

M du P.

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WATERBEHANDELING

Opgeloste lugflottasie
bespaar geld

WASTEWATER TREATMENT

Artificial wetlands
gain ground

WATERKWALITEIT

Alge in
Vaalrivierstelsel
ondersoek

00020066

Anaerobic digestion

Second Symposium

VENUE AND DATE OF SYMPOSIUM

The two and a half day Symposium on Anaerobic Digestion will be held at the CR Swart complex of the University of the Orange Free State, Bloemfontein, South Africa, on 18 to 20 September 1989.

Anaerobic Digestion

Anaerobic digestion is one of the major biological waste treatment processes in use today. Broad-scale application of the process has been largely in the treatment of municipal sewage sludge and, more recently, in the treatment of strong and medium strength industrial wastes. Advances in the basic understanding of the microbiology and biochemistry of the process, along with advances in hardware technology, have helped to overcome many of the problems associated with anaerobic digestion.

Organised by:

Department of Microbiology
University of the Orange Free State
Bloemfontein and
Division of Water Technology CSIR
with the Symposium Secretariat at the
University of the Orange Free State
BLOEMFONTEIN

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OBJECTIVES OF SYMPOSIUM

The first Symposium on Anaerobic Digestion was held at the University of the Orange Free State during 18 to 20 September 1986. This symposium can be considered the beginning of a new era in the development and application of anaerobic digestion in South Africa. The need was expressed for ongoing communication and exchange of ideas between engineers, scientists and operators. The objective of the second symposium is to discuss laboratory, pilot and fullscale experiences, current developments and research trends on processes.

CALL FOR EXHIBITORS AND SPONSORS

Companies who have an involvement in the water industry will be able to participate in the Symposium by advertising in the brochure, renting an exhibition stand, sponsoring of socials and by donations.

ENROLMENT

Payment of the full enrolment fee of R180 will entitle a delegate to:

- Symposium programme and the volume of pre-print papers in advance
 - Lunches and teas
 - Attend the evening socials on 17, 18 and 19 September.
- The enrolment fee will exclude accommodation and breakfast. Depending on the response, a full programme of visits to places of interest will be arranged for accompanying persons (Ladies Programme).

TRANSPORT AND ACCOMMODATION

Transport will be available for the social programme and also from and to the airport. Accommodation will be available in several categories of hotels or other accommodation. Early reservations are urged in order to avoid disappointment. Full details of the social events will be given in the Second Circular.

OUTLINE OF PROGRAMME

The Symposium will include plenary papers, poster papers, panel discussions and exhibits.

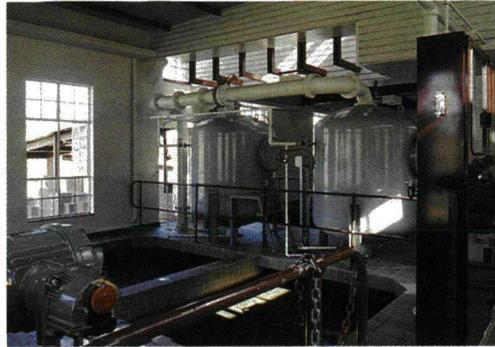
Possible topics to be covered include:

- General outline of the process
- Engineering aspects of digestion
 - Control of the process
 - Industrial effluent treatment
- Sewage treatment using anaerobic digestion
 - Economic and commercial aspects
 - Digestion of agricultural wastes
 - Microbiology of anaerobic digestion
 - Biochemical aspects of the process
 - Storage and use of biogas

The organising committee is negotiating with a number of prominent national and international researchers to attend the symposium.



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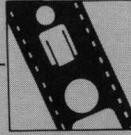
Voorblad: Die Vaalrivier naby Venterskroon

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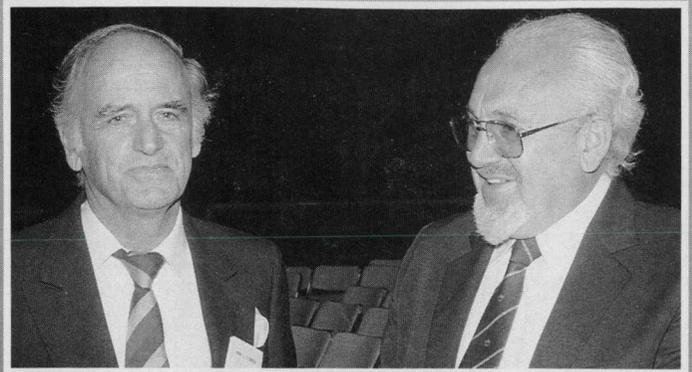
Marine Pollution Symposium

A SYMPOSIUM on marine pollution was held recently at the Muizenberg Pavilion in Cape Town. This one-day symposium was attended by people concerned with the discharge of waste to sea, and the research, management or control of marine pollution.

In his opening address, Dr GS Watermeyer, Director, Hospital and Health Services in the Cape, said that the pollution of the marine environment is recognised as a reality with far-reaching ecological implications. Dr Watermeyer believes that, apart from the danger of disease spreading, the deterioration of the ecology will have an adverse affect on our quality of life. He recommended that preventative and timeous action be taken.

Prof Des Lord from the Department of Oceanography, University of Port Elizabeth, said that the following problem areas will have to be considered when planning for the future:

- demographic changes
- in future, discharges will be of a more diffuse nature
- conflicting use of water bodies, including the ocean e.g. aquaculture, recreation and effluent disposal



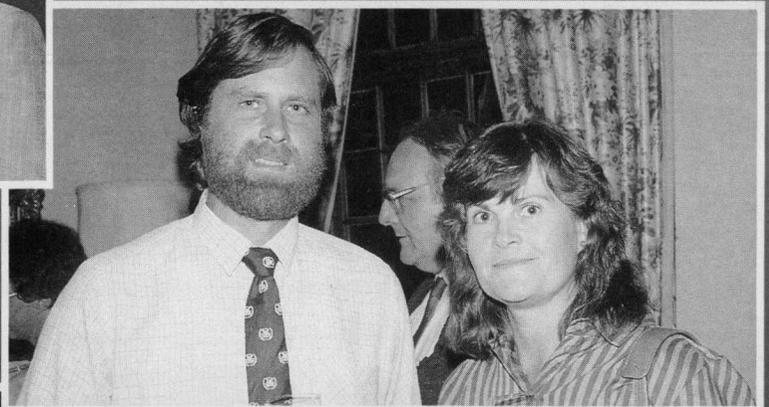
From left: Prof LS Smith (formerly State Pathologist) and Dr GS Watermeyer (Director, Hospital and Health Services, Cape Provincial Administration).



From left: Mr CR Camp (Oil Industry Environmental Engineer, Cape Town), Prof AC Brown (University of Cape Town) and Mr IR Morrison (Cape Town Municipality).



ABOVE: From left: Mr JE McGlashan (WRC) and Prof DA Lord (University of Port Elizabeth). **RIGHT:** From left: Mr AGS Moldan (Dept of Environment Affairs) and Mrs L Shackleton (FRD, CSIR).



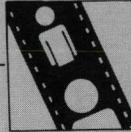
- coastal eutrophication e.g. red tide might occur due to high nitrogen and phosphorus loads in marine discharges

Mr DC Macleod, City Engineer of Durban, said in his presentation: "Sea disposal options depend on the nature of the waste water and also the marine environment, and it is a prerequisite that adequate control be exercised by means of bylaws and inspectorate staff of the quality of discharges to sea."

During the symposium it became evident that the people involved in marine disposal of wastes are aware of the possible threat it poses to the environment and are committed to deal with waste treatment in a responsible manner. 

LEFT: From Left: Prof WOK Grabow (University of Pretoria) and Prof JW Moodie (University of Cape Town).





Kloof Gold Mine hosts open day

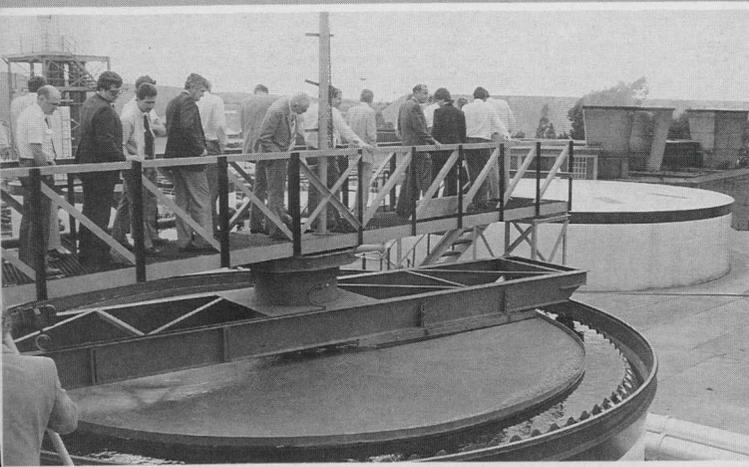
A SPECIAL open day on mine water management was held on 18 October at the Kloof Gold Mine near Johannesburg. Organised by the Joint Organisation Committee of the South African Industrial Water Association and the Water Institute of Southern Africa (WISA), the day was divided into five sessions with speakers presenting papers on water reclamation, the disinfection and filtration of mine service water and hydropower.

Guest speakers were Dr DF Toerien, Director of the CSIR's Division of Water Technology who addressed the delegates on the subject of Marine Water Technology - Quo Vadis? and Bruce Fordyce, eight-time Comrades Marathon Winner who gave a stimulating and entertaining talk on motivation.

Dr Toerien said that due to South Africa's meagre water supply as well as the many authorities involved in the water field, the management of water resources was probably one of the most complex management problems facing the country today.

He said that water managers' future strategies will mainly centre on:

- The development of new technologies - with which the same job can be done using less water,

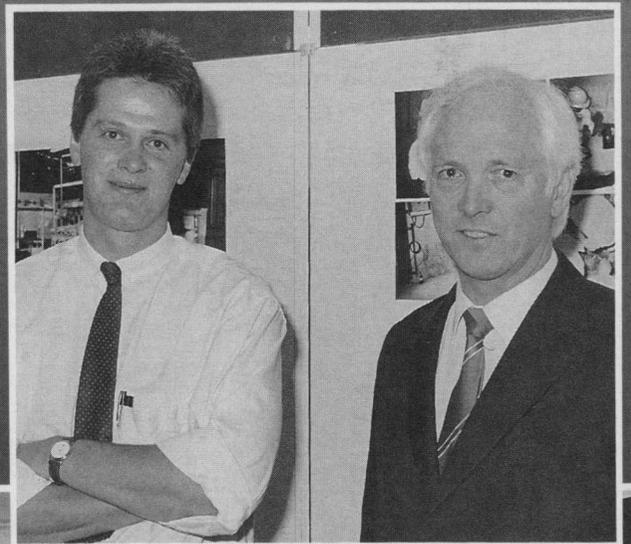


ABOVE: Delegates view the water treatment plant at Kloof Gold Mine's No 1 shaft.

BELOW: From left: Mr Andrew McClaren, Gold Fields, Dr James Barnard, Meiring en Vennote, Dr HNS Wiechers, Chamber of Mines Research Organisation and Mr PE Odendaal, WRC.

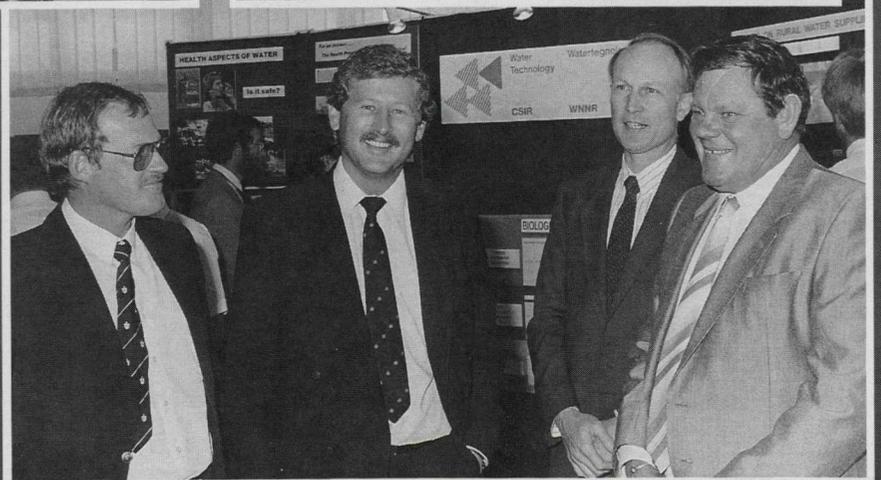
BELOW, RIGHT: From left: Mr W Pulles and Mr BW Busby, both from Chamber of Mines Research Organisation.

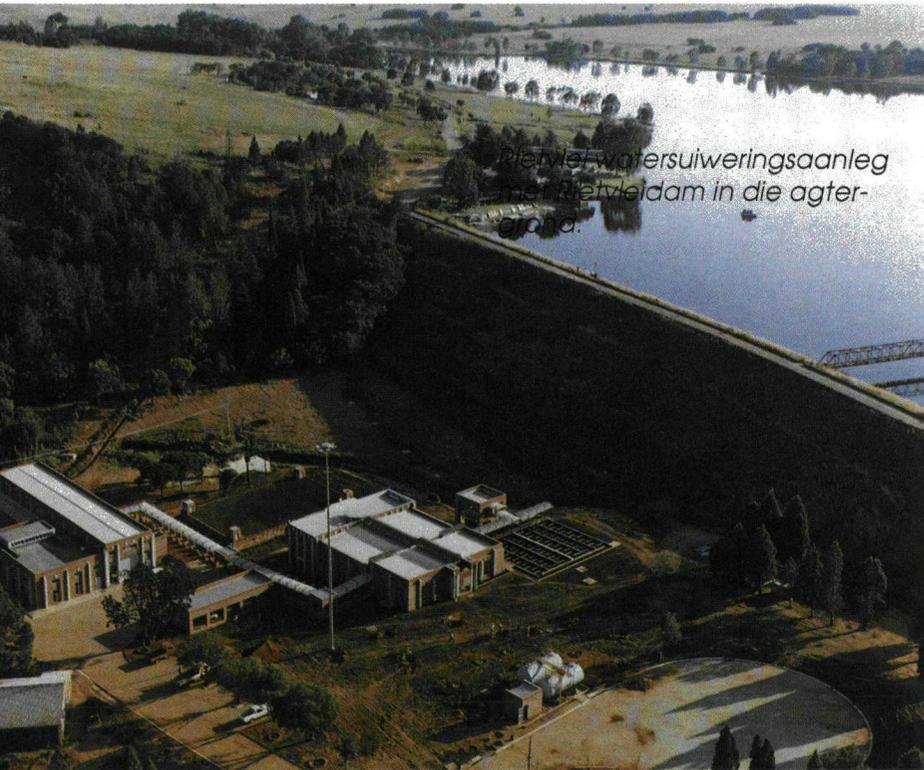
BOTTOM: From left: Mr Rob Wilson, Leeudoring Mine, Mr Bill Pullen and Mr B Schmitz, both from Gold Fields and Mr P Vermaak, Northam Platinum Mine.



- The re-use of water whenever possible, and
- The development of new sources of water, for example, through cloud seeding, desalination and the towing of icebergs to South Africa.

A number of these strategies are at present being implemented at the Kloof Mine, e.g. Kloof has been part of the Chamber of Mines' hydropower research and development scheme since 1984; the Mine has built a full-scale sewage water reclamation plant, using the latest dissolved air flotation techniques to recycle sewage effluent and underground mine water; while trial runs on the use of chlorine dioxide as an alternative to chlorine for the disinfection of service waters have been undertaken since May 1986. **W**





Rietveldwatersuiweringsaanleg met Rietvelddam in die agtergrond.

Opgeloste lugflottasie bespaar Pretoria miljoene

Die suksesvolle toepassing van filterflottasie by Rietveld-waterwerke naby Pretoria is die hoogtepunt van feitlik 'n dekade se navorsings- en ontwikkelingswerk.

Die Rietvelddam word sedert 1934 as 'n bron van drinkwater deur die Stadsraad van Pretoria benut. Die dam is geleë in die Hennopsrivier tussen Johannesburg en Pretoria, en net 'n paar kilometer stroomop van die nuwe meerontwikkeling by Verwoerdburgstad (sien kaart).

Sedert die inwyding van die oorspronklike watersuiweringsaanleg meer as vyftig jaar gelede, het 'n aantal faktore daartoe bygedra dat die Stadsraad met nuwe oë na die Rietveld-aanleg begin kyk het:

Die versekerde lewering wat uit die Rietvelddam onttrek kan word, het gaandeweg verhoog namate die bolope van die Hennopsrivier verstedelik het en die hidrologiese afloop deur onder andere gesuiwerde rioolwater bestendig is;

Die geleidelike eutrofikasie van Rietvelddam, na die verstedeliking in sy opvanggebied, het toenemende waterbehandelingsprobleme as gevolg van algegroei veroorsaak – alternatiewe of aanvullende suiweringsprosesse moes gevind word; en

Die skerp verhoging in die koste van Vaalrivierwater het die Stadsraad genood-

saak om al hulle eie relatief goedkoop bronne ten volle te benut sodat net die minimum aanvullende water die lang afstand van die Vaalrivier ingevoer hoef te word.

Die vergroting van die Rietveld-aanleg was dus voordelig sover dit kostebesparing betref, maar moes rekening hou met 'n "moeilike" bron wat nie konvensioneel tot die gevraagde drinkwaterstandaard gesuiwer kon word nie. Die groot kostebesparing in rouwateraankope wat 'n vergrote Rietveld-aanleg sou teweegbring (ongeveer R6,0 miljoen per jaar) het die deurslag gegee en 'n opdrag is aan raadgewende ingenieurs Geustyn, Forsyth en Joubert (GF&J Ing) uitgereik om die aanleg van 20 Megaliter per dag na 40 Megaliter per dag uit te brei en om 'n gepaste proses vir die suiwing van die algyke water te kies.

Die water uit Rietvelddam word gekenmerk deur lae troebelheid (laer as 10 NTU, gewoonlik 2 - 4 NTU), maar met hoë en veranderlike algbevolkings. Hierdie tipe water skep 'n probleem vir watersuiweringsowerhede dwarsoor die wêreld. Planktoniese alge het dieselfde digtheid as water en sal dus nie vanself besink nie, al word hulle ook deur flokkulasie in aanraking

met mekaar gebring. (Kleipartikels, daarenteen, is swaarder as water en besink geredelik na flokkulasie.) Die besinking-sproses is dus nie geskik om alge effektief te verwyder nie. Indien die algyke water direk deur 'n sandlaag gefiltreer word, word een van twee probleme tipies ondervind:

As die algbevolking oorwegend uit filamente bestaan, dring die alge nie in die sandlaag in nie, maar word bo-op die sandlaag gestuit. Baie gou "weef" die filamente 'n feitlik ondeurdringbare almat bo-op die sand wat die effektiewe watervloei deur die filter blokkeer. So 'n situasie word gekenmerk deur baie kort filterlopiees wat in die uiterste geval net soveel water verg om die filters te was as wat deur die aanleg geproduseer word.

Indien die algbevolking oorwegend enkelsellig is, dring die selle sonder moeite in die sandlaag in, maar word baie moeilik in die sand teruggehou as gevolg van die negatiewe elektriese oppervlaktlading (dieselfde as die sandkorrels) en die neutrale digtheid. So 'n situasie word gekenmerk deur hoë algtellings in die filtraat. Indien 'n groot hoeveelheid chemiese koagulant bygevoeg word om die alge in 'n chemiese vlokstruktuur vas te vang, word die alge beter teruggehou. Die lywige chemiese vlokke verhaas egter dan die verstopping van die filtersand, wat kwalik die koste van hoë koagulantdosering die moeite werd maak.

Weens hierdie redes, word die aanvullende proses van flottasie reeds op 'n paar plekke in Suid-Afrika met sukses gebruik

om die skeiding van alge uit water te bewerkstellig. Tydens flottasie word mikroskopiese lugborreltjies in die water losgelaat wat dan stadig na bo styg en in die proses met algselle bots en flotteer. So word die algselle in 'n drywende skuimlaag op die wateroppervlakte gekonsentreer. Die proses van flottasie word dan deur konvensionele sandfiltrasie gevolg om die oorblywende algselle te verwyder.

By Rietvlei is die prosesse van flottasie en filtrasie in 'n enkele reaktor gekombineer. Dit het die koste-voordeel dat net 'n enkele tenk nodig is in plaas van twee tenks in serie, en ook dat geen dryflaagverwyderingsapparaat nodig is nie - die dryflaag word aan die einde van die filterlopie eenvoudig saam met die filterwaswater uitgewas. Dié koste-voordeel bring egter 'n aantal tegniese komplikasies mee. Die stygspoed van die borrels moet stadig genoeg wees vir effektiewe flottasie, maar hoog genoeg om nie deur die afwaartse vloei van water in die sandlaag ingesui te word nie. Daarby moet die watervlak in die reaktor baie presies beheer word om nie die dryflaag te versteur nie.

Die rouwater moet deeglik met die korrels vermeng word, maar sonder dat oormatige turbulensie geskep word.

Die werking van 'n flottasiefilter (ook bekend as DAFF - "dissolved air flotation filtration") word diagrammaties in Figuur 1 aangetoon. In die geval van die Rietvleiaanleg is daar tien van hierdie flottasiefilters wat vanaf twee sentrale versadigers gevoer word. Die versadiger kringloop kan tot 10 persent van die finale water deur die versadigers teruglei, en die druk binne die versadigers kan ook deur 'n vloeiervstelling gevarieer word. Die effektiewe lugdoseringbereik is tussen 0 en 10 mg lug per liter, rouwater gemeet by vriespunt en atmosferiese druk.

Die voorlopige bedryfsresultate by die aanleg is bemoedigend. 'n Beknopte uittreksel uit die onlangse bedryfsrekords word in die meegaande tabel getoon. In alle gevalle word 'n beduidende fraksie van die partikels geflotteer, met 'n merkbare effek op die filterlooptyd. Dit is egter duidelik dat die flottasie-effek nie konstant is nie, en dat dit deur selfs geringe rouwaterkwaliteitswisselinge beïnvloed word.

Die wisselwerking tussen rouwaterkwaliteit en algbevolking aan die een kant, en die sukses van filterflottasie

aan die ander kant, is 'n braak studiegebied wat 'n doelgerigte navorsingsopgaving noodsaak.

Die aanleg by Rietvlei bied 'n ideale geleentheid vir deurlopende monitoring en die Stadsraad van Pretoria, in samewerking met die GF&J, het reeds 'n beperkte monitoringsprogram aan die gang gesit.

'n Klein mobiele loods aanleg, onder die beheer van die destydse NIWN het die filterflottasieproses sedert 1980 op min-

stens ses verskillende waterbronne in Suid-Afrika op die proef gestel en waardevolle bedryfsinligting ingesamel. Die eerste volskaalse eksperimentering het in 1983 op Richardsbaai plaasgevind, waar een van agt bestaande sandfilters na 'n eksperimentele flottasiefilter omgebou is. Hierdie baie geslaagde werk is gesamentlik deur GF&J en die NIWN uitgevoer en gerapporteer. Die ontwerp van die Rietvleiaanleg het swaar gesteun op hierdie en

BEDRYFSRESULTATE VAN FILTERFLOTTASIE

	WEEK 35	WEEK 36	WEEK 37
Swewende stowwe na dosering (mg/liter)	5,1	7,0	11,0
Swewende stowwe na flottasie (mg/liter)	2,5	1,4	3,0
Persentasie swewende stowwe geflotteer	51%	80%	73%
Chlorofil a na flottasiefiltrasie (mikrogram/liter)	0,4	0,3	1,9
Chlorofil a na filtrasie sonder flottasie (mikrogram/liter)	0,7	0,7	3,8
Verlenging in filterlooptyd as gevolg van flottasie*	70%	52%	28%
* Relatief tot 'n kontrolefilter sonder flottasie			



Die pompruim huisves 15 pompeenhede.

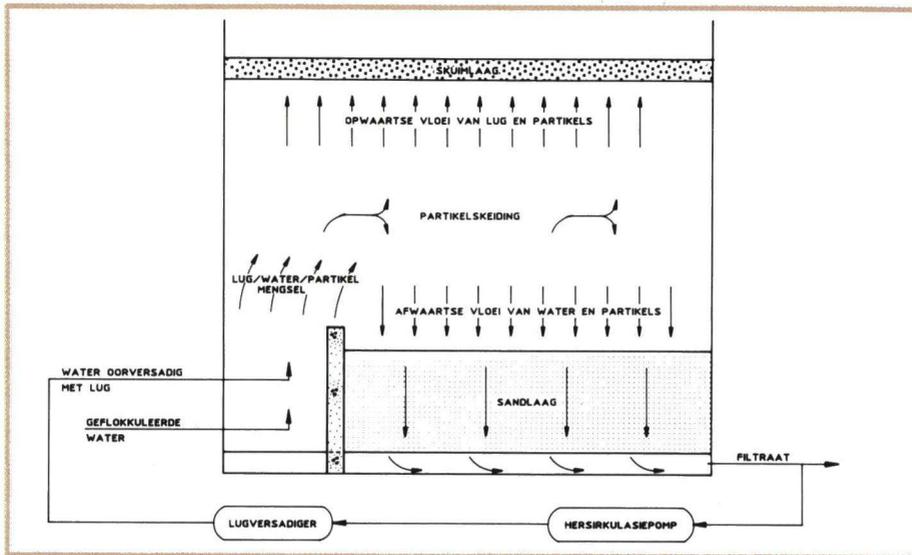
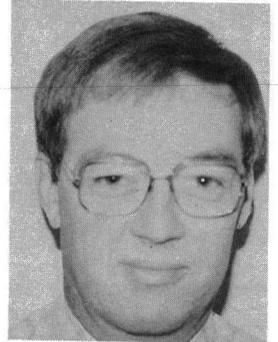
verdere ondervinding, en is ook aangevul deur verdere laboratoriumondersoeke (ook deur GF&J en NIWN) om die nosselontwerp vir die insluit van die oorversadigde water te verfyn.

Die Rietvlei-aanleg is 'n gepaste monument ter nagedagtenis van mnr PBB (Oom Piet) Vosloo. Hy het sy laaste jare met kenmerkende geesdrif aan die volskaalse toepassing van filterflottasie gewy en was tot die dag voor sy skielike dood op 11 Oktober 1987 by die Rietvlei-aanleg met be-

dryfstoetse besig. Sy destydse inisiatief by Richardsbaai, en sy volgehoue betrokkenheid by die detailontwerp van die Rietvlei-aanleg, verdien vir hom 'n ereposisie as een van Suid-Afrika se voorste pioniers op die gebied van filterflottasie - 'n gebied wat nog van deurslaggewende belang gaan word in die toekomstige suiwering van Suid-Afrika se eutrofiiese waterbronne.

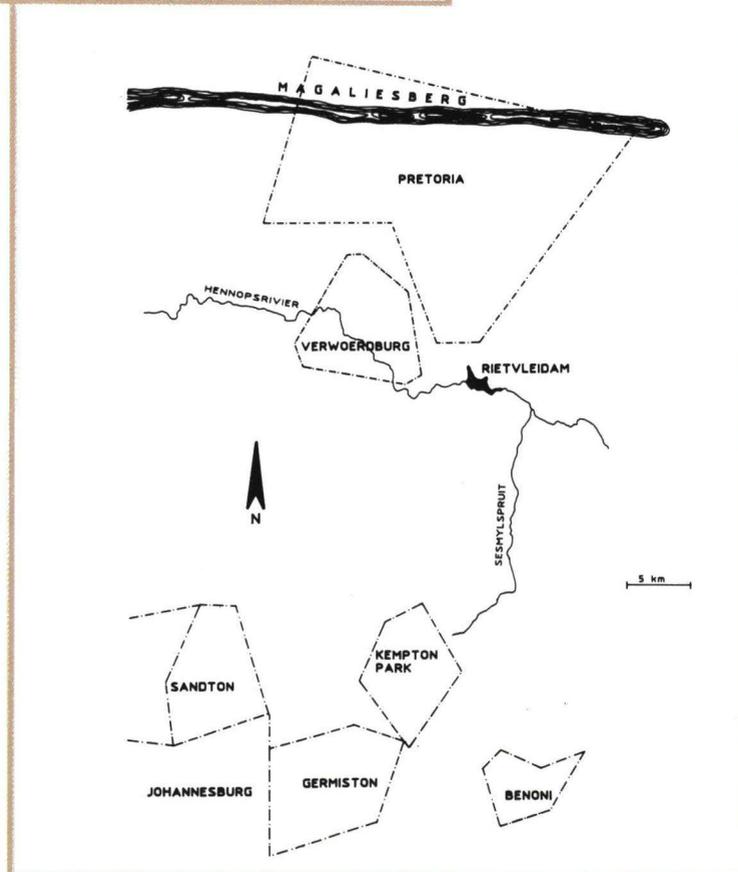
Dr J Haarhoff
GEUSTYN FORSYTH & JOUBERT ING **W**

Dr Johannes Haarhoff van Geustyn, Forsyth en Joubert.



Figuur 1:
Diagrammatiese werking van 'n flottasiefilter

Die kaart toon die ligging van die Rietvleiwatwerke naby Pretoria.



WATERBEHANDELING

Die reaktors waarin die prosesse van flottasie en filtrasie gekombineer word. Agter staan die twee lugversadigers waardeur die her-sirkulasiewater gepomp word.



BO: Die flokkulasie-proses vind plaas in 'n kronkelkanaal.

Die burgemeester van Pretoria, mnr W du P Heunis, wens Pretoria se stadsingenieur, mnr C C du Rand, geluk tydens die inwyding van Rietvlei waterwerke.





The Dual Digestion plant showing, from left to right, the autothermal aerobic reactor, sludge thickener, sludge storage tank (old anaerobic digester), Afrox evaporator and liquid oxygen storage and in the background the anaerobic reactor.

A full-scale dual digestion plant has been constructed at Milnerton's Potsdam Sewage Works near Cape Town to evaluate and optimise this sludge treatment process.

Milnerton masters dual digestion

The process of dual digestion was developed in America and is a two-step system combining a thermophilic aerobic first phase and a conventional anaerobic second phase.

The advantages offered by the Dual Digestion System, especially the disinfection properties, make it a process with tremendous potential for application in South Africa.

RESEARCH

To ensure the disinfection of sludge to suit South African conditions, for example destruction of the ova of the roundworm, *Ascaris lumbricoides* in the sludge, the first stage aerobic process must be operated at a high enough temperature. In America a

temperature of 45 degrees Centigrade is considered to be adequate but in South Africa a higher temperature is required to disinfect the sludge completely.

In a joint venture between the Water Research Commission (WRC) and the City Council of Johannesburg, the effectiveness of the first phase thermophilic aerobic process in terms of the inactivation/destruction of selected pathogens was investigated and the effect of operating parameters and operational problems assessed. The economic implications of operating at thermophilic temperatures using pure oxygen and the potential of the Dual Digestion System in light of the results of the study were also investigated.

In the final report on the research project, it was concluded that the process was very robust and rapidly attained a stable temperature in the order of 60 degrees Centigrade. This temperature could be easily maintained and ensured disinfection of the sludge at retention periods of as low as one day.

The process was self-sustaining, very resistant to change, achieved high solids loading rates and utilised oxygen efficiently. The major cost source for the process was the cost of oxygen.

It was also found, however, that the aerobically treated sludge would not settle and was very difficult to dewater. Furthermore, the treated sludge was found to readily ferment anaerobically, indicating the need for further treatment before final disposal. This further treatment would be provided by adding anaerobic digestion as a second step to complete the total system of Dual Digestion.

CURRENT RESEARCH

After the initial research in Johannesburg, a suitable venue had to be found where adequately sized anaerobic digesters were available to test the process of dual digestion as a whole.

The Town Council of Milneron had the necessary facilities and agreed to assist the Commission in the establishment of a full-scale plant at their Potsdam Sewage Works.

The dual digestion process was installed alongside Milneron's existing Zimpro sludge treatment plant in order that a direct comparison of costs and the quality of the final product could be made.

The research programme has been extended to December 1989 which will

ensure a sufficient time span for the project to achieve its objectives.

FULL-SCALE PLANT

The dual digestion plant at the Potsdam Sewage Treatment Works was constructed using two existing fibreglass tanks



From left: Mr Sampie Laubscher (Deputy Town Engineer, Milneron), Mr Keith Kenmuir (Works Manager, Milneron), Mr John McGlashan (Research Manager, WRC) and Mr John Messenger (Post-graduate student, UCT).

of 50 m³ each and an existing 1 000 m³ reinforced concrete anaerobic digester to which ancillary pipework, pumps, control equipment, temperature recording equipment and an oxygenation system was added. See figure 1.

Operation of the system is started by feeding raw sewage sludge from the primary settling tanks into the first fibre glass tank which is operated as a thickener. From here, sludge is fed intermittently via a macerator pump to the second fibre glass tank which is operated as the autothermal aerobic digester. Mixing and oxygenation of the sludge in the aerobic digester is achieved via an external recirculation pump and specially designed oxygenation system. Before every feed of raw sludge to the aerobic digester, treated sludge is drawn off and pumped to the anaerobic digester. The period between sludge feeds depends on retention time, but is never permitted to be less than two hours to ensure sufficient time for disinfection of the sludge. To prevent heat loss, the aerobic digester is fully insulated with a 50 mm layer of polystyrene cladding on the outside.

Aerobically digested sludge is fed to the anaerobic digester where mixing is provided by a submersible mixer. An external pump is provided to assist in mixing and for

sludge transfer to other sludge holding tanks or to sludge beds for drying.

Monitoring equipment includes a temperature recorder connected to a series of probes to monitor sludge temperature throughout the whole system; oxygen supply meters; gauges for electricity consumption and gas meters for measuring vent gas and digester gas production.

The system was designed for an aerobic retention time of one day and an anaerobic retention time of 10 days. Refinements to these retention times would be made as the research progressed.

The mode of operation employed, i.e. by first drawing off aerobically treated sludge to the anaerobic digester and then refilling the aerobic tank, ensures that short-circuiting of raw sludge cannot occur.

PLANT PERFORMANCE AND RESULTS

After modifications to the existing facilities at the works and installation of ancillary plant, pipework and equipment, the aerobic digester was brought on stream in March 1987.

During the first year, research concen-

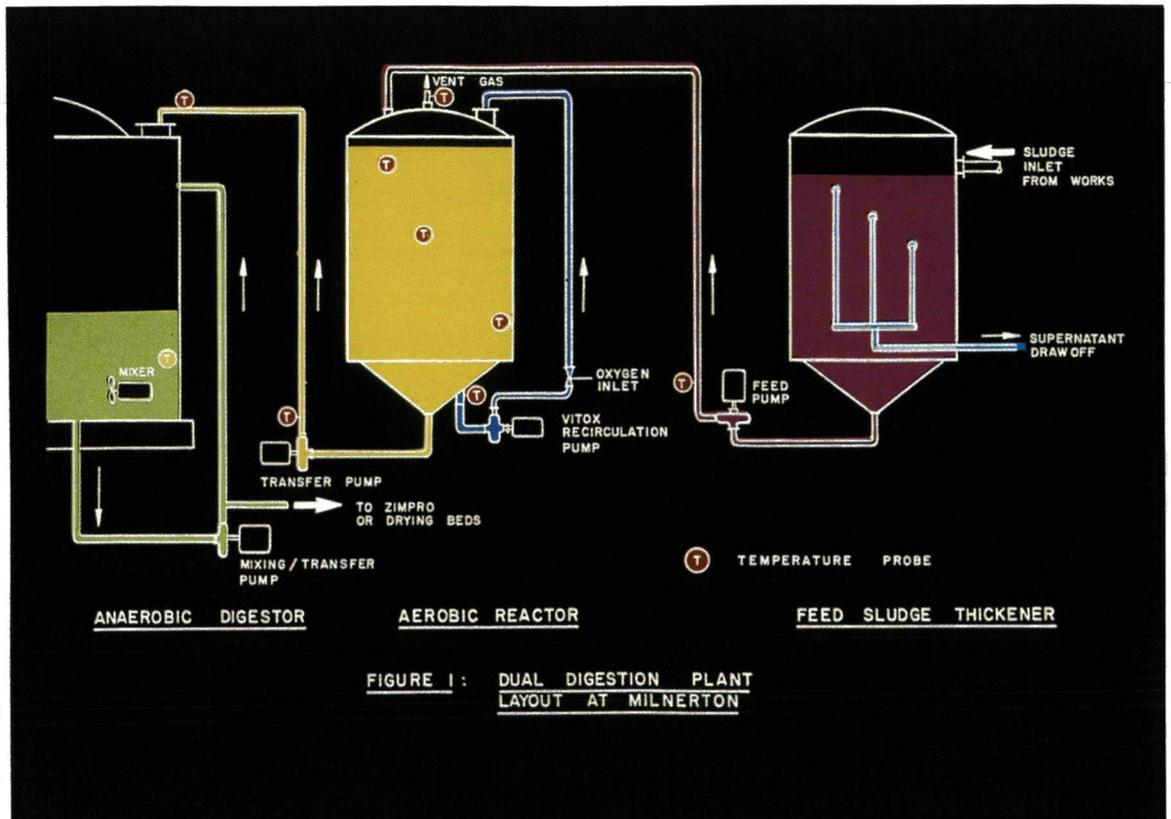


Figure 1: Dual digestion plant layout at Milnerton.

trated on improving the mechanical plant, equipment and controls for the aerobic digester and evaluating the aerobic digestion process itself.

The anaerobic digester was brought on stream during February 1988 after the aerobic stage had demonstrated a relatively trouble-free run representative of normal operation.

Despite the problems encountered, valuable research data has been obtained and practical experience gained since the initial start-up of the aerobic digester.

PLANT AND EQUIPMENT

The design and specifications of certain equipment was found to be absolutely vital to the successful operation of the process. Of particular importance are temperature measurements and recording, safeguards, control equipment and most important, the mechanical plant associated with the oxygenation equipment. A number of modifications to the original design and the standard equipment were necessary to meet the requirements of this special application.

OPERATION, MAINTENANCE AND TRAINING

Full-scale operational research entails much more than pure scientific research. The dual digestion process being researched was linked to an existing treatment system and therefore represents a real life situation, susceptible to shock loadings, variations in the nature of sludge being treated and other operational factors.

The involvement of operating and maintenance staff on such a research project is essential. This can in fact ensure the success or failure of a project. In this regard training of staff at various levels, not only to operate and maintain the system, but also to understand the process, is very important.

COST EFFICIENCY

From the research data obtained so far,

it has been established that the solids content of the feed sludge will have a significant impact on the efficiency of the aerobic process. With the existing sludge thickening facilities, feed sludge solids in the order of 3,5 to 4 per cent have been obtained.

The amount of oxygen needed to maintain the operating temperature of 60 degrees Centigrade is independent of the solids content. So by feeding a thicker sludge, a more efficient process can be achieved due to the greater amount of solids being treated. The process has been found to be more stable with thicker sludges.

The average cost of oxygen and electricity to treat a cubic metre of sludge in the aerobic reactor at a retention time of 1,25 days, is about R3,50. With a thicker sludge, the cost will probably remain the same per cubic metre of sludge treated, but the cost of treatment on a dry solids basis will be considerably lower.

The main purpose of the aerobic process is to generate the necessary temperature for disinfection and the actual con-

sumption of the oxygen supplied to the biomass for autothermal heat generation, is therefore important.

It was found that between 85 per cent and 92 per cent of the oxygen supplied to the aerobic reactor was utilised by the biomass, the balance escaping with vent gases to the atmosphere.

CONCLUSION

The dual digestion system has many attractive features, notably that adding an aerobic reactor to an existing anaerobic digester, can greatly enhance the treatment capabilities of the digester and if properly managed, a disinfected sludge can be produced.

Initial research into the autothermal aerobic stage in South Africa has indicated that the process may very well find application in this country. The research at present being conducted at Milnerton's Potsdam Sewage Treatment Works will verify this and provide guidelines for the design of a plant and operation of the process. **W**

Milnerton's sewage sludge drying beds used for sludge treated in the Zimpro process and Dual Digestion process.





Algprojek in die Vaalrivier aangepak

Die Vaalrivierstelsel met sy netwerk riviere en damme verskaf water aan die ekonomiese hartland van Suid-Afrika: die PWVS-gebied (Pretoria-Witwatersrand-Vereeniging-Sasolburg). Vaalrivierwater word hier gebruik vir huishoudelike doeleindes sowel as grootskaalse myn- en nywerheidsaktiwiteite, en ook vir besproeiing. Terselfdertyd bring die voorsieningsgebied van die Vaalrivier groot hoeveelhede besoedelstowwe, uitvloeisels en afvalwater voort wat in die plaaslike strome gestort word. Die meeste van hierdie uitvloeisel bereik die Vaalbarrage waar die Randwaterraad dit saam met die natuurlike afloop onttrek en ná behandeling weer na die watervoorsieningsstelsel terugvoer.

Die toenemende hersirkulering van uitvloeisel via die Vaalbarrage tesame met die afspoeling van groot hoeveelhede opgeloste soute en voedingstowwe vanuit die opvanggebied asook die gebruik en hergebruik van 'n beperkte watervoorraad het verhoogde soutgehalte en eutrofikasie tot gevolg.

Eutrofikasie - die verryking van water met plantvoedingstowwe - is 'n proses wat deur verstedeliking, landbou en nywerheidsgebruik versnel kan word. Die storting van uitvloeisel wat ryk is aan oplosbare voedingstowwe soos fosfate en stikstof, bevorder die oormatige groei van alge en waterplante. Dit lei tot 'n toene-

mende verswakking in watergehalte en verminder die water se geskiktheid vir alle gebruike behalwe besproeiing.

By die Vaalbarrage en elders in die Vaalrivier het die koste van watersuiwering gestyg vanweë eutrofikasie. Wanneer rouwater eutrofiseer moet chemiese doserings by waterbehandelingsaanlegte tot drievoudig verhoog word vir doeltreffende koagulering, terwyl meer gesofistikeerde behandelingsprosesse soos die gebruik van geaktiveerde koolstof nodig is om onaanvaarbare reuke en smake uit die water te verwyder.

Waterwerke moet dikwels ook een of meer bykomende prosesse soos flottasie en mikrosifting instel vir die fisiese verwydering van alge. Hierdie prosesse kan aansienlike kapitaalbesteding vereis en watersuiweringkoste laat styg.

Eerstige probleme word met alge in die Vaalbarrage en Middel-Vaalrivier ondervind en die Departement van Waterwese het reeds in 1982/83 'n bedrag van R600 000 vir die bestryding van alge in die Vaalrivier begroot.

Tydens 'n werksessie wat vroeër vanjaar deur die Waternavorsingskommissie gereël is om navorsingsbehoefte in die Suid-Afrikaanse watervoorsieningsbedryf te bespreek, het dit geblyk dat die bestryding van alge een van die probleme is waarvoor navorsingswerk gedoen sal moet word. Navorsers sal onder meer moet kyk na:

- Die verwydering van alge uit die rouwater self
- Faktore wat alggroei in die behandelingstelsel beheer, en
- Die ontwikkeling van chemiese, fisiese en operasionele maatreëls wat sodanige groei kan teëwerk
- Riglyne vir die ontwerp en bedryf van OLF-stelsels in waterbehandeling
- Die ontwikkeling van 'n vereenvoudigde, praktiese tegniek om algkonsentrasies te meet.

Professor AJH (Braam) Pieterse, hoogleraar in Plantkunde aan die Universiteit van die Oranje-Vrystaat spesialiseer in die bestudering van vryswewende alge, ook fitoplankton genoem.

SA Waterbulletin het onlangs met hom gaan gesels by die Vaalrivier waar hy en 'n groep derdejaarstudente besig was met navorsingswerk oor die Vaalrivierekosisteem. Professor Pieterse sê fitoplankton is vrydrywende, swewende plantjies wat in die water voorkom. Die plantjies is meestal eensellige organismes wat min of geen verband het met die bodem. As die plantjies meersellig is, is dit klein kolonietjies of filamentvormige struktuurtjies.

Aangesien protoplasma (die inhoud van

selle) digter as water is, sal die alge neig om na die donker gedeeltes naby die bodem van die rivier uit te sak waar hulle nie kan groei nie. Alge se bou is dus aangepas om dié uitsaktempo te vertraag: sommige is skyf- of potloodvormig, terwyl andere vlerkagtige of stekelrige ahangsels het en nog onder hulle digtheid kan verander.

Professor Pieterse sê daar bestaan 'n verband tussen omgewingsfaktore en alge in die Vaalrivier.

"Enige chemiese verandering of wysiging, soos byvoorbeeld 'n verhoging in die soutgehalte en verrykingstoestand van die rivier loop uit op veranderings in die algbevolkingsamestelling asook intensiewe algopbloei."

Hy sê in 'n onbesoedelde rivierstelsel, of 'n stelsel wat nog nie deur die mens beïnvloed is nie, word 'n groot verskeidenheid organismes aangetref, ook alge. Sodra menslike ingryping die ekologie verander en die rivier beïnvloed word, vind daar 'n verlaging van die verskeidenheid organismes en 'n verhoging in die hoeveelheid van enkele soorte plaas. Die sensitiewe soorte verdwyn terwyl die soorte wat beter by die veranderde toestand aangepas is, bykom of oorbly. Namate kompetisie tussen soorte verminder floreer sommige en bou al hoe groter bevolkings op. Dit verklaar hoekom 'n opbloei van alge gewoonlik net uit een of twee soorte bestaan.

Professor Pieterse sê die alge in die

Vaal vertoon verskillende opbloei, maar hulle het vasgestel dat die opbloei wat in die lente plaasvind konstant uit 'n beperkte aantal algsoorte bestaan, naamlik, Micracetium pusillum ('n groen algsoort), Stephanodiscus hantzschii en Cylotella meneghiniana (diatome).

Daar is ook opbloei van ander algsoorte gedurende ander tye van die jaar soos byvoorbeeld die opbloei van die groenes, byvoorbeeld Carteria, gedurende die somermaande maar dit geskied op 'n meer lukrake manier en is nie so voorspelbaar soos die lente opbloei nie.

Die beheer van algopbloei is nie maklik nie. Een manier sou wees om die waterkwaliteit te verbeter.

Professor Pieterse meen dat met die inbedryfstelling van die Lesotho-hooglandskema waar varswater vanuit die bo-lope van die Oranjerivier na die Vaal oorgeplaas word, sal die verbeterde waterkwaliteit van die Vaal moontlik 'n uitwerking hê op die samestelling, die tipes en die hoeveelheid alge in die rivier.

"Uiteindelik sal die effek egter gekanselleer word deur die groter vraag na water in die PWVS-gebied en die gevolglike toenemende hergebruik van 'n beperkte hoeveelheid water.

Sommige van die algopbloei kan gevaarlik wees. 'n Bloei van Microcystis ('n blougroen alg) kan vrektes onder vee en vis veroorsaak, terwyl 'n opbloei van giftige alge soos die dinofiete (byvoorbeeld Peridinium-soorte), hele gemeenskappe in



Prof Braam Pieterse (met die hoed op) en 'n aantal derdejaarstudente in plantkunde aan die UOVS besig met eksperimentele werk oor die Vaalrivierekosisteem. Die Departement van Plantkunde reël elke jaar 'n verpligte veldekskursie vir studente waartydens hulle in die natuur navorsingstegnieke kan aanleer en prakties toepas.

gevaar kan stel, aangesien hierdie groep 'n uiters gevaarlike en potente gif kan produseer.

Professor Pieterse sê die Vaalrivier is uit 'n algologiese oogpunt 'n baie ryk en interessante stelsel. Hulle het tot dusver nagenoeg 180 verskillende algsorte in die Vaal geïdentifiseer, onder andere verskeie dinofietgenusse. Verskeie soorte moet nog geïdentifiseer word.

Hy sê die huidige verryking en versouting van die Vaalrivier se water asook die moontlike wysiging daarvan deur die invoer van hoë gehalte water uit ander opvanggebiede en die algologiese veranderings wat die 'onnatuurlike' en veranderende situasie teweegbring, skep 'n unieke ondersoekgeleentheid, "'n globale eksperiment" wat hy en sy studente gebruik om talle

fasette van alge (taksonomies, fisiologies, biochemies en toegepas) te ondersoek.

Die projek oor die biologie van algsorte in die Vaalrivier waaraan hulle tans werk, bestaan basies uit drie fases.

Fase een behels 'n beskrywing van die omgewingsfaktore en omgewingsaspekte van die Vaal asook 'n beskrywing van die floristies-ekologiese aspekte.

'n Groot verskeidenheid fisiese en chemiese omgewingsveranderlikes word bestudeer waarvan die inligting oor sommige deur die Universiteit self gegeneer word en sommige op 'n bykans daaglikse basis by Balkfontein deur die Departement van Waterwese gemoniteer word.

Die omgewingsgegewens word met die verskillende aspekte van die algbevolkings in verband gebring om kort- en langter-

mynveranderings in biomassa en saamstelling te probeer verklaar en te kan bepaal watter faktore verantwoordelik is vir watter verskynsel in die wateromgewing.

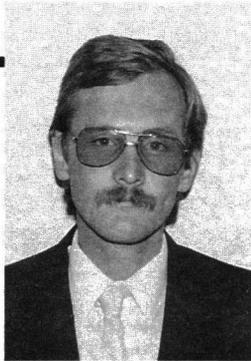
Aan die ander kant word 'n taksonomiese en morfologiese beskrywing van die algflora ook ondeneem. Hier word gekyk na onder meer bevolkings- en gemeenskapsdinamika, suksessiepatrone en -tempo's, nis en nisverwante aspekte, soos nisbreedte en nisoorvleueling, intraspesifieke bondeling en tweerigting interspesifieke bondeling terwyl veranderingstempo's in omgewingsfaktore met suksessietempo's gekorreleer word.

In die tweede fase van die projek, wat nou 'n aanvang neem, word spesifieke verskynsels wat voorheen geïdentifiseer is, eksperimenteel nagevors.



Mnr Jan Roos (regs) besig met primêre produksie eksperimente op die Vaalrivier. Die apparaat, wat deur mnr Roos self ontwerp is, word gebruik om die beweging van water in die rivier na te boots.

Dr Andrew Wood, researcher at the CSIR's Division of Water Technology.



Artificial wetlands can provide in South Africa's need for simple and low cost wastewater systems. Dr Andrew Wood of the CSIR explained this approach at a symposium held recently in America.

Treating effluents nature's way

A researcher from the Division of Water Technology, CSIR, Dr Andrew Wood recently presented a paper on artificial wetlands at an international conference held in Chattanooga, Tennessee, USA. The paper was entitled: Research to develop engineering guidelines for the implementation of artificial wetlands for wastewater treatment in Southern Africa.

Dr Wood and his co-author Dr Laurie Hensman said in recent years considerable interest has been shown in the potential use of artificial wetlands for the complete treatment of waste water from low income areas within the country and its neighbouring states.

The use of constructed wetlands to treat waste waters is a direct realisation of lessons learnt from nature. Nature adapted to the pollution of waterways and the pressures on the surface and aquatic ecosystems by promoting the formation of hydric soils and growth of hydrophytes to protect the environment, at least on the local scale.

It is now with the ever increasing demand on our water bodies that we are realising that nature, via constructed wet-

lands, can again be harnessed to act as an efficient, complete wastewater treatment system comparable to more conventional systems such as biological trickling filters, activated sludge and oxidation/stabilisation ponds.

ADVANTAGES

Artificial wetland systems have been identified as having certain advantages over conventional treatment systems. These include:

- low working expenses
- low energy requirements
- low maintenance requirements
- they can be established at the very location where the waste water is produced
- being a 'low technology' system, they can be established and run by relatively untrained personnel.

Such simple systems are therefore seen as a viable option, especially suitable for small to medium sized communities, in sparsely populated areas and in developing countries.

Prof Pieterse het uit die korreleringsbenadering vasgestel dat vloeisnelheid, troebelheid, totale opgeloste stowwe en die voorsiening van sulfaat, stikstof en fosforverbindinge nou verband hou met 'n aantal eienskappe van die algbevolking in die rivier, soos primêre produksie, konsentrasie en verskeidenheid.

Die bedoeling met die eksperimentele fase is ook om spesifieke algsorte te isoleer.

Aanvanklik was die doel om al die algsorte wat probleme veroorsaak te isoleer, maar sê professor Pieterse, dit is makliker gesê as gedaan.

Tans is nagenoeg 10 algsorte uit die Vaal in enkelalgsorte geïsoleer wat vir 'n

verskeidenheid eksperimente in die laboratorium en in die veld aangewend kan word. Op vyf van die alge word tans kultuurstudies gedoen om vas te stel watter faktore vir hulle groei belangrik is.

Die maankoncentrasie van metaalbesoedeling in die rivier op alggroei word ook ondersoek. Professor Pieterse sê mangaanbesoedeling kom veral in die West-Transvaalse mynbougebied, naamlik in die Stilfontein-Orkney-omgewing voor.

"Wanneer die mangaankonsentrasie in die water hoog is, bemoedig dit chlorering by watersuiveringswerke en dit kan moontlik 'n effek op die biologie van algsorte hê."

Professor Pieterse sê baie van die alge wat in die Vaalrivier voorkom, het doppies

om hulle selletjies wat lorikas genoem word. In hierdie doppies word metaal neergelê, onder meer mangaan en yster.

Hy sê volgens die literatuur is die Vaalrivier ryker aan algsorte wat doppies vorm en wat metale in die doppies neerlê as baie ander riviere. In riviere soos die Teems, die Mississippi, die Amasone en die Ryn kom hierdie alge selde voor en vorm nie so 'n belangrike onderdeel van die algsamestelling nie. Die vraag of die hoë metaalbesoedeling wat in die Vaalrivier aanwesig is hierdie groep alge stimuleer of nie, is tans nog onbeantwoord, sê professor Pieterse.

Die invloed van metale op alggroei wek elders in die wêreld ook groot belangstelling.

Water uit die onderwaterfontein wat die Kinneretmeer in Israel voed, is ryk aan koper, maar die effek van die koper op die alge in die meer was tot onlangs nog onbekend.

Professor Pieterse het verlede jaar tydens 'n besoek aan Israel die invloed van koper op die metabolisme van vyf alge in die Kinneretmeer by die 'Lake Kinneret Limnological Laboratory' naby Tiberias, nagevors.

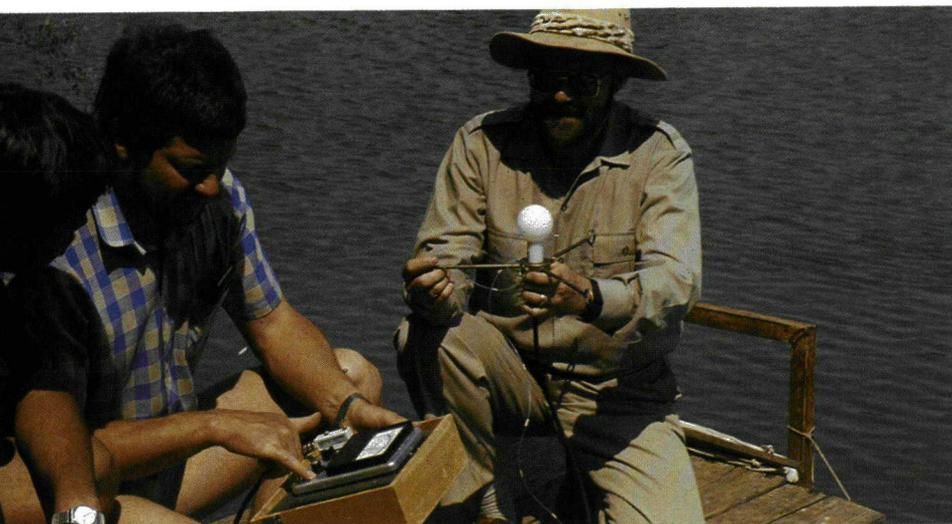
Hy was een van die eerste wetenskaplikes wat die studie begin het en hy beskou dit as 'n voorbereiding tot 'n soortgelyke ondersoek op die Vaalrivier. Hy het die invloed van koper op die tempo's van koolstoffiksering, koolstofuitskeiding asook fosfatase en nitraatreduktase aktiwiteite nagevors en onder meer vasgestel dat mangaan in 'n groot mate die inhiberende en giftigheidseffek van koper onder sekere toestande ophef. Aangesien dit reeds bekend is dat sulfaat en fosforverbindinge 'n soortgelyke invloed op die effek van koper uitoefen, is hierdie navorsing in Israel van direkte belang in professor Pieterse se werk op die Vaalrivier.

In die derde en laaste fase van die huidige Vaalrivierprojek sal gepoog word om met behulp van die inligting wat in die eerste twee fases versamel is 'n rekenaar-model te bou wat vir bestuurs- en voorspellingsdoeleindes in die Vaalrivierstelsel aangewend kan word.

Professor Pieterse sê die besondere benadering wat in hierdie projek gevolg word, is heeltemal oorspronklik ten opsigte van Afrika en in 'n groot mate ook ten opsigte van die res van die wêreld. "Die werk maak nie allen 'n algemene bydrae tot die kennis aangaande plantkundige aspekte van die Vaalrivierekosistiem nie, maar verruim ook in 'n hoë mate die toepassing en benutting van teoretiese aspekte van die ekologie." **W**



Watermonsters uit die Vaal word deur studente ontleed vir pH, geleiding, alkaliniteit en konsentrasies van anorganiese koolstof, suurstof, ammonium-N, nitraat-N en ortofosfaat-P.



Prof Braam Pieterse (regs) en mnr Jan Roos (middel) besig met ligmetings.

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Dr Laurie Hensman, co-author of the paper.

RESEARCH

Natural wetlands already form an important barrier against the non-point source discharges of most heavily industrialised areas of South Africa. Research is now being undertaken at a number of locations to evaluate the role of these natural wetlands as well as artificial wetlands in wastewater treatment in South Africa and Zimbabwe.

Division of Water Technology, CSIR

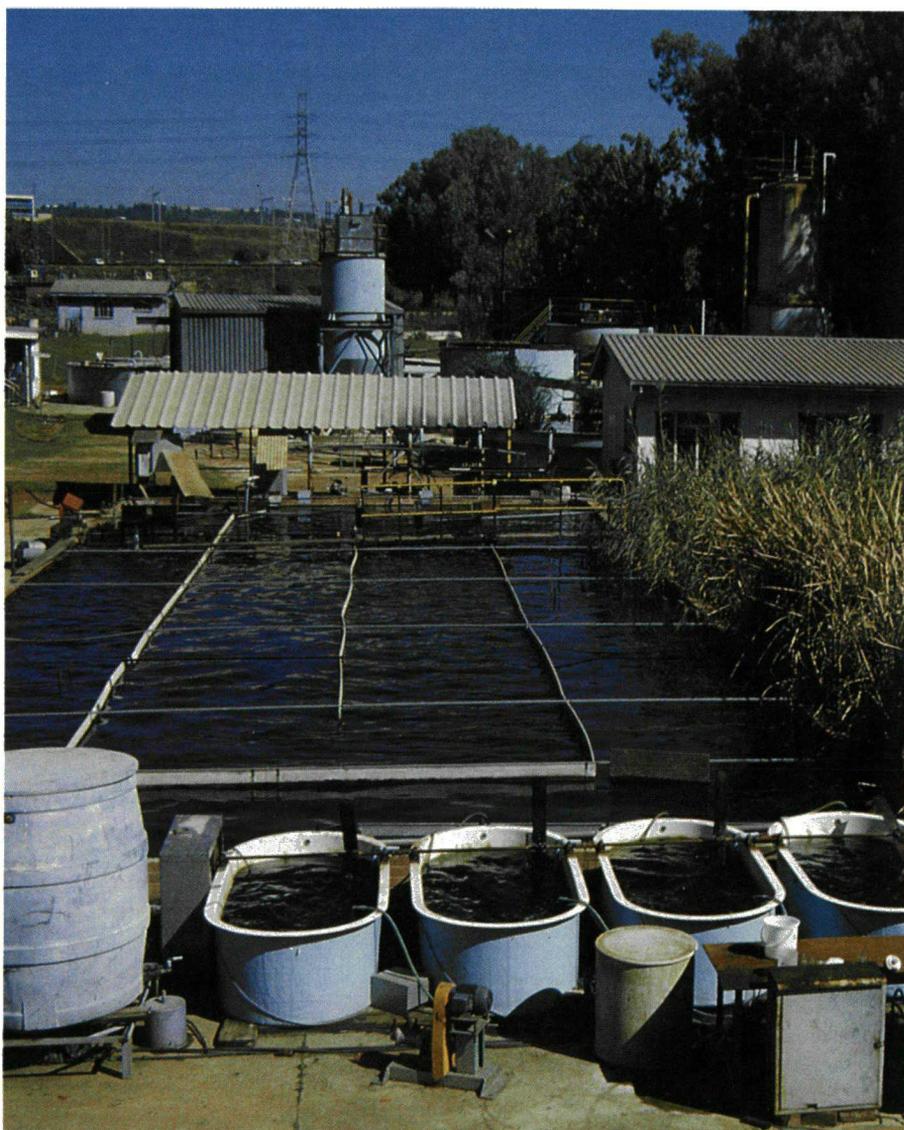
The Division of Water Technology (DWT) of the Council for Scientific and Industrial Research (CSIR) initiated an Artificial Wetland research programme in late 1985. Dr Laurie Hensman for the consulting engineering company, Stewart Sviridov & Oliver is working with the DWT to establish guidelines for artificial wetland construction and application.

The research includes a series of laboratory, bench and pilot scale facilities, under the advice and guidance of a co-ordinating committee comprising scientific, industrial and consulting personnel interested or active in the field.

The first phase of the pilot scale studies principally investigate the controlling factors responsible for the efficient operation and design of wetland systems such as:

- The substrata responsible for the majority of the nutrient removal and hydraulic capacity of the system.

Substrata types are evaluated for their permeability and nutrient removal capacity under controlled conditions, and with the desired effluent type. Studies have been performed on a range of representative soil types, gravels, sands, dolerites and waste ash. Effluents tested range from oxidation pond



effluents, primary and secondary domestic sewage to specific industrial wastewaters.

Waste power station ash is seen as a highly promising substrata as it combines high permeability with a degree of phosphate and pathogen removal as a consequence of its inherent high salt concentrations and alkalinity.

- The macrophyte species responsible for aeration and enhancing permeability.

All aquatic plants appear to possess water treatment characteristics since they offer a surface to which micro-organisms can adhere, and absorb nutrients. The common reed, *Phrag-*

A combined artificial wetland and high rate algal pond for wastewater treatment and protein production at Daspoort sewage works, Pretoria.

mites australis, has deep roots and rhizomes which create a great volume of active rhizosphere per surface area. These attributes have led to the majority of wetland systems being established with this species. Other principal species that have been investigated include Typha, Scirpus, Kikuyu and Arundo.

- Operational regime imposed on the system, in particular effluent characteristics, loading rates and retention times. The pilot scale studies take the form of 12,4 m² surface area reactors investigating specific aspects of the system's operation regimes. These studies have compared two candidate plant species: Phragmites and Scirpus, three effluents: oxidation pond, ash filtered oxidation pond and septic sewage, and two substrata, soil or ash.

Research to date has demonstrated that constructed wetlands can meet the general standard for COD and suspended solids at area loading rates of 200 l/m²/d oxidation pond, ash 50-100 l/m²/d for raw, septic or settled domestic sewage. In respect to nitrogen removal, the loading rate must be lower than required for COD removal, in order to ensure the availability of oxygen. Phosphate removal is intimately associated with the physiochemical characteristics of the substrata. Clay or iron rich soil types and waste ash can achieve removal, to within specific discharge standards, though gravel and sands are relatively inefficient.

For effluents with higher organic or solids concentrations, coarser substrata are required, higher hydraulic heads or lower loading rates in order to achieve adequate passage through the bed.

Additional studies are utilising a 260 m² surface area, 400 mm deep converted sludge drying bed planted with Typha, Phragmites and Scirpus. The system receives septic sewage at 135 l/m²/d, prior to a High Rate Algal Pond acting as the nutrient polishing and high protein biomass production unit. As with the smaller units, general discharge consents for COD and suspended solids are being met, though ammonia removal is restricted to 50 per cent and phosphate 20 per cent, as a consequence of the higher organic loading rates and inability of the gravel media to adsorb or precipitate phosphate.

Similar results have been achieved with a 50 m² gravel bed constructed from a former fish dam also planted with Phragmites and Scirpus receiving settled sewage. This system is now receiving raw

domestic sewage supplemented with molasses to simulate high COD sewage associated with rural communities.

Two other 50 m² surface area beds, one metre deep planted with Phragmites have been established to evaluate nutrient removal to special standards. The first bed receiving raw sewage is filled with waste power station ash to act as the long term removal stage. A second bed, which receives the effluent from the first, is filled with a local soil topped with waste ash. This is designed to achieve the final phosphate, nitrogen and pathogen removal.

At a surface loading of 100 l/m²/d to both these units, the initial results appear promising, and the DWT researchers are highly optimistic of the value of the artificial wetland technology to Southern Africa.

Mpophomeni Sewage Works

Mpophomeni, a Kwazulu town situated on the eastern shore of a sensitive phosphorus-limited impoundment, is served by a biofilter sewage works to which has been added an artificial reed bed for polishing final effluent and nutrient removal.

The surface area of the reed bed is 2 500 m², 1,5 m deep with a maximum design loading of 20 cm/m²/d. The bed is lined with a hyperplastic membrane with a bottom drainage level of crushed gravel and a geotextile filter layer. The bed is constructed of acidic soil of high phosphate fixing capacity and planted with Phragmites.

Actual loading rates have been low and



An artificial wetland for sewage treatment under construction at Norfolk, UK.

variable (between 5 and 23,5 cm/m²/d) which has led to some inability to assess the performance according to loading, although it is evident that the reed bed has a marked effect on the quality of the effluent. All effluent concentrations with the exception of E-coli comply with the General Standard requirements.

Grootvlei Power Station, Transvaal

A novel engineering approach has been applied to trial systems at Grootvlei power station, south of Heidelberg in the Transvaal. Again the system is designed to remove nutrients and pathogens from a bio-filter plant effluent.

The process has an initial horizontal flow stone media stage divided into three zones.

The first planted with *Scirpus* to nitrify, prior to a zone containing mulched plant material which provides the carbon for denitrification. The third zone is an additional store media and is planted with *Typha*. The second stage comprises a vertical flow soil bed with a gravel underdrain and is planted with *Scirpus*.

The treatment achieved through the Grootvlei reed beds bears a close similarity to the DWT and Mpophomeni results. Again, the good nitrification performance by the bio-filters generally results in low ammonia loadings to the beds, which is further reduced in the bed, and thereafter denitrification results in very low nitrogen effluent levels. The phosphate reduction is achieved through the physico/chemical binding with salts principally in the soil layers.

Olifantsvlei Sewage Works, Johannesburg

A system being studied by the Witwatersrand University (Wits) and Johannesburg Municipality may be considered an intermediate between the natural wetlands and artificial wetlands. Three units have been established at Olifantsvlei sewage works near Johannesburg.

The effluent from the works, of the order of 300 Ml/d, discharges to an extensive natural vlei system which achieves a reduction in both nutrients and pathogens. The artificial wetlands are modelled on the natural wetland characteristics. These are geotextile lined, approximately 120 m long by 20 m wide and an effective bed depth of 2 m. Two of the beds were completely filled with peat abstracted from the natural system, whilst the third has a woven rope net suspended across the bed supporting the peat mass above the bottom of the channel. Secondary effluent from the works enters one end of the beds at a loading equivalent to 50 cm/m²/d, and is taken off across the surface at the far end, ideally having passed through the peat mass and growing *Phragmites*.

The positioning of the influent and effluent points at the surface does result in significant short circuiting rather than sub-surface flow, which may be considered to be influencing treatment efficiency. However, data available indicates that the beds are achieving significant nitrification, denitrification, suspended solids and pathogen removal, though phosphate removal is limited due to the lack of suitable binding compounds within the peat mass.

Gazankulu

Reed beds have been established in two rural areas of Gazankulu, a Shangaan tribal area. Giyani, the capital with a population of approximately 90 000, is served by a conventional system, whilst seven reed beds have been planted at the end of the treatment process, principally for nutrient and pathogen removal. The outflow from biological seeping beds is channelled to the reed beds where the retention time is four days. The seven beds are alternately isolated and the effluent drained by 100 mm for one day to destroy mosquito eggs.

During the past four years research in the field of artificial wetlands has been undertaken at a number of locations and prototype units have been constructed. Presently, national design guidelines are being prepared for the use of artificial wetlands in the country. **W**



Artificial wetlands at Benton, Kentucky, USA, consisting of three beds 1 000 feet long and 144 feet wide.

PHOSPHATE STANDARD NOW STRICTLY ENFORCED

Eutrophication, or enrichment with plant nutrients, of rivers and reservoirs in South Africa causes excessive growth of algae.

The department of Water Affairs decided to control the causes rather than the symptoms of eutrophication. Phosphorus is usually the growth limiting plant nutrient in the freshwater environment and is also the easiest to control. In South Africa point sources contribute 60 per cent to 80 per cent of the total phosphorus exported from catchments. Therefore, a special effluent standard of 1 mg ortho-phosphate P/l was promulgated in August 1980 for seven so-called 'sensitive' catchments. These catchments were identified on the basis of the number of point sources they contained as well as their importance as water resources.

Implementation of the 1 mg P/l standard was postponed for five years, until August 1985, to give those who had to comply the opportunity to gear up for it. During that time a preliminary assessment was done of the possible impact of implementing the standard on eutrophication related water quality in reservoirs in sensitive catchments.

Taking into account the recommendations in that report, the importance of certain catchments as water resources and the poor state of the economy in 1985, the Department at that time decided:

- To implement the 1 mg P/l standard in the Vaal River catchment up to the Barrage and in the Crocodile River catchment up to the confluence of the Crocodile and Pienaars Rivers.
- To grant a further three years exemption, until August 1988, from complying to the 1 mg P/l standard in the remaining sensitive catchments. During this period a more comprehensive assess-

ment to the impact of the standard on eutrophication related water quality was to be done.

The Department and the Division of Water Technology of the CSIR undertook a comprehensive investigation of the impact of the 1 mg P/l standard on eutrophication related water quality in sensitive catchments. In this investigation models were used which were specifically developed for the highly variable hydrological conditions experienced in South Africa. The most recent data on contributions from point and non-point sources of phosphorus were also used. The target water quality aimed for by eutrophication control was to: Maintain mean chlorophyll concentrations in the receiving water bodies at such levels that severe nuisance conditions would occur for not more than 20 per cent of the time. That translated into a phosphorus management objective of maintaining mean total phosphorus concentrations in reservoirs at 130 ug/l lower.

Comprehensive reports were prepared on the investigations of the impact of eutrophication control measures on water quality in water bodies in the sensitive catchments. In these reports various scenarios were considered, each representing a different combination of control options, times in the future and alternative plants for developing and/or augmenting the water resources in those catchments. The Department of Water Affairs reviewed its previous decisions concerning the implementation of the 1 mg P/l phosphate standard in sensitive catchments on the basis of the recommendations made in these reports. The revised decisions fell into three categories and are summarised in the accompanying Table. W

SUMMARY OF DECISIONS ON THE IMPLEMENTATION OF 1 mg P/L STANDARD

CATCHMENT	RESERVOIR/RIVER	NO STANDARD*	1 mg P/L STANDARD	+ ADDITIONAL MEASURES++
Crocodile	Rietvlei		x	x
	Hartbeespoort		x	x
	Rooodeplaar		x	
	Apies/Klipvoor		x	
Olifants	Bronkhorstspuit	x		
	Loskop	x		
Vaal	Grootdraai	x		
	Vaal	x		
	Barrage		x	x
	Middle Vaal River	x		
Mgeni	Bloemhof	x		
	Midmar	x		
	Albert Falls	x		
	Nagle	x		
Umlaas	Inanda		x	
	Shongweni		x	
Buffalo	Laing		x	
	Bridle Drift	x		
Berg	Berg River	x		

*No Standard: In some catchments implementation of the 1 mg P/l standard is postponed for a specific period or until further notice. In these catchments further investigations will be done and/or the situation will be monitored on the basis of which the implementation of the standard will be reviewed from time to time.

+1 mg P/l Standard: In some catchments the 1 mg P/l standard will be strictly enforced from August 1988 to protect water quality.

++Additional Measures: In a few catchments the receiving water bodies are so overloaded with phosphorus that implementation of the 1 mg P/l standard only will be insufficient to protect water quality. In these cases the standard will be implemented strictly from August 1988 and the implementation of additional control measures will be investigated.



University of Cape Town
Department of Civil Engineering
Water Research Group

Post-graduate programme in water and waste water treatment

Applications are invited for post-graduate studies in the Water Research Group of the Department of Civil Engineering. Programmes are offered for PhD and two MSc degrees viz MSc (Engineering) and MSc (Applied Science) for Engineering and Science graduates respectively.

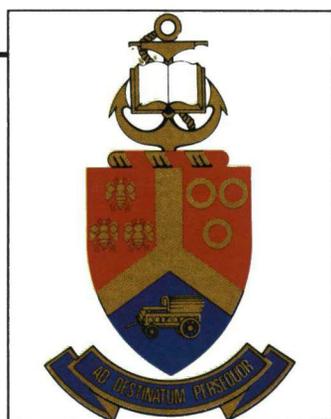
The MSc degrees extend over two years (three years for Science Graduates without Honours) with course work and thesis research.

Courses offered are in Aquatic Chemistry and Water Supply and Wastewater Treatment.

Thesis research areas offered are aquatic chemistry, water and wastewater treatment, biological nutrient removal, anaerobic treatment, activated sludge bulking control, mathematical modelling of biological systems and hydrodynamic transport of nutrients in rivers and impoundments. Most of these research areas are currently active research programmes of national importance funded by the Water Research Commission and Foundation for Research Development.

Bursaries for R10 000 per annum renewable are available to successful applicants.

For further information, contact either Professor G v R Marais or Associate Professor GA Ekama at the Department of Civil Engineering, University of Cape Town, Rondebosch, 7700, (Tel: (021) 659-2582, 659-2588. Fax: (021) 650-3726), or complete the post card included in this Bulletin.



UNIVERSITEIT VAN
PRETORIA
DEPARTEMENT
CHEMIESE
INGENIEURSWESE
AFDELING
WATERBENUTTINGS-
INGENIEURSWESE

Opleidings- en Navorsingsgeleentheid in Waterbenutting

Die Universiteit van Pretoria bied vakkursusse aan ingenieurs en wetenskaplikes wat hulle wil bekwaam as spesialiste op die gebied van waterkwaliteit- en afvalbestuur. Die kussusse kan lei tot BIng (Hons), BSc (Hons), MIng of MSc-grade en kan deelyds gevolg word.

Daar is ook geleentheid om navorsing te doen en 'n bydrae te maak tot die oplossing van die land se besoedelings- en watervoor-sieningsprobleme. Hierdie werk kan lei tot MIng, MSc of PhD-grade. Beurse en beperkte navorsingsfondse is beskikbaar vir geskikte kandidate.

Afrikaans and/or English speaking candidates of all race groups are welcome.

Navrae kan gerig word aan dr Hans van Leeuwen, telefoonnom-mer (012) 420-2291 of telefaks (012) 342-2453 of teleks 322-723 of deur die skeurstrokie op die ingeslote brosjure te voltooi.

Kyoto, Paris, Zurich, Monastir, Rome and Rio de Janeiro are among the exciting venues chosen by the IWSA for its international biennial congress. Despite 'guarantees' and assurances that venues selected would be open to everyone, it occasionally happened that the country selected was particularly inaccessible for South Africans. Kyoto, Japan, was not easy, but eventually, after denouncing the evils of 'apartheid', South Africans obtained their visas.

Monastir, Tunisia, was a different story. No amount of reasoning would persuade the Tunisian authorities to accept South African delegates and no one from this country could attend. This came as a particular disappointment to some of our older colleagues who had served in Tunisia during the Second World War and who

IWSA NEWS: Congress in Rio



ABOVE: The Iguazu Falls. Falls on the Argentinian side of the river, stretch over approximately 1,9 kilometres.



LEFT: Dark brown water of the Rio Negro meets the muddy water of the Solimoes River (Upper Amazon) near Manaus. Above the confluence, the Rio Negro is approximately eight kilometres wide.

were hoping to revive some of their nostalgic memories.

When Rio de Janeiro was chosen for the 1988 Biennial Congress, South Africans were not very optimistic about their chances of obtaining a visa to go to Brazil. All too often, due to sanctions, disinvestment, boycotts and the like, South Africans feel isolated and without a friend in the outside world. South Africa may not have too many friends, but those we can count

on are good ones. Such a friend is Leonard Bays, Secretary-General of the IWSA. He was in South Africa for the KwaZulu Seminar at the end June and it was clear that he and Paulo Cezar Pinto in Brazil had worked hard to try and smooth the way for South Africans wishing to attend the Rio Congress.

Amongst the nine South Africans who attended this year's 17th International Water Supply Congress and Exhibition

from 12 to 16 September were Dr Jacques Kriel, Chairman of the Water Research Commission, and Mr Graham Atkinson, Chief Executive of Umgeni Water. Dr Kriel supplied the pictures and Mr Atkinson gave us the following impressions.

"Dr RJ Laburn, Chairman of IWSA's SA National Committee was due to attend the Congress in Rio de Janeiro as leader of the South African delegation, which comprised nine people. However, he fell ill shortly

before the Congress and was unable to travel. In consultation with the Vice-Chairman of the National Committee, Mr Atkinson was asked to take his place at the Congress.

In his capacity as leader of the South African group Mr Atkinson had the opportunity at a number of functions, organised by some of the National delegations, to meet with the top water personalities in the world and to discuss the problems, challenges and frustrations facing them. These repre-

Water is playing in the provision of supplies to Third World, areas was also displayed at the Congress together with a number of posters from throughout the world. These posters were all well received. The South African delegation was asked to leave theirs behind in Rio de Janeiro for two forthcoming conferences due to be held there.

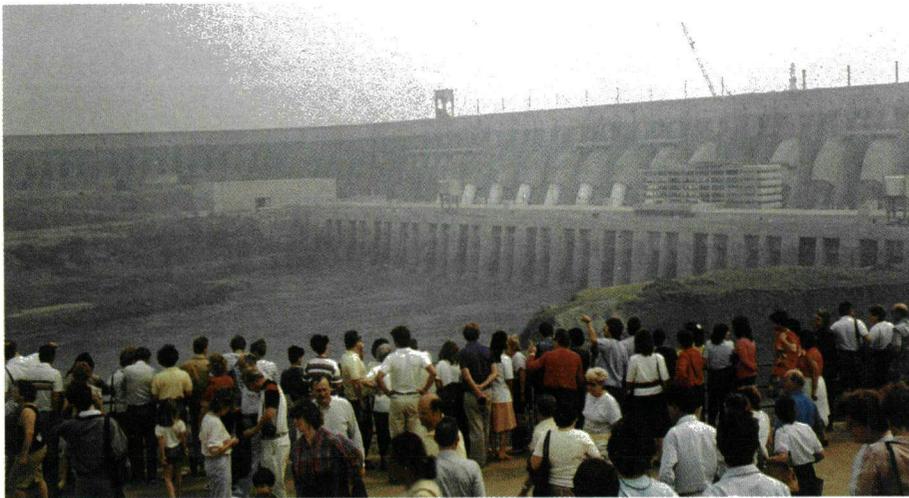
It is interesting to record that the Committee on Co-operation in Development (COCODEV) was disbanded and in its

ity of holding a seminar somewhere in Southern Africa under the auspices of the Foundation.

He represented South Africa at the General Report session entitled 'The Threat to the Environment from Economic Growth - the Public Relations Issue' and delivered a presentation on that occasion.

Various technical visits were arranged including ones to the Lameiro Pumping Station outside Rio de Janeiro, one of the largest in the world; the waterworks at Manaus; the waterworks at Brasilia and the Amazonian Institute in Manaus. One of the most interesting visits was to the Itaipu Hydro-electric Scheme on the Parana River in Southern Brazil - the largest hydro-electric power station in the world with 12700MW of installed power (about two-thirds of South Africa's normal requirements).

In these days of international isolation, it is pleasing to know that South Africa is by and large welcomed in such a prestigious body as the International Water Supply Association. Mr Atkinson believes that South Africa should endeavour to make its presence felt at events organised by the



ABOVE: Itaipu hydro-electric power station in the Parana River on the border between Brazil and Paraguay. The main dam and power station is one of the largest of its kind in the world, and will generate 12 600 MW when completed. Ten of the eighteen turbines are already operational.

RIGHT: The main Falls in the Iguazu River on the border between Brazil (left) and Argentina. The Falls are known as the "Devil's Throat".



sentatives ranged from those coming from very backward Third World countries such as Togo, through to those from First World environments. The problems and challenges in countries such as Tanzania and Kenya are very similar to many of South Africa's circumstances where both First World and Third World environments exist in one country.

A poster which had been prepared in South Africa indicating the role Umgeni

place was set up the Foundation for the Transfer of Knowledge. This body will, as the name implies, have as its prime objective the provision of assistance to developing and under-developed parts of the world in the field of water supply. Mr Atkinson made a plea at the Council meeting that South Africa could take an active part in this body as he believes it could make a positive contribution. Subsequently Mr Atkinson has been requested to explore the possibil-

Association. In this way we will benefit from contact with our colleagues in the water industry and we will also be in a position to "fly the flag".

Perhaps the spirit of the IWSA is best summed up by a colleague, Song Xutong, from the Republic of China. When discussing the prospects for South African delegates to attend a conference in Beijing (Peking), he commented: "We are all friends in the world of water". **W**



FISH PROJECT AT TRISTAN DA CUNHA ISLAND

A PROJECT on the fishes of the British island of Tristan da Cunha has been launched by Professor Tom Hecht, of the Department of Ichthyology and Fisheries Science at Rhodes University, Grahamstown, and the South African Scientific Committee for Antarctic Research (SASCAR) of the Council for Scientific and Industrial Research (CSIR).

Mr Tim Andrew, a research student in the department, is to spend eighteen months on the island to carry out the research. He left aboard the Antarctic supply and research vessel, SA Agulhas, on October 3, from Cape Town.

The three islands of the Tristan group are about halfway between Cape Town and Monte Video. The Tristan environment has not been greatly affected by man and provides a rare opportunity to undertake basic research.

Tristan da Cunha is the only inhabited island in the group, with a population of about 400 people. The island has an area of 117 square kilometres, and slopes steeply to a height of 2400 metres above sea level.

The inhabitants live in a small settlement called Edinburgh, on the north side of the island, and make a living through subsistence activities and employment by a crayfish company.

Research interest in the islands is mainly concerned with the effect of the movement of a seasonal warm water front, the sub-tropical convergence (STC) on the distribution, abundance and biology of the fishes occurring there. **W**



SCHUTTE BEDANK BY WNK

DR FRIK SCHUTTE, voorheen navorsingsbestuurder by die Waternavorsingskommissie (WNK) is vanaf 1 Desember 1988 aangestel as die eerste Uitvoerende Hoof van die Bophuthatswana Waterraad. Die organisasie wat onlangs in die lewe geroep is, sal verantwoordelik wees vir alle aspekte van watervoorsiening in Bophuthatswana.

Frik Schutte het in 1977 by die WNK aangesluit en was verantwoordelik vir die koördinerende en bevorderende van navorsing oor ontsouting, droëverkoeling en waterbehandeling en herwinning.

Sy kundigheid op die gebied van ontsouting het bygedra tot die ontwikkeling van 'n eie Suid-Afrikaanse membraanverwerfing asook die grootskaalse toepassing van verskillende ontsoutingprosesse, hoofsaaklik vir die behandeling van uitvloeisels. Verder het navorsing wat oor 'n periode van tien jaar onder sy koördinerende uitvoer is, ondersteuning verskaf by die oprigting van die wêreld se grootste droogverkoelde kragstasie Matimba, by Ellisras.

Dr Schutte het ook 'n belangrike rol gespeel in die ontwikkeling en toepassing van waterherwinningstechnologie en was verantwoordelik vir die Windhoek en Kaapse Vlakteherwinningprojekte. **W**

TOERIEN ERE-PROFESSOR BY UP

DR DAAN TOERIEN, direkteur van die WNNR se Divisie vir Watertegnologie, is aangestel as ere-professor in die departement mikrobiologie en plantpatologie van die Universiteit van Pretoria.

Dr Toerien het op 12 Oktober vanjaar sy intreelesing gelewer oor die onderwerp: mikrobe-ekologie by water.

"Mikrobe-ekologie is van groot betekenis vir die mens se oorlewing op die aarde," sê professor JM Kotzé, hoof van die departement.

"Die UP is een van die weinige plekke in Suid-Afrika waar dié verwaarloosde maar uiters belangrike studierigting aktief uitgebou word."

Hy sê dr Toerien is aangestel vanweë sy besondere kundigheid en vanweë die aansien wat hy in die veld van mikrobe-ekologie geniet.

Dr Toerien sal nagenoeg ses keer per jaar lesings vir studente in mikrobe-ekologie aanbied. **W**



AQUACULTURE: NEW BOOK FOR BEGINNERS

PROFESSOR TOM HECHT, Head of the Department of Ichthyology and Fisheries Science at Rhodes University, Grahamstown, is the author of a new book called Aquaculture, published by De Jager-Haum, of Pretoria.

The book was written in response to the many questions Professor Hecht has received about aquaculture. Its primary purpose is to serve as an introduction to freshwater and marine fish culture for the beginner.

It begins with an overview of the history of fish culture and continues with a description of aquaculture systems and a discussion of candidate species.

This is followed by chapters on fish propagation, primary nursing, production and harvesting, and genetic selection.

The book concludes with a chapter on diseases and parasites.

The 46-page book, which is well-illustrated, is available at any local book-store in English and Afrikaans at a price of R16,00. **W**

BEST SELLER

SMITHS' SEA FISHES, which was published in September 1986, has sold so well that it is now in its third reprint, reports the JLB Smith Institute of Ichthyology at Rhodes University, Grahamstown.

Many of the illustrations have been improved and the reference list has been expanded. New information on fish distribution and biology has also been included in the species accounts.

The book was edited by Professor Margaret Smith and Dr Philip Heemstra. **W**



HYDROLOGICAL MANUALS PRESENTED TO WRC



Dr JP Kriel, Chairman of the Water Research Commission (left) accepts the new design manuals from Professor C de B Webb, acting Principal of the University of Natal.

THREE NEW HYDROLOGICAL design manuals for use on small catchments were formally handed over on behalf of the University of Natal to the Water Research Commission by Professor C de B Webb, acting Principal of the University at a ceremony in Pietermaritzburg recently.

The manuals are the culmination of ten years of research carried out in the Department of Agricultural Engineering at the University under the supervision of Professor Roland Schulze.



Mr PE Odendaal (left), Executive Director of the WRC with two of the researchers, Professor Roland Schulze and Erik Schmidt (right).

PROEFSKRIF VEROWER TOEKENNING

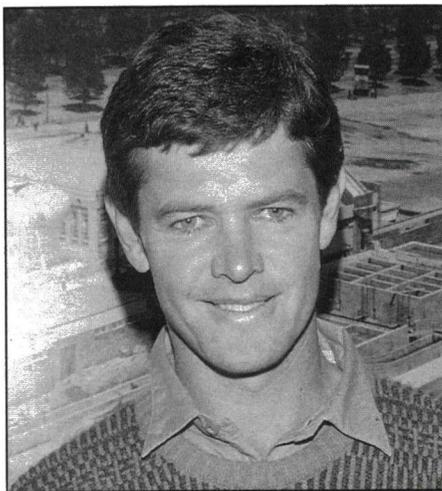
DR BF (Erik) LOUBSER, van die ingenieursfirma Geustyn, Forsyth en Joubert in Stellenbosch, het in Junie vanjaar die Amerikaanse Academic Achievement Award vir sy doktorsale proefskrif losgeslaan.

Die American Water Works Association ken hierdie prys jaarliks toe vir die beste navorsing wat vir 'n doktorsale proefskrif in die waterboukunde gedoen word.

Dr Loubser het sy proefskrif in 1987 aan die Colorado State University voltooi. Dit was 'n uitbreiding van 'n rekenaarmodel wat deur dr Johannes Gessler, lektor aan die Colorado State University, en dr Tom Walski van die US Army Corps of Engineers ontwikkel is. Hulle model was daarop gemik om die pypnetwerke in 'n waterspreidingsstelsel te optimaliseer.

Dr Loubser het hierdie model uitgebrei om ook die koste van reservoirs en watertorings in ag te neem. Tans pas hy hierdie navorsing toe by die ontwikkeling van waterspreidingsnetwerke vir munisipale dorpsontwikkeling. Verder word die model ook gebruik by die ontwerp van 'n beplande waterpypnetwerk by Oudtshoorn wat aan boere in die Olifantsriviervallei water sal voorsien.

Dr Loubser beoog om volgende jaar, tydens dr Gessler se besoek aan Suid-Afrika, die model bekend te stel en kort kursusse oor die gebruik daarvan aan te bied. **W**



Dr Erik Loubser

This major research effort, which was funded by the WRC, fulfils a long felt need by engineers and hydrologists for design manuals on small catchment hydrology specific to Southern Africa, based on the latest hydrological data bases, concepts and techniques.

Senior researcher Erik Schmidt and Professor Schulze produced one volume providing the professional engineer and hydrologist with background, theory and procedures, and a second volume in the form of a simpler user manual, with worked examples, for use in the field. The third volume of appendices, to which Mr Mark Dent, currently manager of the Computing Centre for Water Research (CCWR), also contributed, comprises maps, graphs and tables for use with the other two manuals. The vast number of computations which had to be undertaken in the production of the manuals, was carried out at the CCWR in Pietermaritzburg.

The three researchers were recently awarded Silver Medals by the SA Institute of Agricultural Engineers for the Best Publication of the Year 1987.

Copies of the manuals are available, from the Water Research Commission, P O Box 824, Pretoria, 0001. **W**



SYMPOSIUM: PLANT RESPONSES TO STRESS

AN INTERNATIONAL SYMPOSIUM entitled "Plants Under Stress: Biochemistry, Physiology and Ecology and their Application to Plant Improvement" was held earlier this year at the University of Lancaster in England. Dr DM Oosterhuis, Professor of Crop Physiology at the University of Arkansas, reports on the proceedings.

The symposium, sponsored by the Society of Experimental Biology and the Association of Applied Biologists as part of their annual meeting, was attended by leading scientists from many countries.

WATER, TEMPERATURE AND SALINITY

The meeting examined plant responses to a variety of stresses (including water, salinity and temperature) with a view to identifying common principles in the stress physiology of plants. Evaluation of ways in which the information might be applied to the development of new varieties of existing crops or new crops was also covered. The 2-day symposium consisted of invited review papers, invited topical papers and a large poster session. The symposium started with a review of stressful environments, terminology, the concepts of adaptation, and the importance of environmental stresses. This was followed by discussions on whole plant responses to stress, photosynthesis and gas exchange, plant development, membrane and cell physiology, and metabolism and protein biochemistry.

DROUGHT STRESS AND OSMOTIC ADJUSTMENT

The most common environmental stress covered was drought stress and one particular aspect of this, osmotic adjustment, was the focus of much attention. For example, Dr MM Ludlow from Australia showed that there were clear physiological linkages between osmotic adjustment and higher grain yield in sorghum under water-limited conditions.

The author, Dr Oosterhuis, presented evidence that considerable genetic diversity exists for osmotic adjustment among the different cultivars, primitive landraces and wild types of cotton. The role of osmotic adjustment in establishing and maintaining turgor was mentioned in a number of presentations.

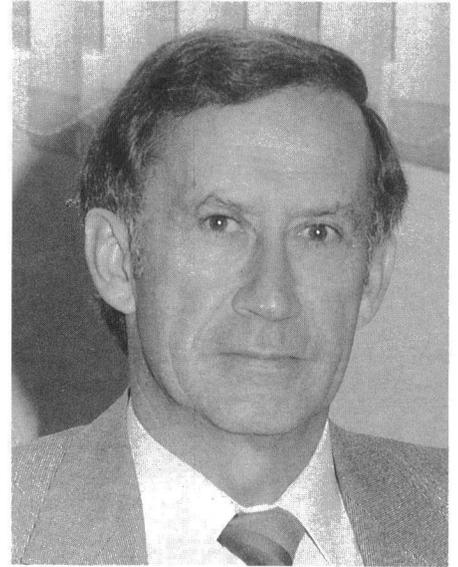
MOLECULAR APPROACH TO STRESS TOLERANCE

The second part of the meeting addressed the application of molecular biology to studies of stress tolerance. Also discussed were the environmental control of gene expression and stress proteins, tissue and protoplast culture, conventional breeding with special reference to drought tolerance, and the selection of physiological characters using examples from breeding for salt tolerance.

The symposium proceedings is to be published soon. **W**

STUDIES SUKSESVOL VOLTOOI

DR MJ (THYS) PIETERSE, navorsingsbestuurder van die WNK, het vanjaar die senior bestuursprogram (SBP) by die Nagraadse Bestuurskool, Departement Bestuurswese, aan die Universiteit van Pretoria suksesvol voltooi.



Dié program sluit die volgende kursusse in: strategiese bestuur, organisasiestruktuur en -gedrag, finansiële bestuur, bemarkingsbestuur, arbeidsverhoudinge, onderhandelingsvaardighede, organisasie-ontwerp, -beplanning en -beheerstelsels asook bestuursinligtingstelsels. **W**



NAVORSINGSBESTUURDER BY WNK AANGESTEL

MNR HUGO MAAREN is aangestel as navorsingsbestuurder by die Waternavorsingskommissie. Hy sal hoofsaaklik verantwoordelik wees vir navorsing oor oppervlakwater. Mnr Maaren was voorheen verbonde aan die Departement van Waterwese se Hidrologiese Navorsingsinstituut (HNI). As adjunk-direkteur van opvanggebiedstudies het hy daar grotendeels bygedra tot die implementering van afstandwaarneming vir beter waterbronbestuur.

Mnr Maaren is op 24 September 1937 in die Nederlandse dorpie Jobbega gebore as die seun van 'n plattelandse huisdokter.

In 1960 verwerf hy 'n graad in landbou-ingenieurswese aan die Universiteit van Landbou in Wageningen, Nederland. Hy spesialiseer in "Tropiese kultuurtegniek" wat hoofsaaklik bestaan uit agrohidrologie en bodemkunde en is een van die eerste studente in dié vakrigting wat rekenaarmodelle begin skryf.

In 1967 immigrer hy na Suid-Afrika.

Hy doen twee jaar lank bodemopnames op die Makatinvlakte vir die Navorsingsinstituut vir Grond en Besproeiing en werk daarna vir 'n privaatonderneming, Loxton, Hunting and Associates. Dié werk, hoofsaaklik veldwerk, behels bodem- en landopnames vir beplanning in Suid-Afrika, Zimbabwe, Angola en Mosambiek. In 1976 sluit hy by die Departement van Waterwese aan.

Mnr Maaren is getroud met Yvonne Letterie. Die egpaar het twee seuns en 'n dogter. In sy vrye tyd is mnr Maaren 'n entoesiastiese duiweboer wat resiesduiwe teel. **W**



NUWE WNK KOMMISSIELID

DR AJ HEYNS, superintendent-generaal van die Departement van Landbou en Watervoorsiening, is aangestel as lid van die Waternavorsingskommissie. Hy volg dr DW Immelman op wat vroeër vanjaar met pensioen afgetree het.

Alexander Jacobus Heyns is op 7 November 1925 op Nieuwoudtville in die distrik Calvinia gebore.

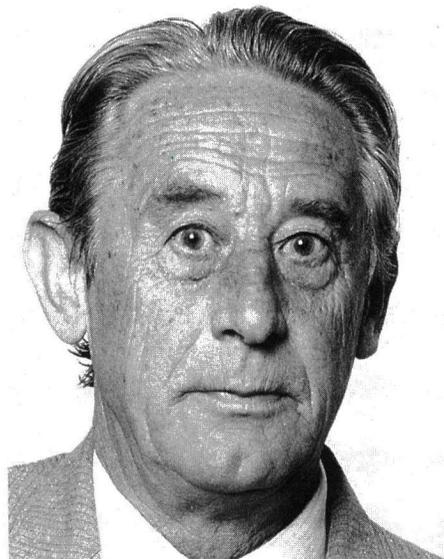
Hy behaal 'n B.Sc.-graad aan die Universiteit van Stellenbosch in 1946 en in 1948, aan dieselfde Universiteit, 'n M.Sc.-graad in plantkunde met sistematiek en ekologie as hoofrigtings.

Van 1961 tot 1964 studeer dr Heyns in Brittanje aan die Wye Agricultural College (Universiteit van London) en behaal sy Ph.D.-graad met 'n verhandeling oor "Fungicidal and Systematic Fungicidal Activity in certain Organo-Sulphur Compounds".

Gedurende die periode 1950 tot 1969 is hy verbonde aan die plantpatologiese seksie van die Navorsingsinstituut vir Vrugte en Voedseltegnologie (NIVV) en doen navorsing oor siektes van kern- en steen-

vrugte, onder andere skurfsiekte van appels, bakteriese kanker, loodglans, gomvlek en vaalvrot.

Dr Heyns word in 1970 bevorder tot adjunk-direkteur van die NIVV en in 1974 tot direkteur. In 1980 word hy aangestel as direkteur van die Navorsingsinstituut vir



Tuinbou (tans Groente en Sierplante) en daarna as hoofdirekteur Tuinbou in Maart 1984. In Desember 1984 word hy hoofdirekteur koördinerende, in 1987 uitvoerende direkteur en in Desember 1987 superintendent-generaal van die Departement van Landbou en Watervoorsiening.

Dr Heyns is lid van talle komitees, onder andere die Bestuurskomitee van die Departement (as voorsitter), die Nasionale Komitee van die Internasionale Unie vir Biologiese Wetenskappe, die Adviserende Onderwyskomitee van die SA Raad vir Natuurwetenskaplikes, die komitee vir die toekenning van fondse vir ad hoc-navorsing, die oorhoofse komitee van Nasionale Navorsingstigting van die WNNR en die adviserende komitees vir plantverbeteringsaangeleenthede en aartappelverbouing.

Dr Heyns is die outeur van vele wetenskaplike publikasies, verslae en artikels en het dikwels buitelandse studiereise onderneem om plantverbeteringskemas te ondersoek asook om die moontlikheid van samewerkingsoor- oorsese lande te bevorder. **W**

TUKS BIED NUWE M-GRAAD IN WATERBENUTTING

DIE UNIVERSITEIT VAN PRETORIA bied nou die moontlikheid aan ingenieurs en wetenskaplikes om 'n meestersgraad op grond van vakkursusse en slegs 'n kort navorsingskripsie te behaal. Anders as die tradisionele meestersgraad wat slegs na vakkursusse en nog minstens een jaar se voltydse navorsingswerk en die skryf van 'n aanvaarbare verhandeling verkry kon word, word persone wat voltydse werk nou in staat gestel om op 'n deelydse basis 'n M-graad te behaal.

BSc- of BIng-gegradeerde moet 128 goedgekeurde kursuseenhede voltooi om in aanmerking te kom vir die M-graad in Waterbenutting of in Waterbenuttingsingenieurswese. Dit kan gedoen word deur eers aan die vereistes vir 'n honneursgraad te voldoen, naamlik om 64 kursuseenhede deelydse oor twee jaar te voltooi en dan die verdere 64 eenhede deur óf goedgekeurde navorsing wat tot 'n verhandeling lei óf nou ook deur die voltooiing van 'n verdere 48 eenhede se vakkursusse en sestien eenhede se navorsing soos benodig vir 'n skripsie. Die honneursvakkursusse word op 'n blokwekbasis aangebied, dit is een week se voltydse klasbywoning elke drie maande tesame met selfstudie en take en die magistervakkursusse op selfstudiebasis met uitvoerige take. Dit is ook moontlik om honneursvakke in ander departemente of enige honneursvakke in die afdeling wat nog nie vir die honneursgraad gevolg is nie, vir voltooiing van die M-graad te gebruik. Gedeeltelike vrystelling van die vereistes op grond van nagraadse vakkursusse reeds geslaag, sal oorweeg word.

Die tipiese vereistes vir 'n skripsie is die ekwivalent van drie maande se voltydse navorsing of ses maande na-uurs. Die

personeel en voltydse nagraadse studente werk aan verskeie navorsingsprogramme waaruit skripsie-onderwerpe geformuleer kan word.

Op 'n volledig deelydse basis is dit moontlik om die M-studie na 'n B-graad binne vier jaar af te handel. Daar is ook studente wat een jaar voltydse navorsing doen en teweens deelydse die nagraadse vakkursusse volg. Op hierdie wyse kan die M-graad met een jaar se voltydse en een jaar se deelydse studie verkry word.

Gedurende die agtien jaar se bestaan van die Leerstoel in Waterbenuttingsingenieurswese is daar reeds 82 honneurs-, vyftien magister- en agt doktorsgrade toegeken.

Meer besonderhede oor die nagraadse programme kan verkry word deur dr Hans van Leeuwen by telefoon (012) 420-2291 te skakel of deur die aansoekvorm agter in die brosjure wat by hierdie uitgawe van die SA Waterbulletin ingesluit is, te voltooi. **W**



PHD ONTVANG

DR LAURRAINE LÖTTER van Johannesburg se Stadsgesondheidsafdeling en 'n bekende in die waternavorsingsveld, het onlangs 'n PhD-graad aan die Randse Afrikaanse Universiteit verwerf.

Dr Lötter se navorsing het gehandel oor "Die metaboliese beheermeganismes in biologiese fosfaatverwydering deur die geaktiveerde slykproses, met spesifieke verwysing na Acinetobacter SPP". **W**

TREES MONITOR SOIL WATER

TREES can be simple and effective monitors of groundwater contamination and are suitable as inexpensive additions to permanent groundwater monitoring systems, according to scientists working at a site in Kentucky, USA. In order to find effective sampling systems for the continuous groundwater monitoring needed near a retired low-level radioactive waste disposal site, the group used tritium as a tracer in forest foliage to reflect tritium activities in soil water along the perimeter of the site. The burial area is bordered by forest, and 90 trees (mostly white and chestnut oaks about 50 to 60 years old) were sampled on the monitor plot.

Spatial variability in the foliage clearly delineated patterns of tritium in soil water as deep as three meters. The study by PJ Kalisz, et al., reported in the *Journal of Environmental Quality* (Vol 17, No 1) showed that foliage sampling complements conventional instruments and can be used to check areas of interest. The technique could provide data on potential trouble spots and target areas needing more intensive monitoring.

Water Newsletter 31588 

WORKSHOP ON THE MODELLING OF ROOT ZONE WATER AND CHEMICAL BUDGETS

16 TO 20 JANUARY 1989

AIM

The aim of the workshop is to communicate the theory and use of a mechanistic model (LEACHM) of transient water and solute dynamics. The model describes the dynamic root zone processes of nitrogen fertilizers, pesticides and inorganic salts.

PRESENTERS

The workshop will be presented by Prof RJ Wagenet and Dr JL Hutson of Cornell University, USA.

FORM

The workshop will be divided into two phases

During the first two-day phase participants will be

- presented with an overview of the current status of modelling as a tool to simulate and predict soil and groundwater pollution.
- exposed to some of the research areas and problems that still exist; and
- introduced to the model structures and simulated processes.

The second phase of three days will be devoted to data file preparation and hands-on experience by participants in operating models using both their own and demonstration data.

FEE

Attendance at the workshop is free of charge but limited to 40 persons by the available computing facilities.

VENUE

University of Natal, Pietermaritzburg.

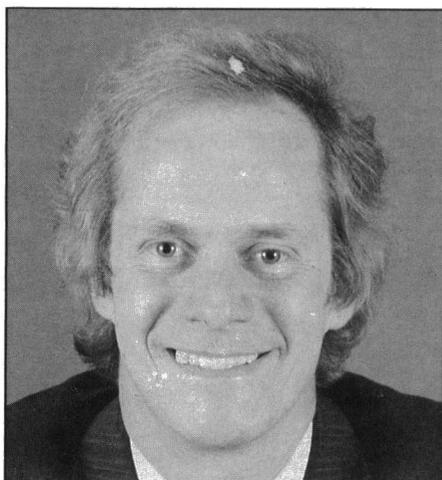
ACCOMMODATION

Convenient accommodation and meals are available to participants in University residences at about R45 per day.

ENQUIRIES

Mr Meiring du Plessis, Water Research Commission, P O Box 824, Pretoria, 0001. Tel: (012) 330-0340. Fax: (012) 705-925.

Ding vir Van Leeuwen

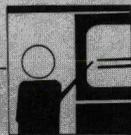


DR HANS VAN LEEUWEN, senior lektor in die Departement Chemiese Ingenieurswese van die Universiteit van Pretoria het op die Lentepromosieplegtigheid van dié Universiteit die graad Ding ontvang.

Die graad is toegeken op grond van 'n seleksie van dertien van dr Van Leeuwen se publikasies, saamgevat onder die titel "Advanced wastewater purification using ozone and other oxidants".

Dr Van Leeuwen is in 1946 in Gouda, Nederland, gebore en immigrer in 1954 na Suid-Afrika. Hy voltooi sy skoolopleiding aan die Afrikaanse Hoër Seunskool in Pretoria en verwerf daarna 'n baccalareus- en magistergraad in chemiese ingenieurswese aan die UP. 

Die redaksie van
SA Waterbulletin wens
al sy lesers en
korrespondente
'n geseënde
Kersfees toe.



WATER POLLUTION

The thirtieth Convention of the SA Chemical Institute will be held on 15 to 20 January 1989 at the Johannesburg Sun. The Convention will accommodate a number of themes including "Environmental Protection" which will incorporate Water Pollution.

Enquiries: Prof J Boeyens, University of the Witwatersrand, Department of Chemistry. Tel: (011) 716-2076.

AQUACULTURE

An international symposium on water quality in aquaculture will be held in Los Angeles, California, from 12 to 16 February 1989.

Enquiries: Aquaculture '89, c/o Crest International, 940 Emmett Avenue, Suite 14, Belmont, CA 94002, USA.

WASTE WATER

Seminars on Nutrient removal from wastewater streams, Design and operation of biological treatment plants and Industrial and hazardous waste treatment will be held from 20 to 22 March 1989 at the Mount Grace Country House Hotel near Magaliesburg, Transvaal.

Enquiries: Ms Monika Mersich, Conference Co-ordinators, CSIR, P O Box 395, Pretoria 0001. Tel: (012) 841-4615.

COMPUTERS

A conference on computers and automation in the water industry will be held from 2 to 4 April 1989 in Denver, USA.

Enquiries: Rick Harmon, AWWA, 6666 West Quincy Avenue, Denver, CO 80235, USA.

BIOFILMS

A symposium on the technological advances in biofilm reactors will be held from 4 to 6 April 1989 in Nice, France.

Enquiries: Mr J Bernard, AGHTM, 9 Rue de Phalsbourg, 75854 Paris Cedex 17, France.

GROUNDWATER

A symposium on contaminant transport in groundwater will be held from 4 to 6 April 1989 in Stuttgart, West Germany.

Enquiries: Dr W Kinzelbach, Institut für Wasserbau, Universität, Stuttgart, Pfaffenwaldring 61, D-7000 Stuttgart 80, West Germany.

ULTRAVIOLET

The 2nd International Conference on UV and Ozone in the treatment of water and other liquids will be held in Berlin FRG from 10 to 12 April 1989.

Enquiries: AMK Berlin, M2/Wasser Berlin, Postfach 191740, D-1000 Berlin 19, FRG.

CATCHMENT RUNOFF

An international conference on channel flow and catchment runoff: Centennial of Manning's formula and Kuichling's rational formula will be held from 22 to 26 May 1989 in Charlottesville, Virginia, USA.

Enquiries: Dr BC Yen, Civil Engineering Department, University of Virginia, Thornton Hall, Charlottesville, VA 22901, USA.

MEMBRANES

An international technical conference on membrane separation processes will be held in Brighton, England, from 24 to 26 May 1989.

Enquiries: Lorraine Grove, Conference Organiser, Membrane Separation, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK 43 OA, UK.

OZONE

The 9th ozone world congress will be held in New York, USA, from 3 to 8 June 1989.

Enquiries: 9th Ozone World Congress Organiser, International Ozone Association PAC, 83 Oakwood Avenue, Norwalk, CT 06850 USA.

WATER QUALITY

An international conference on the design of water quality information systems will be held at the Colorado State University, USA, from 7 to 9 June 1989. Call for papers.

Enquiries: Thomas G Sanders, Program leader, Environmental Engineering, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523 USA.

COAL MINING

A symposium on the treatment, disposal and management of wastewaters in the coal mining industry will be held from 15 to 19 June 1989 in Warsaw, Poland.

Enquiries: Dr M Gromiec, Institute of Meteorology and Water Management, Uli-Podlesna 61, 01-673 Warsaw, Poland.

WASTEWATER PLANTS

A symposium on the design and operation of small wastewater treatment plants will be held from 26 to 29 June 1989 in Trondheim, Norway.

Enquiries: Dr P Odegaard, Institute for Vassbygging, UNIT/NTH Klaebuveien 153, N-7034 Trondheim-NTH, Norway.

SAGIS

The Southern African Geographic Information Systems conference and workshop will be held at the University of Natal, Pietermaritzburg, from 3 to 6 July 1989.

Enquiries: Dr RJ Fincham, Institute of National Resources, P O Box 375, Pietermaritzburg 3200.

WATER LAW

A mini-symposium on water: laws and management, will be held on 7 July 1989 at the University of Cape Town.

Enquiries: Dr JA Thornton, Town Planning Branch, P O Box 1694, Cape Town 8000.

RIVER BASINS

The 5th river basin management conference will be held in Rovaniemi, Finland, from 31 July to 4 August 1989.

Enquiries: The Secretary, Ms Anja Holmsten, P O Box 250, SF-00101 Helsinki, Finland.

WASTEWATER TREATMENT

A symposium on the upgrading of wastewater treatment plants will be held in Munich, FRG, in August/September 1989.

Enquiries: Dr C-H Plumer, EWPCA, Markt 71, D-5205 Sankt Augustin 1, Federal Republic of Germany.

DRAINAGE

The 28th international post-graduate course on land drainage will be held from 20 August to 1 December 1989 in Wageningen, the Netherlands.

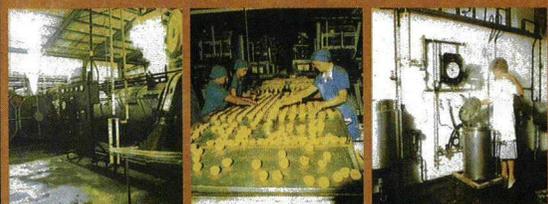
Enquiries: The Director of the International Agricultural Centre, P O Box 88, 6700 AB Wageningen, the Netherlands.

ACID RAIN

A symposium on acid rain will be held from 5 to 7 September 1989 in Amsterdam, the Netherlands.

Enquiries: Prof R Perry, Public Health and Water Resources Engineering, Department of Civil Engineering, Imperial College, London SW7 2 BU, UK.

GUIDE TO WATER AND WASTE-WATER MANAGEMENT IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY



A guide for the planning, design and implementation of wastewater treatment plants in the textile industry. Part Two

This Technical Guide describes some treatment schemes for dyehouse effluents which do not involve the biological treatment stage, but which do include, in particular, the application of modern technology such as pressure driven membrane processes.

An outline is given of the principles of water and effluent management and their importance in the planning and implementation of an effluent treatment system.

Treatment processes for pretreatment prior to dis-

Two new WRC reports available

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order now!**

Guide to water and wastewater management in the fruit and vegetable processing industry

This guide identifies the need for improved water and waste-water management in the Fruit and Vegetable Processing Industry, based on the results of a country-wide survey carried out for the Industry.

Factors causing excessive water usage and waste-water generation are discussed, while the water usage and effluents generated by individual process steps and techniques for saving water and reducing waste-water quantity and pollution strength are given. Methods that can be used to pretreat effluents are also described.

The detailed results of the surveys undertaken are summarised in a companion volume entitled "Water and Waste-water Management in the Fruit and Vegetable Industry", WRC Report No 96/1/86, which is available on request from the Water Research Commission.

charge to sewer or the environment and closed loop treatment for water reuse are discussed in some detail for:

wool/synthetic fibre dyehouses;
synthetic fibre (polyester) dyehouses and
cotton/synthetic fibre dyehouses.

Both guides are available free of charge from the Water Research Commission, P O Box 824, Pretoria 0001. Tel: (012) 28-5461.

To order, please complete the order card in this Bulletin.

