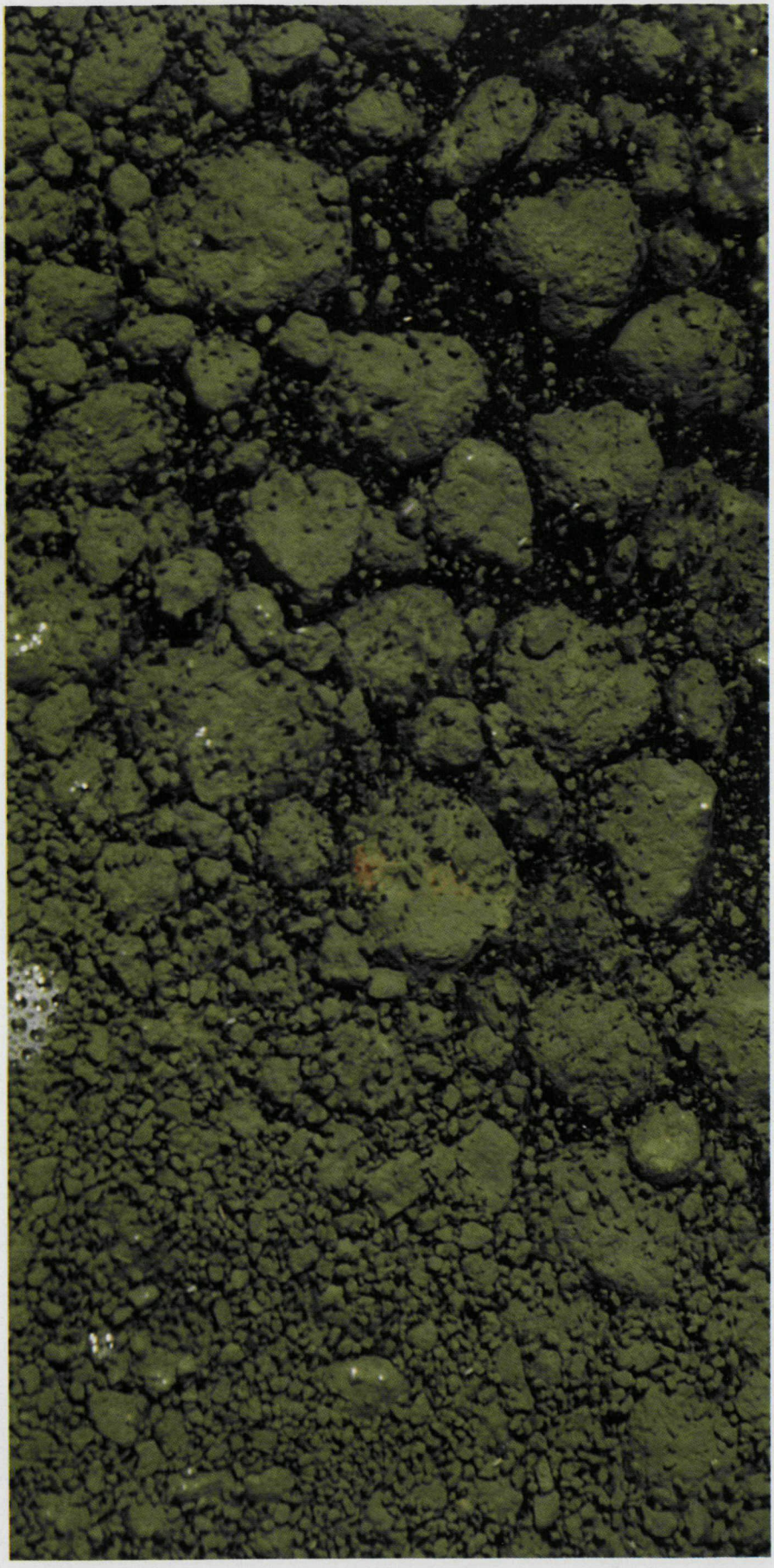
Water levels from continuous strip chart recorders, as well as levels measured by hand, have contributed by far the largest portion of data presently available on the National Ground-Water Data Base.

Details and results of this research project are available in the form of a report entitled: **Enhancement of the National Ground-water Data Base Facilities: Extended Executive Summary.** A demonstration diskette accompanies the report, which requires an EGA/VGA screen for execution

Enquiries on the HydroCom software should be directed to:

Prof FDI Hodgson, Institute for Groundwater Studies, PO Box 339, Bloemfontein 9300. Tel (051) 401 2394.

New PEM model



A simple deterministic phosphorus export model called PEM, was developed by researchers from the CSIR's Division of Water Technology to simulate the accumulation, washoff and transport of phosphorus from catchments dominated by non-point pollution sources.

According to a final report released by the Water Research Commission the model operates on a monthly time scale. It accepts as input observed or modelled streamflow (runoff) which is divided into surface and ground water components.

Phosphorus is assumed to accumulate in the catchment at a uniform rate and is transported in its soluble form through surface runoff towards streams and rivers.

Calibration and sensitivity of the model parameters is described in the report and the results of phosphorus load export simulations from nine southern African catchments, using the PEM model, are provided.

The researchers, JP Weddepohl and DH Meyer, say that even though the PEM is a fairly simple model and the parameter demands are modest, the results show that phosphorus loads exported from non-point source dominated catchments can be simulated to an acceptable degree of accuracy.

The report also summarises the researchers' quantification of the uncertainties and inaccuracies associated with a number of stochastic models making up the Reservoir Eutrophication Management Decision Support System (REMDSS) suite of models. The models studied are: the Pitman monthly model, the stochastic non-point source phosphorus export model of Grobler and Rossouw, the REMDSS phosphorus budget model, the chlorophyll concentration model and the reservoir eutrophication model.

Copies of the report entitled **Utilisation of models to simulate phosphorus loads in southern African catchments** (WRC report 197/1/92) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Orders received from outside South Africa will be charged a list price of $25 per copy.

The development of phosphorus export models in South Africa did not recieve a high priority in earlier research endeavors, although a simple stochastic model was developed to relate phosphorus export to catchment runoff in South Africa for catchments containing mainly non-point sources.

Two researchers, Grobler and Rossouw, in 1988 developed regression parameters relating phosphorus export to runoff in seven non-point source dominated South African catchments. Similarly, in 1989, a dynamic phosphorus export model that describes the transportation of phosphorus through the Berg River drainage basin was developed by A. Bath.

South Africa's growing population has generated associated problems of bigger urban and rural sewage volumes and an increasing need for crop and livestock agriculture. These developments have led to increasing contamination of natural waterways by a multitude of domestic, industrial and agricultural pollutants among which is phosphorus.

The effect of the increase in phosphorus loads is graphically illustrated by the on-going battle against eutrophication in the Vaal River system and the Hartbeespoort Dam. Thus the need to quantify phosphorus concentrations exported from catchments and to understand the processes of phosphorus losses from these catchments, to improve or maintain acceptable phosphorus levels in South Africa's natural waterbodies and water supply systems, remains an imperative requirement.

Water quality models which include phosphorus considerations are available from international concerns such as the American Environmental Protection Agency. However, these models have been developed for local conditions in parts of the USA and their applicability to southern African conditions is often in doubt. A shortage of the required data further reduce the range of models that can be used locally.

As a result of these considerations it was decided to use a two pronged approach to the problem of simulating phosphorus export from catchments, viz, the development of a deterministic phosphorus export model (PEM) coupled to hydrology (for use in catchments with adequate data), as well as the evaluation of and improvement to stochastic PEM models currently in use.

PEM MODEL

The researchers say that for the development of a deterministic phosphorus export model (PEM) it was decided to use the so called Pitman monthly runoff model to generate monthly runoff values as input to the PEM. The Pitman hydrological model is being used by the Department of Water Affairs and Forestry for runoff prediction. Since P-export is so dependant on runoff it was deemed advisable to use the same model as the basis for runoff estimations.

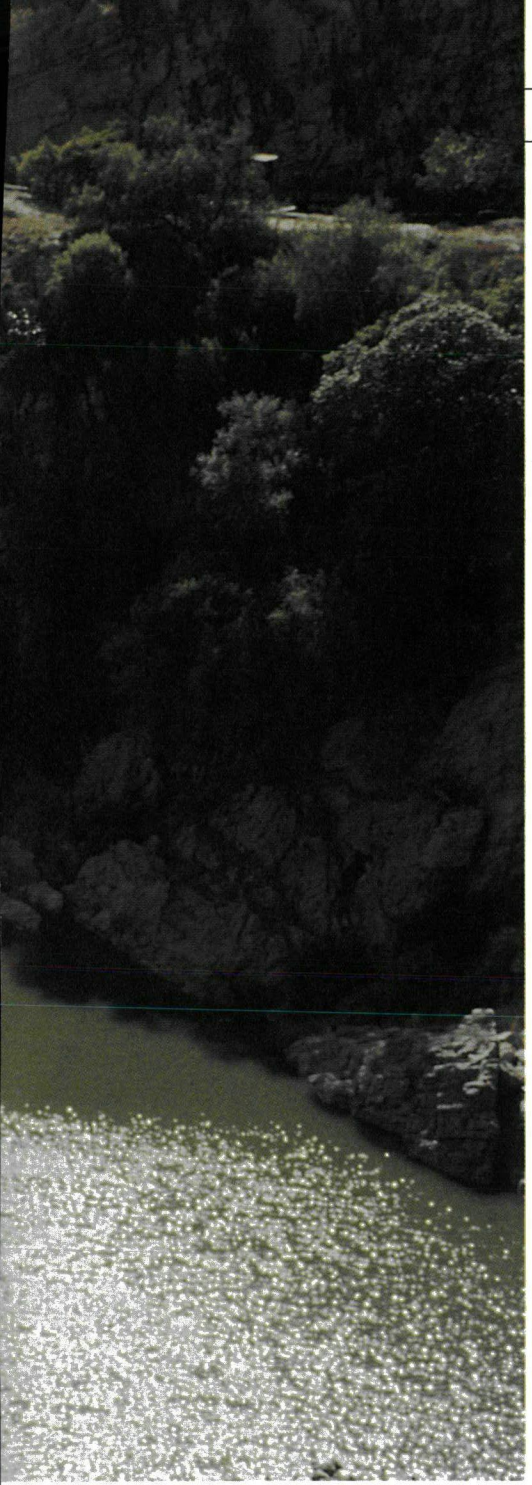
However, the Pitman model does not calculate the export of nutrients and contaminants which reach the catchment waterway via runoff and pickup from non-point sources. A

Hartbeespoortdam: The effect of increasing phosphorus loads in South Africa's natural water bodies is graphically illustrated by the on-going battle against eutrophication in the Vaal River system and the Hartbeespoortdam.

simple deterministic PEM was thus developed to simulate the accumulation, wash-off and transport of phosphorus from a non-point source dominated catchment. Although the model was based on deterministic principles it can more accurately be described as a physical conceptual model relying heavily on *a priori* parameter estimation followed by parameter optimization based on the results of several objective functions. The deterministic PEM accepts as input observed or simulated monthly catchment runoff values provided via the Pitman model and is based loosely on the monthly diffuse salt load model developed by CE Herold in 1980.

CATCHMENTS

The same catchments selected by Grobler and Rossouw in 1988 for their research into stochastic models for estimating phosphorus export from non-point source, sensitive catchments were used for this study to test the deterministic PEM. Separate lists of all flow gauging stations and stations for which water quality data are available, were obtained from the Department of Water Affairs and Forestry. From these lists gauging stations were identified for which both discharge and total phosphorus concentration data were available and which could thus potentially be used for estimating the parameters for



JP WEDDEPOHL
DH MEYER

UTILISATION OF MODELS TO SIMULATE PHOSPHORUS LOADS IN SOUTHERN AFRICAN CATCHMENTS

Report to the
WATER RESEARCH COMMISSION
by the
DIVISION OF WATER TECHNOLOGY, CSIR

WRC Report No 197/1/92

the phosphorus export model. This list of potentially suitable catchments was systematically worked through to eliminate those catchments for which phosphorus export were significantly influenced by point sources.

To identify catchments in which point sources had a significant influence, information provided by the Department of Water Affairs and Forestry as well as records of total phosphorus concentrations at the gauging stations for the catchments were used. Once one or more catchments in a drainage basin suitable for estimating the parameters of the non-point source derived phosphorus export model had been identified, it had to be determined how representative the catchments were of the drainage basin as a whole. Several sources of information were used for this purpose, e.g. site visits, the maximum sediment yield map for South Africa, geological, geographical and demographic information.

OBJECTIVE FUNCTIONS

Objective functions, the researchers say, are statistically derived measures of how well the model simulates the observed data. The following four criteria were used to measure this goodness-of-fit between simulated and observed monthly phosphorus loads:

- Mean
- Standard deviation
- Sum of squared residuals
- Coefficient of determination, r^2
- Visual fit

In the case of the first two functions listed, the objective would be to obtain values for the simulated data that were as close as possible to that of the observed data. The functions, mean and standard deviation do, however, have severe disadvantages in that they represent the values for the total data set. Thus the severity of simulated values far higher than observed values for a specific year may well be reduced by the simulated values being far lower than the observed values in a subsequent year. The researchers say that this should be kept in mind and visual fitting should be used to check for this occurrence. The sum of squared residuals is the sum of the squared differences between observed and simulated monthly phosphorus loads and should be kept to a minimum. For the coefficient of determination, the value of r^2 should be as close to unity as possible. This remains perhaps the simplest but most frequently used method of model calibration, especially in non-research applications.

RESULTS

Results for all but two of the test catchments gave coefficients of determination of better than 80 per cent.

Analysis of the one-to-one results against measured phosphorus load plots shows that in most cases the simulation is better at low flows than at high flows. This can be expected as the phosphorous load is directly related to the quantity of flow and is thus highly variable at times of high flow when the system is not in equilibrium. High flows, however, may present a major problem concerning the water quality of catchment outflow and subsequent inflow to a reservoir, not only in terms of the additional phosphorus load washed off the catchment, but also due to resuspension of bottom sediments and associated adsorbed phosphorus in the transporting waterway.

The researchers say Pitman used a system of parameter regionalisation which facilitated the selection of appropriate parameter values for input to the Pitman monthly rainfall and runoff model. No such regional pattern of parameters could be discerned for the PEM. However, future inclusion of a wider range of test catchments may reveal a regional pattern, especially of the parameters Spar and Ppar. These two parameters, which control the rates of soluble and particulate losses from the catchment, have no physical meaning but appear to be major controlling factors in the calibration of the PEM.

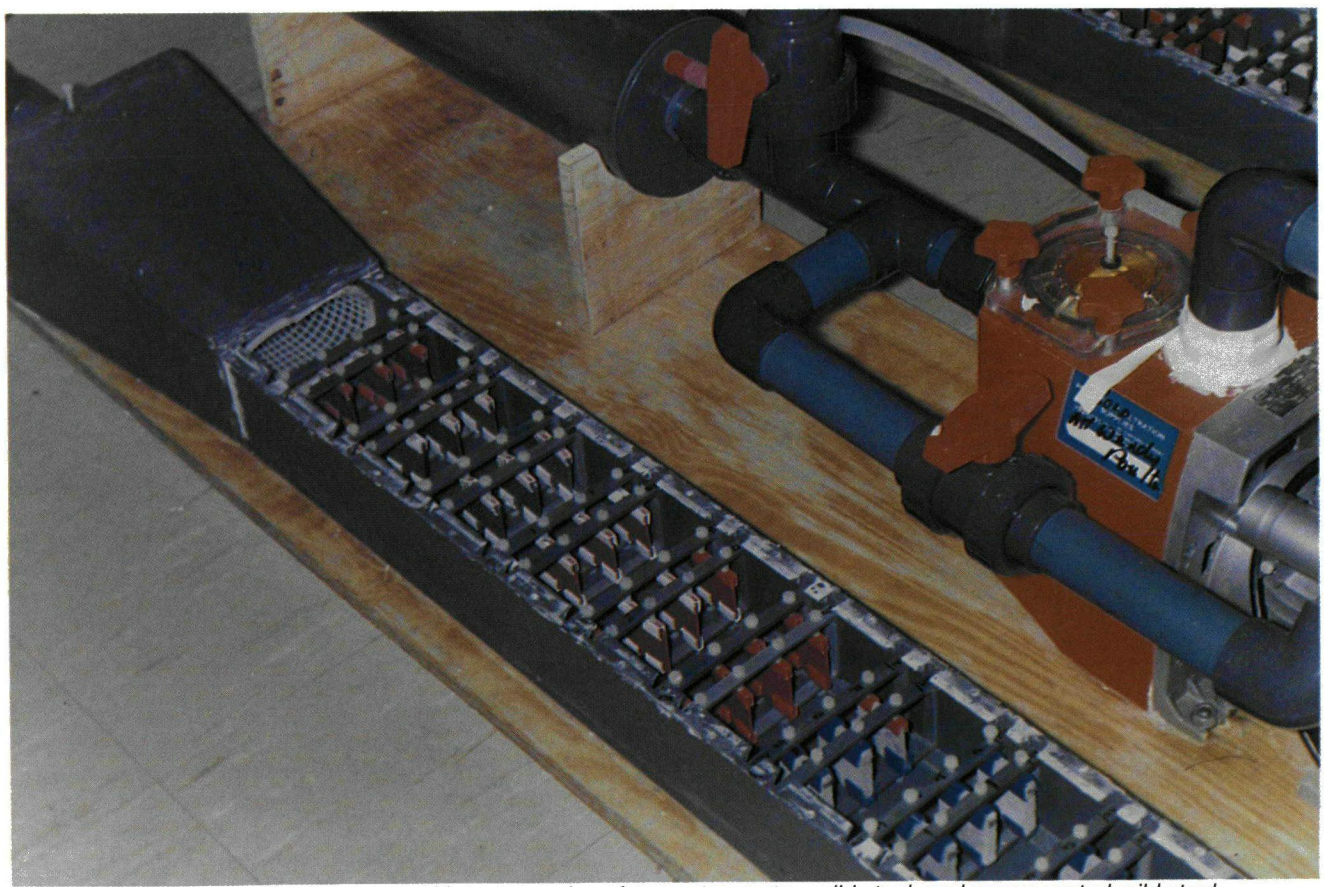
Mortar linings found suitable for corrosi

Mortar linings and concrete could prove a cheaper alternative to thin-film organic coatings on mild steel, provided that the various bacteria commonly found in industrial water system do not degrade such cement-based lining materials, says W Poulton and M Nixon of Eskom Technology Research and Investigations. Their project report to the Water Research Commission, entitled **Investigation into the degradation of mortar linings and concrete by micro-organisms in industrial water systems** (WRC report no 398/1/93) is available to interested persons. Copies can be obtained, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Orders form outside South Africa will be charged $20 per copy.

In the past mild steel, covered with thin-film organic coatings, has been used extensively for the fabrication of pipework in industrial water systems. However, microbially influenced corrosion has caused numerous failures as well as severe metal loss and organic coatings require considerable downtime for maintenance and repair. The estimated direct costs of microbially influenced corrosion in South African industry, in terms of material and chemical treatment is approximately R400 million per annum. These direct costs do not include consequential downtime costs.

Research on alternative materials has shown that austenitic stainless steels, although more resistant to microbially influenced corrosion than mild steel, are also prone to fairly severe attack. High nickel-containing alloys such as 2RE 10, 2RK 65 and SANICRO 28, appear to be resistant. However, these materials are extremely expensive and therefore cost prohibitive for general applications such as industrial water systems.

According to the report the dramatic increase in microbially influenced corrosion in recent years has been attributed directly to the recent drought and subsequent deterioration of water quality expe-



One of the test rigs set up with test samples of concrete, mortar, mild steel, and epoxy coated mild steel.

n protection of industrial water systems

rienced in South Africa. Under drought conditions industrial users are forced to operate systems at extremely high cycles of concentration. The effects of the concentration of aggressive species such as chlorides and sulphides on mortar and concrete need to be investigated where water is recycled in industrial systems. Considering that these species (sulphates and chlorides) may not have any deleterious effects on concrete and mortar linings at commonly used concentrations, these materials could then possibly be used in systems operating at higher cycles of concentration, thus reducing water consumption and permitting such systems to operate under zero effluent discharge conditions.

Most of the research done on concrete and mortar linings, both locally and overseas, has been conducted on sewage systems or in marine environments. Information available relating to industrial cooling or fire-water systems is very limited.

According to the report the bacteria which degrade concrete, such as Thiobacillus spp and the Anaerobic Sulphate Reducing Bacteria (ASRB's) have been identified in both literature as well as in an Eskom case study. The researchers say that these bacteria are commonly found in industrial water systems throughout South Africa.

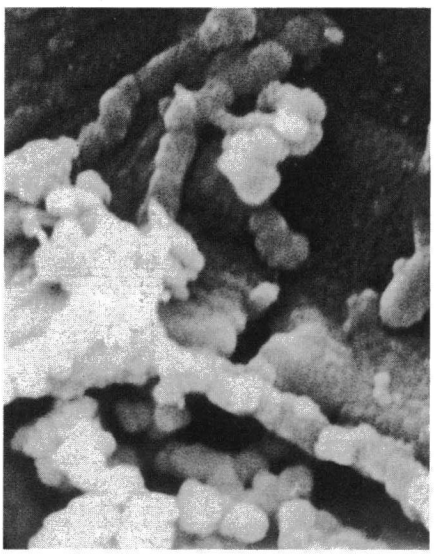
It has been widely reported that in an aqueous system, micro-organisms will attach themselves to available surfaces by means of extracellular polysaccharide polymers, forming biofilms or biofouling deposits. The presence of such deposits in cooling water systems can result in frictional resistance. In addition, discrete colonies within the biofilm or biofouling deposits on metal or concrete structures can result in material degradation. It was therefore considered important to assess the effects of these bacteria on concrete and mortar linings prior to specifying these materials for use in industrial water systems.

The project was divided into two phases. The first phase was designed to investigate the effects of the mentioned bacteria on concrete and mortar linings. If any deleterious effects should be observed as a result of microbial activity, a second phase of the project would be initiated to examine the possible methods of mitigation, for example the use of biodispersant dosing programmes.

MATERIALS

The materials evaluated were concrete, mortar, mild steel and epoxy coated mild steel. Two identical rigs were constructed, one of which was to be maintained under sterile conditions for the duration of the testing. This allowed for comparison between the chemical and microbiological effects on the materials. Samples obtained from theses rigs were carefully analysed and the results are given in the report.

A mild steel sample showing microbially influenced corrosion (MIC) attack.



Scanning electron micrograph showing attached bacteria on the surface of a mild steel sample.

CONCLUSION

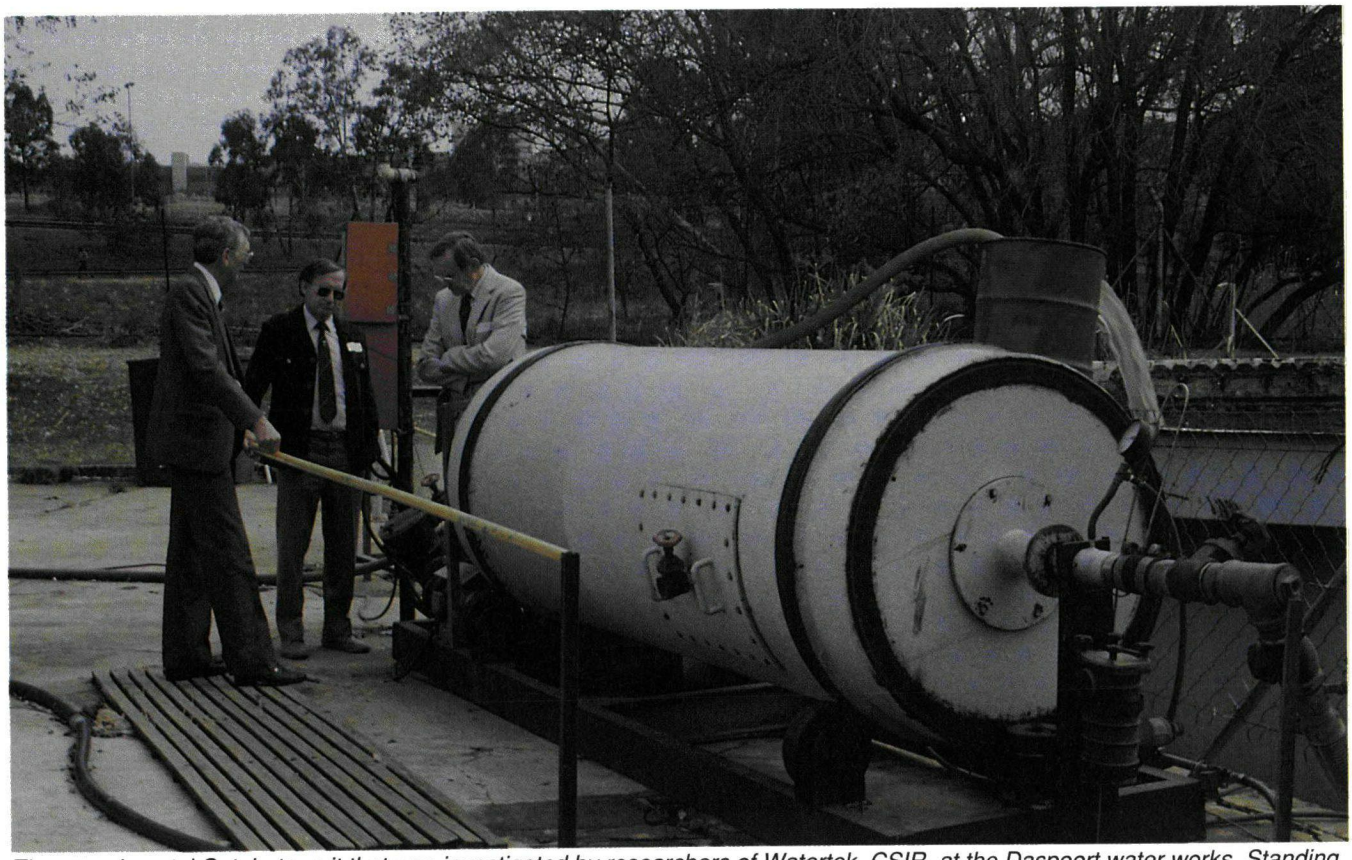
From the results obtained the researchers concluded that:

- Active microbiologically influenced corrosion occurred in the test rigs as demonstrated by the metal loss determined on the control mild steel samples.
- The materials evaluation showed no deleterious effects on the concrete or mortar samples under the test conditions.
- Uniform microbiological attachment occured on all the materials evaluated.
- Although complete sterility was not achieved in the sterile rig, the microbiological activity was nevertheless appreciably reduced.
- The addition of a biodispersant to the non-sterile rig resulted in a significant reduction in the numbers of attached bacteria.

Mortar linings and concrete are therefore considered to be suitable alternative materials for the corrosion protection of industrial water systems with a water chemistry similar to that used in this investigation. The researchers recommend that the choice between mortar linings and concrete for any specific system should be determined by the mechanical engineering aspects of that system.

However, they concluded the report with a note of caution regarding the specification of concrete or mortar linings for industrial water systems with a water chemistry significantly different to that used in the research project, pointing out that the performance of these materials in other waters, cannot be guaranteed.

SCRAP IRON EFFECTIVELY REMOVES PHOSPHATE FROM WASTE WATER



The experimental Catphate unit that was investigated by researchers of Watertek, CSIR, at the Daspoort water works. Standing next to the unit are Dr Henry Saayman and Dr Thys Pieterse (WRC) and Mr Piet Meiring (Wates, Meiring & Barnard).

In a recent report to the WRC, entitled **A comprehensive study on an iron-phosphate removal system**, researchers GA Momberg and RA Oellermann say that a major advantage of the iron contactor system which they investigated, is the use of relatively inexpensive raw material such as iron filings or scrap iron. Furthermore this iron-phosphate removal system, the Catphate system, requires minimal operator attention. WRC report no 430/1/93 is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Price for foreign orders: $20 per copy.

Removal of phosphate from waste water can be achieved by chemical or biological means. Chemical means involve precipitation by metal oxides (eg Ca, Mg or Na aluminate), or by addition of chlorides or sulphates of metal salts (eg Fe or Al) during the wastewater treatment process. Metal oxides are strongly alkaline thus demanding pH control so as not to interfere with the treatment process. Metallic salts are strongly acidic with similar problems resulting. However, efficient control of chemical dosage or continuous operator attention is a definite prerequisite. Efficient phosphate removal may also require additional flocculation for which equipment such as clarifiers will be needed to dispose of the voluminous sludge produced. Ions remaining in solution further detract from the suitability of conventional process technologies.

The iron filings used in the Catphate unit to remove phosphate from effluent.

CATPHATE SYSTEM

Aqueous contact of phosphates with elemental iron could enable the formation of insoluble iron phosphate compounds with little effect on the pH of the wastewater treatment process. Additional chemicals would not be necessary, thus requiring a less sophisticated treatment system. No soluble compounds are introduced into the effluent. The researchers say preliminary investigations have indicated that the iron contactor system (Catphate system) is successful in the removal of phosphate from sewage waste water. An extension of the studies was necessary to establish the optimal performance criteria essential for the implementation of such a system. Major advantages in the application of the system reside in the use of relatively inexpensive raw material, such as iron filings or scrap iron, and minimal operator attention.

AIM

According to the final report the purpose of this study was to establish conditions for the continuous and optimal removal of phosphate from sewage effluent by means of a contactor containing iron filings.

Individual aspects evaluated and reported on, as well as possible adjustments to the system, are the following:

- optimisation of phosphate removal
- modification of the existing contactor to allow for pH control in the contactor.
- the parameters which can influence the performance of the system would be varied to achieve phosphate removal to a maximum level of 1 mg/ℓ.
- compilation of guidelines for the application of phosphate removal by an iron contactor/the Catphate system in municipal wastewater treatment.

MAIN FINDINGS

The researchers experienced a trouble-free run of the plant with a minimum of supervision. The following parameters were addressed and results were as follows:

Phosphate removal

The Catphate system can efficiently and consistently remove in the order of 5 mg P/ℓ.

pH range

The pH ranged between 6,6 and 8,8. The pH level was dependant on the algal growth in the holding tank, which in turn was temperature dependant. The pH had no significant effect on the phosphate removal.

Temperature

The temperature ranged between 12° and 28° C, with the highest temperatures occuring in January, at the beginning of the project, and the lowest in July, towards the end of the project. There was no visible effect of temperature on the phosphate removal, thereby eliminating the possibility of climatic changes affecting the removal process.

Ions (Ca & Mg)

The effect of calcium ions was addressed first. There was no significant variation in calcium concentration throughout the process, and the phosphate removal did not seem to be affected by the presence of the calcium ions. On this basis it was decided that it was not necessary to address the effect of magnesium ions.

Heavy metals

The most commonly found heavy metals in sewage treatment works effluent are copper, chrome, and nickel. These three metals were therefore selected for investigation. None of them had any negative influence on the phosphate removal. However, the system was able to reduce the concentration of the metals by substantial amounts, eg,

Chrome - 1,03 mg/ℓ

Copper - 0,30 mg/ℓ

Nickel - 0,30 mg/ℓ

This was regarded as a bonus to the potential of the system.

Retention time

Retention time affected the performance of the system. The longer the retention time the higher the removal of phosphate.

CONCLUSION

The report states that the system would be appropriate for tertiary water treatment, where the required discharge phophate concentration is below 1 mg P/ℓ, or where phosphate concentrations of 5-6 mg P/ℓ need be removed at an acceptable retention time in the order of five minutes. Future studies could involve the possible upscaling of the Catphate system to full-scale application.

UF SYSTEM DEVELOPED FOR PRETREATMENT OF SEAWATER

A practical membrane separation system for the pretreatment of seawater, prior to desalination by reverse osmosis, is the result of a research project funded by the WRC. Researchers of MEMBRATEK and the Institute for Polymer Science, University of Stellenbosch, jointly developed low-cost tubular and capillary polyethersulphone ultrafiltration modules and investigated their use in the pretreatment of seawater for desalination by reverse osmosis.

The researchers, Ströhwald, Jacobs and Wessels, say that the cost-effectiveness of using these ultrafiltration membranes for pretreatment to reverse osmosis, depends on a combination of membrane configuration, type and frequency of cleaning, as well as the rate of production of desalinated water. These aspects were all incorporated in the development of the SWUF (seawater ultrafiltration) module/system and are discussed in the report titled **Development of an ultrafiltration pretreatment system for seawater desalination by reverse osmosis**. WRC report no. 467/1/93 is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Foreign orders will be charged a list price of $20 per copy.

Desalination of seawater by reverse osmosis is one of the most feasible processes for providing a reliable supply of potable water to remotely located coastal settlements, such as Walvis Bay. The seawater along the Atlantic coast of southern Africa is known for its high content of membrane fouling materials: nutrients, suspended solids and organic materials. These materials caused major pretreatment problems during earlier reverse osmosis desalination trials near Swakopmund, Namibia, in 1982/83. One of the findings of these trials was that membrane filtration may be a viable alternative to conventional pretreatment methods, provided that the operation can be kept inexpensive, simple and preferably automated. The development of low-cost tubular MEMTUF modules at Membratek and capillary ultrafiltration modules at the Institute for Polymer Science (IPS), therefore, aroused renewed interest with regard to the pretreatment of seawater by ultrafiltration.

The use of membrane filtration, in particular ultrafiltration, in the pretreatment of seawater destined for desalination by reverse osmosis, has been reported to be competitive with combined media and carbon filtration. Previous pilot plant work concerning seawater desalination by reverse osmosis (WRC Report no 345/1/92 entitled "Pilot scale desalination of seawater by reverse osmosis"), during which the pretreatment of seawater by ultrafiltration (UF) was attempted, showed the main advantage to be the production of reverse osmosis feedwater of sufficient quality for direct use with compact and highly efficient membrane desalting permeators such as hollow fine-fibre systems. The incentive for the latest project, was to evaluate and optimise various UF membrane configurations for the pretreatment of seawater, with specific emphasis on membrane cleaning.

AIMS

This project's aims with regard to the development of a locally manufactured UF membrane system for seawater treatment prior to reverse osmosis, were the following:

- **Technical feasibility of the UF pretreatment**

  To identify the requirements of an ultrafiltration system for such particular use.

- **Development of UF pretreatment system**

  To develop and refine an ultrafiltration pretreatment system, in conjunction with ancilllary equipment, which would satisfy the desired requirements.

- **Evaluation of UF pretreatment system**

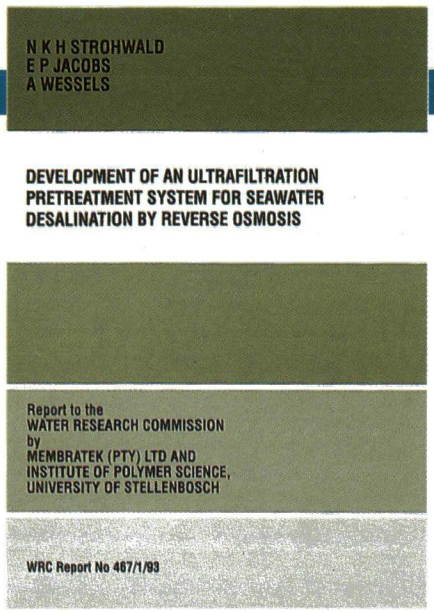
  To evaluate the performance of the developed system through long-term continuous operation.

RESULTS

Two important requirements for the successful application of an ultrafiltration (UF) pretreatment of seawater, for reverse osmosis desalination, were identified:

Low module cost

The module material cost in conjunction



with the productivity of a particular module, was regarded as the prime indicator of the economical viability of the UF membrane system. Therefore, rather than comparing module material cost per square metre membrane area (R/m^2), a cost factor incorporating module cost per cubic meter of permeate per day (R/m^3/d), was adopted to allow a direct comparison between different module types. In this prelimimary investigation of different module types, the comparison was limited to accounting for the module material cost rather than the installed plant capital cost. Since the differing module types require different ancillary equipment, a comparison of installed plant cost on an identical basis is difficult, unless detailed plant design and costing exercises are performed.

Mechanical membrane cleaning

It was shown in earlier seawater desalination trials funded by the Water Research Commission (abovementioned WRC report no 345/1/92) that foulants could be removed from the UF membranes by mechanical cleaning techniques. Module configurations which allowed mechanical membrane cleaning were considered to have operational advantages provided that the mechanical membrane cleaning procedure was highly effective and inexpensive. In other words, the net gain in productivity obtained through mechanical cleaning had to offset the higher module material cost of these large-bore tubular modules, when compared to other module types of higher packing density, eg. capillaries.

Experimental Approach

The researchers followed two distinct approaches in this project, in an attempt to reduce the specific cost factor:

- Operation of the new low-cost SWUF design at the highest sustainable flux, using frequent mechanical cleaning by sponge balls. The researchers anticipated that the higher membrane productivity would offset the higher module material cost when compared to MEMTUF and capillary modules.
- Operation of the low-cost MEMTUF and capillary modules at stabilised lower flux, using infrequent chemical cleaning. The researchers expected that lower module material cost of these configurations would outweigh the net loss in productivity. These systems (MEMTUF and capillary modules) do not lend themselves to sponge ball cleaning because of their inherent design.

MEMBRANE FOULING

Medium and low molecular mass cut-off UF membranes used in the pretreatment of seawater for reverse osmosis systems, were found to be equally prone to fouling. This resulted in a susbstantial reduction of productivity. The nature of the foulants and mechanism of fouling could not be determined, due to their complex nature. Physical examination and EDAX analysis of the membrane surface, however, indicated a combination of organic and inorganic fouling.

MEMBRANE CLEANING

Tubular seawater ultrafiltration modules (SWUF) with 12,5 mm diameter tubes, could be cleaned mechanically with sponge balls through short cycle flow reversal while in operation, to maintain flux values which were approximately three times higher than those which were achieved without routine mechanical cleaning. In contrast, the tubular MEMTUF (9 mm tube diameter) and capillary modules, which could not be cleaned by sponge balls, showed considerably lower but stable flux. In these modules, the foulant could be removed by adopting a biochemical cleaning regime with a proteolitic enzyme followed by a chlor-alkali rinse.

COST COMPARISON

According to the report the higher material cost of the SWUF module was balanced by the higher productivity which could be maintained with on-line sponge ball cleaning. However, the potential advantage of lower material cost of the capillary module was diminished by the lower productivity as sponge ball cleaning could not be used. The specific cost factors as calculated showed that the SWUF and capillary configurations have potential for the pretreatment of seawater, from both technical and economic viewpoints.

CONCLUSION

The experimental work conducted in the course of this project, resulted in the development of an ultrafiltration module which is specifically designed for the pretreatment of seawater. The researchers say that although the use of capillary modules in this application is technically feasible, the ability of the SWUF modules to be cleaned mechanically with the aid of sponge balls, has a definite advantage. Chemical cleaning may be reduced considerably, resulting in longer membrane life, easier operation, less down-time and lower operating costs. These advantages however, may be regarded as somewhat subjective as they cannot easily be expressed in direct monetary terms. Nevertheless, from an operational point of view a membrane system which allows sponge ball cleaning is preferable.

Hydrologist as a natural scientific profession

We received the following press release from Dr Frik, president of the SA Council for Natural Scientists (SACNAS). As you can see from the "categories of registration" the hydrological scientist is not there! The SANCIAHS committee has made a recommendation to SACNAS that a category of hydrological scientists should be added allowing natural scientists to register as such.

The act has been promulgated in the Government Gazette 14945 of 16 July 1993.

You will also note that SACNAS has changed its name somewhat to SA Council for Natural Scientific Profession.

Hugo Maaren

PRESS RELEASE

The *Act on Natural Scientific Professions, 1993 (Act 106 of 1993)* provides for the establishment of a South African Council for Natural Scientific Professions and for the registration of persons carrying on natural scientific professions.

The Act supersedes the *Natural Scientists" Act, 1982 (Act No. 55 of 1982)* which provides for the registration of only natural scientists and natural scientists-in-training. The most important additions to and amendments of the old Act are as follows:

1 The recognition of the natural science technologist as a part of the natural scientific profession and the acknowledgement of his contribution to the public interest are ensured by provisions regarding the constitution of the council (clause 3(1)(c) and (e), the registration of such technologists in terms of clause 11(5) and the possibility of appropriate work being reserved for natural science technologists by the Minister in terms of clause 7(6), with the concurrence of the Competition Board.

2 The accommodation of natural science technologists will entail a regulation of the profession, since the work of technologists can now also be taken into account in considering the reservation of natural scientific work. The maintenance of proper standards will thus be promoted.

3 The accommodation of natural science technologists in the Act became necessary by virtue of the fact that technologists in the field of engineering and medicine have, for example, been included in legislation relating to these professions. It is, therefore, imperative also to provide for the registration of natural science technologists in order to rationalize their professional relationship with such other technologists with a view to equal opportunities vis-á-vis competition.

4 Wider participation by the client community and relevant natural scientific societies in the constitution of the council is brought about by the provisions contained in clause 3(1). It implies a democratization of the composition of the council.

5 The insertion of the word "professional" before the words "natural scientist" and "natural science technologist" underlines the object of the Act namely, that a person with knowledge of a specific section of the natural sciences is registered with the council as a person who, to the satisfaction of the council, has sufficient knowledge and experience of such section of the natural sciences and that he practises it as his profession.

6 While the profession as such is being promoted, the public interest is also taken into account, vide clause 13, which concentrates particularly on the correct relationship between profession and client.

7 Provision is made for international cooperation and aid in the field of the professions concerned, in particular within the African context (clause 23).

8 An appropriate structuring of registration and an indication of the professions to which the Act refers are brought about by categorizing the professions of scientists and natural science technologists in Sections A and B of Schedule 1 to the Act.

Dr C Frik
President

Natural Science Professions

Agricultural Scientist
Animal scientist
Biological Scientist
Botanical Scientist
Chemical Scientist
Environmental Scientist
Geographical Scientist
Geological Scientist
Industrial Scientist
Material Scientist
Mathematical Scientist
Metallurgical Scientist
Microbiological Scientist
Physical Scientist

Professions of Natural Science Technologist

Agricultural Technologist
Animal Technologist
Biological Technologist
Botanical Technologist
Chemical Technologist
Forestry Technologist
Geographical Technologist
Geological Technologist
Industrial Technologist
Marine Technologist
Material Technologist
Metallurgical Technologist
Microbiological Technologist
Mining Technologist
Nuclear Technologist
Water Technologist

SOUTH AFRICAN WATER INFORMATION CENTRE

Mrs Angela Rethman, Project Manager: Waterlit/South African Water Information Centre (SAWIC)

Thank you to all those people who took the trouble to return the questionnaires which were circulated recently. Your responses were most valuable for the workshop which was held in June to determine what users expected from SAWIC and how those expectations could best be met.

The most significant finding was how many people, in particular researchers, requested direct access to WATERLIT instead of having to work through an intermediary. This is now possible using a PC with a suitable modem. New software has been developed which makes it easy to carry out searches by selecting keywords and combining these using a series of menus.

For groups which make extensive use of WATERLIT, the WATERLIT CD-ROM is an attractive alternative. The equipment needed is a personal computer connected to a CD-ROM reader (which may also be used to play music CDs). The database is searchable using either the simple menu-driven system or search command language. An annual subscription includes the cost of the manuals, software and quarterly update disks and there is the advantage of having the database available on your desk at any time.

For some time now users have requested that references be supplied on diskette instead of a paper copy. This is now possible for literature searches and it is hoped that this alternative will soon be available for the monthly alerting profiles.

SAWIC is presently investigating the possibility of producing WATERLIT references with abstracts. Users have requested this for some time as they feel that it will help them in the final selection of documents to be ordered.

From time to time there are queries about the cost of database services and document supply. When the cost of journal subscriptions and the time it would take to carry out a manual search are taken into account, database searches provide a most efficient and cost-effective source of essential references. A WATERLIT search provides a list of references selected from more than 750 local and international journals for approximately one-tenth of the cost of an equivalent search on an overseas database. Using these references, copies of the original articles can either be requested from the author, obtained through a library on inter-library loan or ordered through a document supply centre. In the latter case, the cost of labour, postage costs and the supplier's charges contribute to the cost.

For more information or a demonstration of the services available, please contact Angela Rethman or Francette Myburgh, Tel. (011) 841-2048.

DATABASE OF WATER RESEARCH PROJECTS

The Database of Water Research Projects which was developed for the Water Research Commission in 1992 by CSIR Information Services is now being managed by the South African Water Information Centre.

The aim is to maintain the database as a comprehensive source of information on all water research being carried out in South Africa to prevent duplication of research effort and to incease awareness of expertise in various fields.

Many researchers have already provided the information required for the database records. It would be greatly appreciated if those whose projects have not yet been listed would contact the South African Water Information Centre for copies of the data form.

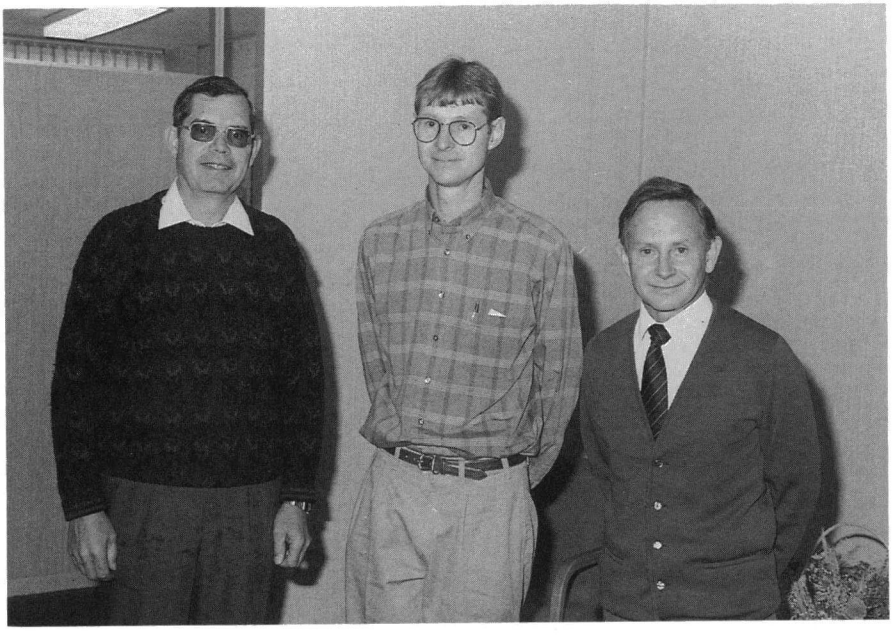
The most important information required is the nature of the project, the name and contact address of the project leader and a few keywords which will serve to identify the project in a database search. A short list of keywords is supplied, but if researchers feel that more specific keywords are required, they are welcome to indicate these as well.

Other information which may be useful is also requested on the data forms, but fields which are regarded as confidential, may be omitted.

The database will be updated annually and the next update forms will be posted to participants in October.

The database is available on floppy diskette in either ASCII or Q&A format. Participating researchers may obtain their copies by contacting Retha Molier, South African Water Information Centre, PO Box 395, Pretoria 0001, or Tel. (012) 841-2048.

US PROF LEADS WORKSHOP AT TUKS



From left: Visiting US Professor Gaylon S Campbell, Washington State University, Pullman, with Dr J Annandale, Department of Plant Production, University of Pretoria and Dr George Green, Water Research Commission.

Professor Campbell led a workshop on the soil water balance in the modelling of cropping systems held at the University of Pretoria during the last week of June.

The workshop was sponsored by the Water Research Commission and the University of Pretoria.

It provided the opportunity for crop and hydrological modellers and scientists doing research on the various processes the models attempt to simulate, to exchange information and ideas. The interchange of ideas, facilitated by Professor Campbell, proved to be an exciting experience out of which participants gained many new insights.

BURSARY AVAILABLE

The South African Branch of the International Ozone Association is offering a R6 000 bursary in January 1994 to a post-graduate student in the field of water utilisation who complies with the conditions of acceptance.

Applications must include a complete curriculum vitae and academic record, speciality field/s as well as the purpose for which the bursary is required.

Prospective candidates should write to Mr SW van der Merwe, Rand Water Board, PO Box 1127, Johannesburg 2000.

The closing date for applications is 10 October 1993.

REQUEST FOR SPECIMENS OF AQUATIC/WETLANDS PLANTS

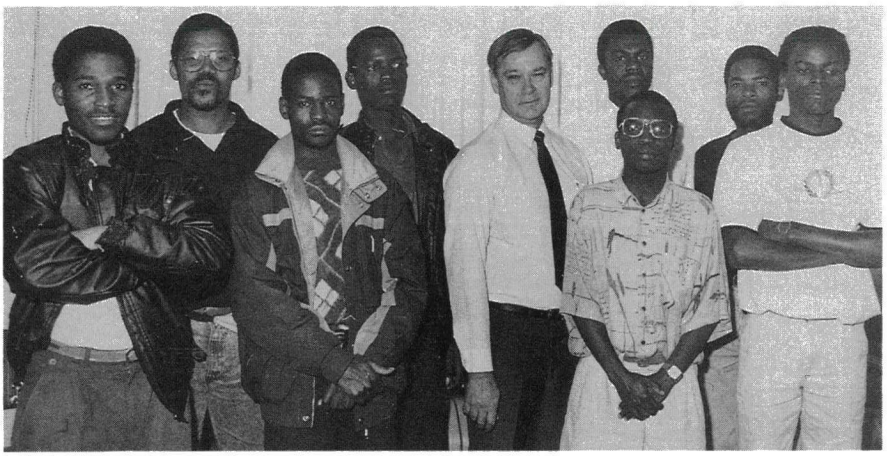
Specimens of aquatic and wetlands plants are required by staff of the National Botanical Institute.

Anyone who can help or who requires further information should contact:

Mrs Rene Glen
National Botanical Institute
Private Bag X101
0001 PRETORIA

Tel: (012) 804-3200

MOZAMBICAN STUDENTS VISIT WRC



Students from the Faculty of Agriculture and Forestry of the Eduardo Mondlane University in Maputo, Mozambique, recently paid a visit to the Water Research Commission.

The seven students, accompanied by two lecturers, were on a fact finding tour of South African research institutions. Pictured with the visitors is Mr Piet Odendaal (centre), Executive Director of the Water Research Commission. The students were briefed by WRC personnel on the Commission's activities and research involvement in irrigation, agrometeorology, forestry and salinisation.

WATER INSTITUTE OF SOUTHERN AFRICA
New Division on River Basin Management

The Council of the Water Institute of southern Africa earlier this year approved the formation of a technical division on river basin management. The inaugural meeting of the Division was held on 16 February 1993 under the chairmanship of Mr Wouter van der Merwe.

The mission of the Division is "the promotion of integrated river basin management to achieve the sustained use and preservation of the water resources of southern Africa".

OBJECTIVES

The Division has a number of objectives to support the broad mission statement. These include the following:

Forum

- To serve as a non-political forum to promote co-operation and exchange of information on the integrated management of river basins.
- To serve as a forum, which is not linked to any specific profession, for the co-ordination of activities related to the field of river basin management.

Liaison/communication

- To liaise at local and international levels with interested and affected parties in the field of river basin management.
- To liaise and communicate with other local organisations active in fields and spheres related to river basin management.

Technology development

- To assist and foster the appreciation of the importance of integrated river basin management principles. The broad management aspects of planning, negotiation, conflict resolution, communication, etc. should also receive adequate attention.
- To assist in the acquisition of skills in the field of integrated river basin management.
- To assist in the development of technology which can be applied to integrated river basin management.
- To create opportunities for the transfer of technology required for integrated management of river basins.
- To identify knowledge gaps, research needs and to influence decision makers to support research in this field.

Decision makers

- To advise decision makers within WISA, government organisations and non-government organisations on all issues related to integrated management of river basins.

Promotion

- To promote an interest in and application of the principles of river basin management among all role players active in the field and related fields.
- To promote the implementation of river basin management principles.

INVITATION

Participation in the activities of the Technical Division is open to any individuals with an interest in river basin management. The benefits of participation will include information on technical and scientific activities and issues, attendance of workshops, seminars and conferences and tours to river basin management projects. The Division is already co-operating in the planning and organisation of the 7th international specialist conference on river basin management next year in the Kruger National Park.

Individuals or companies interested in participating in the activities of the Division are invited to contact Dr Andre van Niekerk, Wates, Meiring and Barnard Inc, PO Box 74397, Pretoria 0001. Tel (012) 348-6201. Fax (012) 348-6291.

ERWAT SE EERSTE GROOT KONTRAK TOEGEKEN

'n Konstruksiekontrak van R43,67 miljoen is onlangs deur die Oos-Rand Waterversorgingsmaatskappy (ERWAT) aan Stocks Civils (Edms) Bpk toegeken vir die konstruksie van uitbreidings aan die Olifantsfontein Waterversorgingswerke. Die kontrak is in Germiston onderteken deur mnr Arie Korf, Besturende Direkteur van ERWAT (voor links) en mnr Richard Saxby, Besturende Direkteur van Stocks Civils. Die getuies was (agter van links) mnre Koos Wilken, Algemene Bestuurder: Kapitale Werke van ERWAT, Bruce Chalmers, Kontrakbestuurder, Stocks Civils, en Johan Wagner, 'n raadgewende ingenieur.

Die Oos-Rand Waterversorgingsmaatskappy (ERWAT) het 'n kontrak van R43,67 miljoen toegeken vir die konstruksie van 'n 70 Mℓ/dag uitbreiding aan die Olifantsfontein waterversorgingswerke.

Dit is die grootste konstruksieprojek wat deur die nuutgestigte Artikel 21-maatskappy tot op datum toegeken is. Die werk sal deur Stocks Civils (Edms) Bpk gedoen word. By voltooiing sal hierdie werke groot dele van Midrand, Tembisa, Ivory Park, Rabierif en 'n gedeelte van Kemptonpark bedien.

ERWAT is in September verlede jaar gestig nadat die Administrateur van Transvaal aangekondig het dat die watersuiweringstelsel, insluitende rioolwerke, hoofafvalgeleidings en water-hergebruikstelsels binne die Oos-Randse Streekdiensteraadgebied verstreek moet word.

Uitgrawings en terraswerke vir die uitbreidings by Olifantsfontein is reeds ver gevorder. Die grootste gedeelte daarvan is ingevolge 'n afsonderlike kontrak deur Stocks Roads (Edms) Bpk voltooi.

Weens swak grondtoestande en die dolomitiese geaardheid van die gebied, het gedeeltes van die bestaande Olifantsfontein-aanleg tot so 'n mate versink dat die voortbestaan van gedeeltes van die werke bedreig word.

Om soortgelyke probleme in die toekoms te voorkom, is deeglike geotegniese opnames in die gebied van die beoogde uitbreidings gedoen.

Hoewel die dolomietrisiko van die nuwe aanlegterrein heelwat laer is as die van die ou terrein, verg die voorkoms van uitsetklei bykomende maatreëls.

Omvattende voorafbenatting onder die hoofstrukture sal die klei laat uitsit voordat dit aan die druk van bouwerk blootgestel word.

Voorsiening is in die ontwerp gemaak vir 'n massa-dreineringsopvangstelsel, bestaande uit naatlose ondeurdringbare plastiekmembrane, om toekomstige waterindringing in die grond te verhinder.

Die hoofstruktuur van die aanleg sal bestaan uit 'n inlaatgedeelte, twee primêre besinktenks van 36 m in deursnee, twee geaktiveerde slykreaktors, vier afskeiers van 38 m in deursnit, 'n lugflottasie-eenheid, 'n drukfiltreer-eenheid, drie groot pompstasies, drie substasies, 'n beheerkamer en verbindingskanale, pypwerk en ander klein strukture.

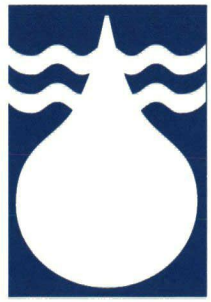
Dolomiet-aggregaatbeton van hoë gehalte sal gebruik word vir die konstruksie van die waterhoudende strukture.

Die nuwe werke het 'n gefaseerde oorhandigingstydperk vir meganiese en elektriese toerusting, tot die begin van April aanstaande jaar. Weens die dringendheid van die probleme wat met die bestaande aanleg ondervind word, sal die eerste helfte van die uitbreiding na verwagting teen die einde Junie 1994 operasioneel wees.

Die raadgewende ingenieurs is Wagner Nel. Die geotegniese ingenieurs, Jones en Wagener, is vir die geotegniese en strukturele ontwerpe verantwoordelik.

'n Subkontrak vir die opgradering van die bestaande waterversorgingseenheid moet nog deur ERWAT toegeken word.

WATER RESEARCH COMMISSION FELLOWSHIP 1994/5



POST-GRADUATE TRAINING IN AQUATIC SCIENCES

AN EXCITING AND RELEVANT RESEARCH OPPORTUNITY

BACKGROUND

The conservation of aquatic ecosystems has become a critical facet in the overall conservation strategy of South Africa. This is due to the ever-increasing pressure that is being placed on our aquatic systems (rivers, wetlands and estuaries) as a result of abstraction and pollution of water. Potentially serious degradation of these systems can be minimised if we improve our understanding of vital matters such as:

- The structure and functioning of the abiotic environment of water ecosystems.
- The structure and functioning of aquatic biotas.
- Identification of key abiotic components of water ecosystems, their variability and their effects on aquatic biotas.

The newly acquired knowledge will need to be integrated and used for the effective management of our water resources and our environment in general; this process may well require the development of a model(s) as a management tool. South Africa is critically short of relevant expertise and we therefore invite prospective candidates for full-time study in this exciting and creative field to apply for this fellowship.

WHO MAY APPLY

Persons with:

- a bachelor degree in life or environmental sciences; and
- a concern for the environment and for the orderly development and management of water resources.

Additional qualifications and/or experience in this field will be a recommendation but are not essential.

NATURE OF FELLOWSHIP

A generous financial package is being offered to meet all study costs towards a higher degree as determined jointly by the successful candidate and a panel of advisers appointed by the Water Research Commission. Duration of the fellowship will be two (2) years.

OBLIGATIONS

The successful candidate will be contractually bound to serve in a research environment at a WRC approved South African university or other institution. The period of the contract will be equal to the duration of the fellowship.

APPLICATIONS

Applications must include a complete curriculum vitae and the names of at least two referees, and be sent to:

The Executive Director
Water Research Commission
PO Box 824
PRETORIA 0001
(for attention: Dr PC Reid)

The closing date for applications is 30 September 1993.

SA WATERKALENDER

The Water Research Commission is placing this calendar in order to assist with the co-ordinating of water events in South Africa.

You are invited to send information about conferences, symposia or workshops to the SA Waterbulletin.

Address:
The Editor,
SA Waterbulletin,
P.O. Box 824,
0001 Pretoria
Tel (012) 330-0340
Fax (012) 331-2565

Legend:

- ○ An SA Water Event arranged for these dates.
- □ 2nd SA Water Event scheduled for these dates.
- ✗ 3rd SA Water Event scheduled for these dates.

See conferences and symposia pages for events.

Die Waternavorsingskommissie plaas hierdie kalender om te help met die koördinering van watergebeurtenisse in Suid-Afrika.

Alle belanghebbendes word uitgenooi om inligting aan SA Waterbulletin te stuur.

Adres:
Die Redakteur
Posbus 824
0001 Pretoria
Tel: (012) 330-0340
Faks: (012) 331-2565

Gids:

- ○ Een SA Watergeleentheid vir hierdie dae.
- □ 'n Tweede SA Watergeleentheid gereël vir dié datums.
- ✗ 'n Derde SA Watergeleentheid gereël vir dié datums.

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

1993

OCTOBER 1993

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NOVEMBER 1993

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1994

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SEPTEMBER 1995

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SOUTHERN AFRICA 1993

MARINE SCIENCE

OCTOBER 17 - 22
The 8th South African Marine Science symposium will be held in Saldanha Bay near Cape Town.
Enquiries: Samms Secretariat, Zoology Department, University of Cape Town, Rondebosch Cape 7700. Tel (021) 650-2681 Fax (021) 685-3937.

WATER CARE

NOVEMBER 1993
Three short courses on water care will be presented at the Faculty of Natural Sciences, Technicon Pretoria. For more details, see announcement on page 2 of this Bulletin.

1994

ANAEROBIC DIGESTION

JANUARY 1994 23 - 27
The seventh international symposium on anaerobic digestion will be held in Cape Town. Call for papers.
Enquiries: Symposium Secretariat, IAWQ: AD-94, PO Box 3123, Tygerpark 7536 SA.

DISINFECTION

MARCH 13 - 18
An international conference on disinfection of potable water will be held in the Kruger National Park.
Enquiries: Miss Louise Fourie, Conference Secretariat, Rand Water Board, PO Box 1127, Johannesburg 2000. Tel (011) 682-0472. Fax (011) 682-0444.

WATER & VOEDSEL

MAART 21 - 22
Die 8ste jaarlikse voedselwetenskapsimposium met die tema "Food Science in Africa" word in die Wes-Kaap by die Lord Charles Hotel, Somerset-Wes, gehou.
Navrae: Professor G van Noort Tel (02231) 74-506 Faks (02231) 833-737.

WATER TECHNOLOGY

JUNE 6 - 9
The 1994 international African water technology exhibition and conference, Afriwater, will be held at the National Exhibition Centre, Johannesburg.
Enquiries: Natalie Sanders, McNaughton Victor CC, PO Box 31368, Braamfontein 2017. Tel (011) 643-4824/8 Fax (011) 642-9860.

WATER ENGINEERING

JULY 14 - 15
A symposium entitled "50 years of water engineering in South Africa (a tribute to Prof Des Midgley)" will be held at the University of the Witwatersrand, Johannesburg.
Enquiries: Ms C Bernard, c/o Dr SJ van Vuuren, BKS Inc, PO Box 3173, Pretoria 0001. Tel (012) 209911 Fax (012) 20 9220.

CORROSION CONTROL

AUGUST 29 - 31
The sixth international corrosion conference entitled "Cost effective corrosion control into the 21st century" will be held at the Elangeni Hotel in Durban. CALL FOR PAPERS.
Enquiries: SA Corrosion Institute, PO Box 77, WITS 2050. Tel (011) 802-5145 Fax: (011) 804-3484.

ICOLD

NOVEMBER 1 - 5
The 62nd executive meeting of ICOLD will be held at the Elangeni Hotel in Durban.
Enquiries: Mrs Ginny Eslick, ICOLD 1994 Organising Committee, PO Stamford Hill, 4025 Durban. Tel (031) 303 2480 Fax (031) 239 441.

ICOLD

NOVEMBER 6 - 11
The 18th ICOLD congress will be held at the Durban Exhibition and Conference Centre.
Enquiries: Mrs Ginny Eslick, ICOLD 1994 Organising Committee, PO Stamford Hill, 4025 Durban. Tel (031) 303 2480 Fax (031) 239 441.

ANALYTICA '94

DECEMBER
The second national symposium on analytical science will be held early in December 1994 in the Western Cape. Theme: "Toward the Welfare of Man and his Environment".
Enquiries: Dr IM Moodie, ANALYTICA '94, c/o PO Box 19070, Tygerberg 7505. Fax (021) 932-4575.

1995

RIVER MANAGEMENT

MAY 14 - 19 1995
The IAWQ conference on river basin management will be held in the Kruger National Park.
Enquiries: Dr Ben van Vliet, Watertech, CSIR. Tel (012) 841-2237 Fax (012) 841-4785.

IWSA

SEPTEMBER 11 - 15
The biennial congress of IWSA will be held in Durban.
Enquiries: Mrs E Nupen, SA National Committee: IWSA, DWT< CSIR, PO Box 395, Pretoria 0001

OVERSEAS 1994

HYDROLOGY

Commencing Semester:
1 February 1994
The joint universities' masters program in hydrology and water resources will be held in Adelaide, South Australia.
Enquiries: Project Administrator, The Flinders University of South Australia, FPO Box 2100, Adelaide, South Australia 5001. Tel: (61-8) 2012650. Fax: (61-8) 2012676.

WATER IN AFRICA

FEBRUARY 1 - 4 1994
An international conference on the efficient utilisation & management of water resources in Africa will be held in Khartoum, Sudan. **CALL FOR PAPERS.**
Enquiries: Dr Gamal M Abdo, Faculty of Engineering and Architecture, University of Khartoum, PO Box 321 Khartoum, Sudan. Tel 011 75931 Fax 249 11 44898.

AQUIFERS

APRIL 11 - 15
An international symposium on transport and reactive processes in aquifers will be held at ETH Zürich, Switzerland.
Enquiries: Symposium Secretariat, IAHR Symposium, c/o Institute of Hydromechanics and Water Resources Management, EJH Hönggerberg, CH-8093 Zürich, Switzerland. Tel (01) 377 3065 Fax (01) 371 2283.

SLUDGE

APRIL 12 - 15
A European conference on sludge and organic waste will be held at the University of Leeds, England. **CALL FOR PAPERS.**
Enquiries: Mrs Zena Hickinson, Course Secretary, Dept of Civil Engineering, University of Leeds, Leeds LS 9JT. Tel (0532) 347158 Fax (0532) 332265.

MEMBRANES

APRIL 26 - 28
A conference with the theme: "Engineering of membrane processes 2" will be held in Tuscany, Italy.
Enquiries: Kay Russell, Elsevier Advanced Technology, Mayfield House, 256 Banbury Road, Oxford OX2 7DH, United Kingdom.

WATER SUPPLY

MAY 15 - 20
An IWSA regional conference entitled Water Supply 2000 "Rehabilitation" will be held in Zürich, Switzerland.
Enquiries: Zürich Water Supply, Hardhof 9, PO Box CH-8023 Zürich. Tel (*1) 435 2111 Fax (*1) 435 2557.

GROUNDWATER

JUNE 13 - 16 1994
An international conference on future groundwater resources at risk will be held in Helsinki, Finland. **CALL FOR PAPERS.**
Enquiries: Ms Tuulikki Suokko, FGR 94, National Board of Waters and the Environment, PO Box 250, SF-00101 Helsinki, Finland. Fax: +358 0 4028 345.

IAWQ

JULY 24 - 30 1994
The 17th biennial conference and exhibition of the International Association on Water Quality (formerly the IAWPRC) will be held in Budapest, Hungary. Call for papers: Deadline-date 1 August 1993.
Enquiries: IAWQ, 1 Queen Anne's Gate, London SW1H 9BT England. Tel: +44 (0) 71-222 3848. Fax: +44 (0) 71-233 1197.

MEMBRANES

AUGUST 29 - SEPTEMBER 2
The 7th international symposium on synthetic membranes in science and industry will be held in Tübingen, Germany. **CALL FOR PAPERS.**
Enquiries: DECHEMA e.V. Exhibitions and Congresses, Theodor-Heuss-Allee 25, PO Box 150104, D-6000 Frankfurt am Main 15.
Tel (069) 7564-241/242/243 Fax (069) 75 64-201.

8th Southern African Marine Science Symposium

Triennial Marine Science Symposium

"Marine science for a sustainable future"

17-22 October 1993
Club Mykonos, Saldanha Bay,
Cape, South Africa

AIMS AND SCOPE

This symposium will provide a forum for the exchange of marine scientific information as it applies to southern Africa. Information from all facets of marine science will be entertained.

PROGRAMME

The Symposium will include invited keynote speakers, contributed papers, poster papers, workshops and sessions for professional upgrade (tutorials). The Symposium will be held at Club Mykonos, Saldanha Bay - on the western Cape coast of South Africa. (Approximately 90 minutes drive from Cape Town). Delegates will be accommodated at Club Mykonos.

COST

A Symposium fee will be levied to cover the cost of registration, meals and teas. Further details of the Symposium, together with a registration form, will be sent to those who are interested. Any further enqueries concerning the Symposium should be directed to:

SAMSS Secretariat
Zoology Department
University of Cape Town
RONDEBOSCH CAPE 7700
SOUTH AFRICA
Telephone: +27-21-650-2681
Fax: +27-21-685-3937

WATER-
NAVORSINGS-
KOMMISSIE
NAVORSINGSBEURS

NAGRAADSE
OPLEIDING
IN WATER-
WETENSKAPPE

'N OPWINDENDE STUDIEGELEENTHEID IN 'N BELANGRIKE WERKSVELD

AGTERGROND

Die bewaring van water-ekostelsels het 'n kritiese faset geword in die totale bewaringstrategie van Suid-Afrika. Dit is toe te skryf aan die steeds toenemende druk wat geplaas word op ons waterstelsels (riviere, vleilande en riviermondings) as gevolg van waterbesoedeling en -onttrekking. Potensieel ernstige agteruitgang van hierdie stelsels kan tot in 'n minimum beperk word indien begrip van deurslaggewende aspekte soos die volgende verbeter kan word:

- Die struktuur en werking van die abiotiese omgewing van water-ekostelsels.
- Die struktuur en werking van waterbiota's.
- Identifisering van belangrike abiotiese komponente van water-ekostelsels, hulle veranderlikheid en hulle uitwerking op waterbiota's.

Nuwe kennis in hierdie verband sal geïntegreer en gebruik moet word vir die doeltreffende bestuur van ons waterhulpbronne en ons omgewing in die algemeen; hierdie proses mag vereis dat 'n model(le) ontwikkel word as 'n bestuurshulpmiddel. Suid-Afrika het 'n kritiese tekort aan toepaslike kundigheid op hierdie gebied. Aansoeke vir hierdie beurs, vir voltydse studie in hierdie opwindende en kreatiewe veld, word ingewag.

WIE KAN AANSOEK DOEN

Persone met:

- 'n baccalaureus-graad in die lewens- of omgewingswetenskappe; en
- 'n belangstelling in die omgewing en in ordelike ontwikkeling en bestuur van waterhulpbronne.

Addisionele kwalifikasies en/of ondervinding in hierdie veld sal dien as 'n aanbeveling, maar is nie noodsaaklik nie.

DIE AARD VAN DIE BEURS

'n Ruim finansiële pakket word aangebied om alle studiekoste vir 'n hoër graad te delg, soos ooreengekom deur die suksesvolle kandidaat en 'n paneel adviseurs wat deur die Waternavorsingskommissie aangestel word. Die beurs word vir 'n periode van twee (2) jaar toegeken.

VERPLIGTINGE

Die suksesvolle kandidaat sal kontraktueel gebonde wees om in 'n navorsingsomgewing aan 'n WNK-goedgekeurde Suid-Afrikaanse universiteit of ander instelling diens te aanvaar. Die kontrakperiode sal dieselfde wees as dié van die beurs.

AANSOEKE

Aansoeke moet 'n volledige curriculum vitae en die name van ten minste twee referente insluit en moet gerig word aan:

Die Uitvoerende Direkteur
Waternavorsingskommissie
Posbus 824
PRETORIA
0001
(Vir aandag: Dr PC Reid)

Die sluitingsdatum vir aansoeke is 30 September 1993.

Seventh International Symposium
on
ANAEROBIC DIGESTION
23 - 27 January 1994
CAPE TOWN

IAWQ

For information or registration enquiries please contact:

Symposium Secretariat
IAWQ: AD-94
PO Box 3123
TYGERPARK
7536
South Africa

Contact person: Dr Bill Ross

International Tel: +27 - 21 - 998901
(Cape Town) +27 - 21 - 993172

International Fax: +27 - 21 - 994707

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