Sa vaterbulletin

ISSN 0258-2244

MAN THE WITH THE

WATERKWALITEIT

WNK fekus op drinkwatergehalte

00020036



Die Afdeling Wis- en Natuurkunde van

DIE SUID-AFRIKAANSE AKADEMIE VIR WETENSKAP EN KUNS

bied aan 'n eendagsimposium oor

WATER VIR OORLEWING

op 21 Augustus 1987 in die konferensiesaal

van die Akademie, te Hamiltonstraat,

PRETORIA

Die doel van hierdie simposium is om 'n wye spektrum van akti-witelte op die gebied van waternavorsing en -beplanning aan te sny ten einde belangstellende wetenskaplikes, professionele mense en die wyer publiek in te lig oor dit wat alles gedoen word om volgehoue watervoorsiening vir die toekoms te verseker.

Onderwerpe wat aandag sal geniet is o.a. waterbesoedeing, reënvalstimulering, dolomitiese water, langtermyn reënvaltendense, en die Vaalrivierstelselontleding. Sprekers sluit o.a. in mnr PE Odendaal, Uitvoerende Direkteur van die Waternavorsingskommissie, dr DF Toerien, Hoofdirekteur van die Nasionale Instituut vir Water-

navorsing, prof DC Midgley, Professor emeritus van Wits, prof P van Rensburg van die departement Geografie van RAU en mnr J Best, Hoofdirekteur Watergehalte van die Departement Waterwese.

'n Volledige program met registrasiestrokies sal in die volgende uitgawe van die **SA WATERBULLETIN** verskyn.

Vir verdere navrae skakel asseblief Pretoria (012) 420 2454.



Waterkwaliteit grafies uitgebeeld. Lees die artikel op bladsy 13.



VOLUME 13 NR 2

APRIL 1987

contents

SA Waterbulletin is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organization established in 1971 by Act of Parliament.

Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

Editorial offices: WRC, PO Box 824, Pretoria 0001, Republic of South Africa. Tel (012) 28-5461.

Editor: Jan du Plessis Asst Editor: Ilse Lombard Ed. Secretary: Rina Human Typesetting: Type Technique Colour separations: Litho Technik Typography and design: Nicola van Nikkelen Kuyper Printed by Creda Press, Cape Town

SA Waterbulletin is 'n tweemaandelikse tydskrif oor water en waternavorsing wat uitgegee word deur die Suid-Afrikaanse Waternavorsingskommissie (WNK), 'n statutêre organisasie wat in 1971 by Wet gestig is.

Intekening is gratis. Stof in dié publikasie weerspieël nie noodwendig die oorwoë menings van lede van die WNK nie, en mag hergebruik word met erkening van die bron.

Redaksie: WNK, Posbus 824, Pretoria 0001, Republiek van Suid-Afrika. Tel (012) 28-5461.

Redakteur: Jan du Plessis Asst-redakteur: Ilse Lombard Red. sekretaresse: Rina Human Setwerk: Type Technique Kleurskeidings: Litho Technik Tipografie en uitleg: Nicola van Nikkelen Kuyper Gedruk deur Creda Press, Kaapstad

SLUDGE	6	Pasteur's process perfect for sludge
GRONDWATER	9	Boorgate in Pretoria bekyk
THE COLORADO RIVER	10	Salinity control American style
WATERKWALITEIT	13	WNK fokus op drinkwater- gehalte
WATER RESEARCH	16	Freshwater studied at the coast
SLUDGE DIGESTION	29	The Hagerstown stopover
SURFACE HYDROLOGY	24	Estimating floods from small catchments
REGULAR FEATURES	4	Waterfront
	19	Salinity news
	26	News snippets
	28	Books
	30	Conferences & symposia





The Water Research Commission recently held an ad hoc meeting at Espada Ranch near Pretoria to discuss research, development and technology transfer needs in the field of water supply and sanitation for small communities. The objectives of the meeting were to:

- Review the activities, ongoing research and problems experienced in this field
- Define research, development and technology transfer needs and establish priorities
- *Agree on proposals for further action.

- From left: Mr C Mann (Valley Trust), Miss B Mogane (NIWR), Mr J Abbott (University of the Witwatersrand).
- 2 IFrom left: Mr HC Chapman (WRC), Mr D Kerdachi (Umgeni Water Board).
- From left: Dr WHJ
 Hattingh (WRC), Mr JE
 McGlashan (WRC), Dr PJ
 Aucamp and Mr FS Vivier
 (Department of National
 Health and Population Development).

- From left: Mr Z Paszek
 (Kwazulu), Mr P Sadzik
 (NIWR), Mr P Alcock (University of Natal), Mr C Louw
 (University of Zululand).
- From left: Dr HG Strijdom (HSRC), Dr A Wood (NIWR), Mr B Walford (Umgeni Water Board).
- From left: Mr R Crabtree (NBRI), Mr J Wium (NIWR).

1



2



3





4

5

6

4



- From left: Mr GH du Plessis (SASOL), Mr JJ Gericke (SASOL), Mr PE Odendaal (WRC).
- From left: Dr WHJ Hattingh (WRC), Mr C Buckley (University of Natal), Mr A Gerber (NIWR).
- 9 From left: Dr PL Dold (UCT), Mr BC Trim (JHB Municipality), Mr I H Palmer (Ninham Shand Inc), Mr M Taljaard (Divisional Council Cape Town).

- From left: Prof WA Pretorius (UP), Miss C Turner (SASOL), Mrs LC Wijnmaalen (SASOL).
- From left: Mr G
 Richardson (Durban Municipality), Mr FF Kolbe
 (Stewart, Sviridov & Oliver),
 Mr JE McGlashan (WRC).
- Parties interested in the process of anaerobic digestion met at Jan Smuts Airport on 19 March. The objectives of the meeting, chaired by Mr PE Odendaal of the Water Research Commission, were to
- Review ongoing South African research and application in anaerobic digestion
- Discuss the potential applications of anaerobic digestion in the country
- ☐ Define the main research needs and priorities
- ☐ Agree on proposals for further action





7

8



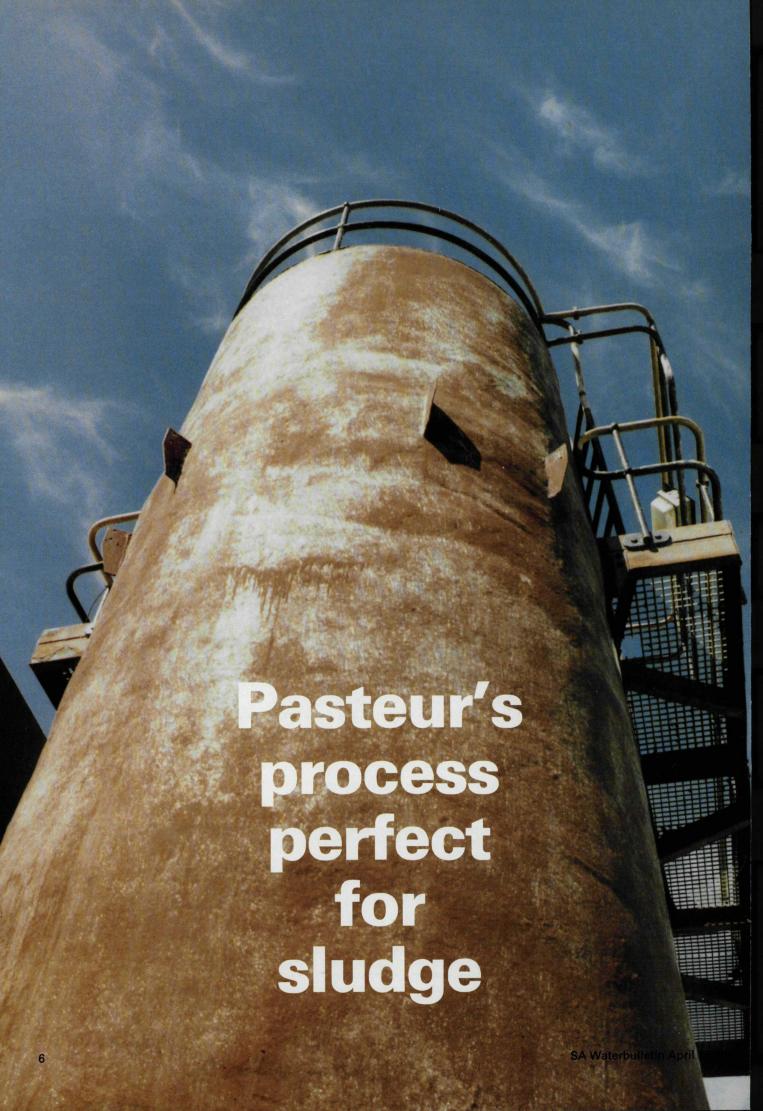




9

10

11





Sludge treatment facilities

The Cape Town City Engineer's Department recently successfully completed a research programme to determine the sterilisation characteristics of a full-scale continuously operated wastewater sludge pasteuriser. The pasteuriser was monitored over a three year period and it was found that a temperature of 53°C for 30 minutes was sufficient to inactivate *Ascaris Lumbricoides* ova.

Copies of the final report on the full results and findings of the investigation are now available from the Water Research Commission.

he treatment and disposal of various types of sludge is an important problem facing local authorities operating sewage treatment works. Many works, which were originally situated in spacious grounds on the outskirts of cities, now find themselves surrounded by suburbs and under pressure to give up more land for housing and other purposes. Thus, the treatment and disposal of sludge by spreading it on the land within the perimeter of the works is steadily becoming a less suitable procedure and there has for many years been a trend to use sludge treatment processes which require less space and which allow disposal away from the works.

Anaerobic digestion is an economical and widely used process for rendering the organic content of the sludge nonputrescible. However the resulting digested sludge, although a valuable soil conditioner, is not considered safe for unrestricted use, thereby complicating the disposal problem.

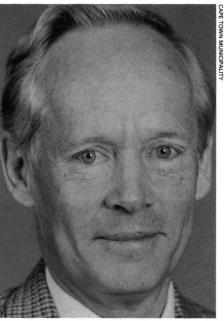
Although sludge has recently found a small-scale industrial use as a brick-making material where it acts as an internal fuel, the most beneficial use is undoubtedly in agriculture and horticulture, provided that some form of further treatment is adopted to improve its hygienic properties.

The undesirable constituents of most concern are heavy metals and pathogenic bacteria, viruses and helminths. The problems presented by heavy metals are not considered in this report but are presently best dealt with by strict control of discharges into the sewerage system and by restrictions on the amount of sludge used on any particular piece of land.

Various methods, including pasteurisation, lime-treatment and irradiation have been used for disinfecting sludge. Some stabilisation processes such as thermophilic anaerobic digestion, composting and autothermal aerobic di-

gestion also have disinfection properties. These processes can be used in various combinations with other stabilisation processes and the choice of a suitable treatment is therefore not an easy one, particularly as the associated costs and performance factors under local conditions are not always known.

To assist local authorities in dealing with such problems, the Water Research Commission has for some time been engaged in a comprehensive research programme on sludge treatment and disposal in conjunction with various other bodies. As the Cape Town City Engineer's Department was, in 1979, constructing a new wastewater treatment plant incorporating a full-scale pasteuriser, it was considered opportune to engage in a research project aimed at defining the performance of such a unit.



Mr I R Morrison, City Engineer's Department, Cape Town.

The aims outlined in the agreement entered into between the Commission and the Cape Town City Council were:

- To operate a full-scale pasteurisation plant for a period of 30 months, using feeds of:
 - mixed primary and waste activated sludge and

the effectiveness of pasteurisation

mesophilically digested sludge.
 To investigate the economics and

S·L·U·D·G·E



Outlet from pasteuriser

at various operating temperatures within the range 60°C to 80°C in terms of the inactivation/destruction of selected micro-organisms (Ascaris ova, E Coli).

To monitor suitable parameters with a view to defining the operational conditions on the plant at all stages.

The programme initially also included the investigation of the economics and effectiveness of full scale thermophilic anaerobic digestion. However, the plant to be used for this purpose was subsequently found to be unsuitable and this part of the project had to be discontinued. Due to delays in commissioning the pasteuriser, the completion date of the project was extended to May 1986.

PASTEURISATION

Pasteurisation, invented by Louis Pasteur in the 1860's, is a heat treatment process mainly used for destroying pathogenic micro-organisms in foods and beverages. For milk, the required temperature is 62°C for 30 minutes or 72°C for 15 seconds. These conditions were chosen to destroy *Mycobacterium tuberculosis*, one of the most heat resistant of the non-spore-forming microorganisms capable of causing disease in humans. In the pasteurisation of sewage sludge the customary conditions are 70°C for 30 minutes.

Most development work on the pasteurisation of sludge has been carried out in Switzerland where the main goal has been the elimination of Salmonellae. Pasteurisation is usually carried out after conventional anaerobic mesophilic digestion but it has recently been found by the Swiss that regrowth of enterobacteria, including Salmonella, occurs readily on storage of pasteurised sludge, the numbers sometimes exceeding those in the original raw sludge. The exact reasons for this effect are not yet known, but it is considered likely that the heat treatment reduces the level of competitive flora and breaks down large organic molecules to easily assimilable compounds. Regrowth only occurs with certain bacterial species and not with human or animal viruses and helminth ova.

For this reason Swiss regulations requiring all sludge to be disinfected were suspended pending further investigations, which subsequently showed that a re-arrangement of the process sequence had a beneficial effect. It was found that pasteurisation of raw sludge followed by mesophilic anaerobic digestion gave a stable product with no regrowth of pathogens. On initial introduction of pasteurised sludge into a contaminated digester, the counts of enterobacteria were found to rapidly decrease and subsequent accidental contamination with unpasteurised sludge only resulted in temporary increases.

Pilot-plant experiments in Germany have confirmed the stability of pre-pasteurised sludge. The following levels were found:

Log coliforms/100 ml

Raw sludge 9-10

Pasteurised raw sludge 2-4

Digested pasteurised sludge 5-6

Stored digested pasteurised 5-6

sludge

Mesophilically digested 6-7 sludge
Pasteurised digested sludge 2-4 Stored pasteurised digested 8-9

Artificially introduced *S. senftenberg* was destroyed by pasteurisation and Salmonella levels were very low during all stages of the process.

Because partial dewatering from the secondary digester is practised in most

plants with two-stage digestion, the volume of digested sludge is usually about half that of the raw sludge. Prepasteurisation thus has the disadvantage, that twice as much sludge has to be heated than in post-pasteurisation installations.

The pasteuriser system investigated in this study forms part of the Cape Flats Wastewater Treatment Plant situated near Muizenberg, Cape, and serving the southern suburbs of the Cape Peninsula. This activated sludge plant, of design capacity 150 Ml/d, presently treats about 100 Ml/d of raw sewage, mostly of domestic origin.

The unit was monitored over a three year period in the following ways:

- At fixed temperatures in the range 50 - 70°C, with feeds of raw and digested sludge, over experimental periods of up to one hour.
 - Under routine conditions in the prepasteurisation mode (pasteurisation before anaerobic digestion) with target conditions of 70°C for a minimum of 30 minutes, and a feed of raw sludge plus waste activated sludge thickened in a dissolved air flotation unit.

It was found that a temperature of 53°C for 30 minutes was sufficient to inactivate *Ascaris Lumbricoides* ova, but that 66°C was required for faecal coliforms. There was good agreement between decimal decay rates obtained in these full-scale experiments with sludge feeds and those in the literature for various media and conditions.

Under routine conditions, the median values for the *Ascaris* embryonation ratio and faecal coliform counts in the pasteurised sludge were 1% and 200/100 ml respectively. For digested sludge produced with a pasteurised feed the corresponding figures were two percent and 120 000/100 ml.

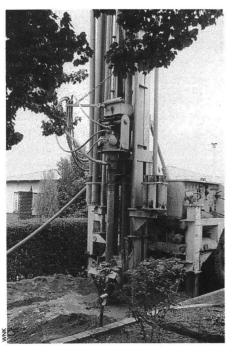
Operation in the pre-pasteurisation mode is recommended to avoid regrowth of pathogenic bacteria, and because it allows almost full heat recovery, provided suitable heat-exchangers are used and the digester heat supply is via the feed.

Copies of the final report entitled *The* pasteurisation of sludge are obtainable on request, free of charge, from the Water Research Commission, P O Box 824, Pretoria 0001.

ie Waternavorsingskommissie het onlangs 'n ooreenkoms met die WNNR aangegaan ingevolge waarvan die Nasionale Bounavorsingsinstituut, navorsing sal doen oor die uitwerking wat die onttrekking van grondwater deur huiseienaars in Pretoria het op die munisipale watervoorsieningstelsel.

Volgens mnr Charles Chapman, senior adviseur van die Waternavorsingskommissie, is die hoofdoel van die projek om te bepaal hoeveel water jaarliks deur middel van privaatboorgate in Pretoria onttrek word asook watter persentasie hierdie hoeveelheid water uitmaak van die water wat deur die Pretoriase munisipaliteit aan huishoudelike verbruikers verskaf word.

Mnr Chapman sê dié inligting is noodsaaklik vir die beplanning van die stad se toekomstige waterbehoeftes, aangesien sodanige beplanning die totale waterverbruik in die gebied moet insluit en nie net voorrade vanaf sommige van die waterbronne nie. Indien hierdie inligting vir een metropolitaanse gebied in Suid-Afrika beskikbaar is, kan die behoefte aan soortgelyke studies elders in die land ook makliker bepaal word. Inligting wat bekom word kan ook aangewend word vir die beplanning van noodwaterverskaffing deur die afdeling Burgerlike Beskerming.



Boorgate in Pretoria bekyk

Mnr Chapman sê die ondersoek sal 'n belangrike bydrae lewer tot die ontwikkeling van 'n geheelbeeld van waterverbruik in stedelike gebiede en word as aanvullend beskou tot vorige WNK-projekte oor waterbesparingsmaatreëls in stede, soos die beheer van waterverliese in verspreidingsnetwerke en die huidige ondersoek na die afsonderlike meting van water in woonstelle.

Hoewel baie plekke in die droër dele van Suid-Afrika grotendeels van grondwaterbronne afhanklik is, word die grondwater wat onder die groter dorpe en stede in die land voorkom oor die algemeen nie as 'n ekonomies ontginbare waterbron beskou nie. Die rede hiervoor is dat oppervlaktewater tans goedkoper gebruik kan word met meer doeltreffende behandeling en verspreidingstelsels.

In gebiede met voldoende hoeveelhede oppervlaktewater was die invloed
van privaatboorgate op grondwaterbronne en munisipale waterbehoeftes
vroeër jare gering. Maar in die jongste
tyd met die toenemende tekorte aan
water in die groot stedelike gebiede en
veral met die instelling van waterbeperkings en straftariewe word boorgate nou
as 'n lewensbelangrike item deur baie
tuiniers beskou. Groot bedrae geld word
deesdae in privaatboorgate belê, terwyl
die eienaars, met hier en daar 'n uitsondering, min kennis het oor grondwater,

boorgatbestuur en die invloed wat boorgate op die grondwaterbronne kan hê.

Die Nasionale Bounavorsingsinstituut het reeds in November 1985 met 'n klein loodsprojek begin om die boorgate op 13 eiendomme in Pretoria op 'n gereelde grondslag te moniteer. Die boorgate op sewe van hierdie eiendomme is met watermeters toegerus.

Met hierdie nuwe WNK-projek word beoog om nagenoeg 100 boorgate in die Pretoria-gebied met meters toe te rus en gereeld te moniteer. Die data wat só ingesamel sal word, sal aangewend word om antwoorde op die volgende vrae te vind:

- Hoeveel water pomp privaatindividue uit die grondwaterbron in stedelike gebiede en hoeveel energie word in die proses gebruik?
- Wat is die kwantitatiewe effek van die gebruik van boorgatwater op die munisipale waterbehoefte?
- Word boorgate doeltreffend gebruik?
- Hoe vergelyk die gehalte van die boorgatwater met dié van die munisipale water en is daar enige tekens van grondwaterbesoedeling?

Die stadsingenieursafdeling van die Pretoria munisipaliteit sal die NBNI behulpsaam wees met die navorsingsprojek deur inligting te voorsien in verband met Pretoria se waterbehoeftes, boorgatregistrasies en sal ook help met die installering en monitering van watermeters en boorgattoerusting.





SALINITY CONTROL AMERICAN STYLE

Although salinity problems in South Africa may not yet be as severe as in other countries, our ever increasing utilisation of finite water resources is emphasising the need to carefully manage such quality problems. To date we have tended to address the symptoms of salinity by releasing freshening water into affected rivers and reservoirs. In contrast, salinity control measures in the semi-arid areas of the USA directly address the causes of the problem. For this reason it was considered valuable to examine more closely the American approach to salinity control.

The Colorado River is not too dissimilar to our own salinity problem catchments in that fresh water which drains high mountainous areas, is subsequently used for the irrigation of soils overlying partially weathered geological formations of marine origin. The subsequent irrigation return flow is highly saline and gives rise to a gradual downstream deterioration in river water quality. At this point the similarity ceases. The USA are bound by international law to ensure the quality of the Colorado River at the point where it flows over the Mexican border.

In an attempt to comply with this, Congress have during the last twelve years, voted considerable funds for the investigation and amelioration of the Colorado River Basin salinity problem.

GRAND VALLEY

One area of the Upper Colorado catchment which has experienced considerable attention in this respect is the Grand Valley irrigation scheme situated in and around Grand Junction. Salinity control measures on this scheme can be divided into on-farm measures and off-farm measures. Both are aimed at minimising the deep percolation of irrigation water which is responsible for

In August 1986 Mr Simon Forster of the Department of Water Affairs and Dr George Green of the Water Research Commission undertook a tour of the South-Western United States of America in order to study salinity control measures. This article is taken from the report of their findings.

the mobilisation of large quantities of salt in the gypsum-rich subsoil horizons.

On-farm control measures essentially aim to improve the efficiency of surface irrigation which is by far the most widely practised irrigation technique. These measures include actions such as the lining of laterals (smaller canals which distribute water from the main canal to groups of farmers), replacing earth ditches on farms with galvanised irrigation pipes, laser levelling of fields and promotion of irrigation scheduling. All the measures are introduced as part of a voluntary agreement between the Soil Conservation Service and the farmer. A 75 percent subsidy is available to the farmer for the cost of the improvements. At the present time, however, less than half the farmers have made use of this facility. Some appear to fear the loss of a portion of their water allocation, while others have difficulty in financing their contribution of the installation costs.

Due to the importance of applying water evenly to furrow irrigated fields in the Grand Valley a number of ingenious mechanisms have been adopted to control the discharge of water from laterals and gated pipes. Among them are the "skategate" and "cablegation" systems, both of which were developed in the Valley.

Off-farm control measures in the Grand Valley consist of the lining of sections of the main 47,5 m3/s Government Highline Canal which supplies the irrigators with Colorado River water. Initially a seven mile stretch of the original 54 mile earth canal was lined with concrete. Future improvements include the lining of a further 37 miles with 20 mm PVC membrane. PVC was chosen in preference to concrete partly because of cost and partly due to the severe cracking of the new concrete in the winter months. Selection of canal stretches for lining is made on the basis of results obtained during ponding tests. Due to the use of underground pipe laterals associated with the concrete-lined section of the main canal, it is important that all debris is removed from the water. Consequently, \$1 million was spent on highly elaborate trash removal facilities on the Government Highline Canal.

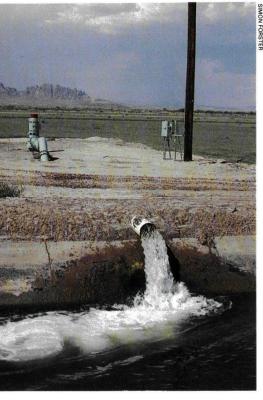
The Grand Valley contributes 580 000 tons of salt to the Colorado River annually. The current programme aims to reduce this by 130 000 tons, although this target is threatened by the inviolable and generally excessive water rights of the farmer, and the widespread tendency to over irrigate.

LOWER COLORADO

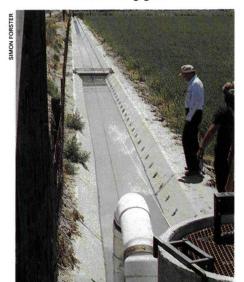
Salinity control in the Lower Colorado catchment differs markedly to the Grand Valley programme both in the measures adopted and in the degree of success achieved. Admittedly however, the Lower Colorado programme (particularly the work in the Yuma area) has been going on for over 10 years, and is nearing completion.

The Yuma area, which is located on the Colorado River close to the Mexican border, has both on-farm and off-farm control programmes. One of the on-farm programmes is located on the Wellton-

Groundwater pumps abstracting saline root zone percolate from deep wells in order to maintain the water table at 8 feet. The water is discharged into a lined drainage canal.



The "skategate" method of evenly applying water to a flood irrigated field. So named because of the incorporation of skateboard wheels in the design of the moving gate.



Mohawk irrigation scheme. It includes similar improvements to those implemented at Grand Valley, but with the addition of a groundwater level control system. Saline groundwater (± 3 750 mg/ℓ TDS) is maintained at a minimum depth of eight feet by a number of strategically located pumps which abstract the excess rootzone percolate from a deep underlying gravel aquifer and discharge it into a lined canal system. This water flows via the Santa Clara Drain into the Gulf of California, although it is eventually intended for it to be fed into the Yuma reverse osmosis desalination plant. The on-farm programme at Wellton-Mohawk is without doubt a major success for salinity control. Only surface irrigation is practised, mainly by flooding of large laser-levelled fields of up to 20 ha in size. Unlike Grand Valley, there has been no attempt to mechanise surface irrigation. Not only has the irrigation efficiency increased from less than 50 percent to more than 70 percent, both the return flow and return salt load have been reduced by 40 percent. Unfortunately this degree of success was not anticipated and a recent redesign of the desalination plant has had to be carried out.

It is claimed by the Bureau of Reclamation that the Yuma desalination plant, when completed, will be the largest reverse osmosis plant in the world. Its construction to date has been beset with problems such as rapidly changing technology, extensive pretreatment facilities, and a decrease in the original design capacity from 364 800 m³ per day to 275 120 m³ per day. The plant will produce a final water of 285 mg/\ell TDS at a cost of \$0,26m. This water will be discharged to the Colorado River. Project engineers expressed concern at this strategy which in their opinion was wasteful. They felt that it would be better to pipe the purified water across the Mexican border for urban use.

CALIFORNIA

Salinity management in the USA has benefited from the results of extensive research programmes on salt tolerance of crops. Furthermore, workers at the US Salinity Laboratory at Riverside, California have undertaken the consi-

derable and most valuable task of compiling and regularly updating salinity tolerance criteria for the widest possible range of economic crops, using data available from a variety of sources. Although appropriate crop choice cannot be considered a salinity control strategy as such, it is often more appropriate to adapt to conditions. There is however one salinity control strategy for which good crop salt tolerance criteria is essential, this being the recycling of irrigation drainage water which in the process becomes increasingly saline. In certain parts of the San Joaquin Valley, for instance, where disposal of saline irrigation drainage water has become an otherwise insurmountable problem, reuse of drainage water has become almost mandatory. Some very interesting approaches to the alternate use of saline and fresh waters to economically produce, under such conditions, a range of crops having different salinity tolerances, are currently being field-tested.

Most crop salt tolerance studies were once conducted at the US Salinity Laboratory at Riverside, California, However, due to the Los Angeles smog only a limited number of glasshouse experiments can now be performed. Most of the field experiments for crop salt tolerance are now carried out at the US Water Management Research Laboratory in Fresno, in the heart of the San Joaquin Valley. In many ways this move has been beneficial in that the research there is very appropriate to local problems and excellent field and other facilities are available with experiments being performed on both entire orchards of varying ages and commercial scale field crops.

In general, there are few revolutionary salinity control measures being adopted in the USA today. However, there is much to be learnt, including pitfalls to be avoided, from the way in which such measures are researched, evaluated and implemented. Fortunately, in South Africa there is still some time before we need to make major committments regarding salinity control programmes. Therefore it is essential that we use this time wisely and research our options thoroughly. Such research should address both the scientific aspects as well as the economic implications of salinity control.

WNK fOkus op drinkwatergehalte

ie gehalte van drinkwater het 'n direkte invloed op die gesondheid van die mens. Hippocrates, die vader van medisyne, het dit reeds in 460 vC besef toe hy opgemerk het dat 'n mens se gesondheid baie afhang van die water wat jy drink. Watergedraagde siektes soos cholera kom van tyd tot tyd op verskeie plekke in die wêreld voor. Syfers wat deur die Wêreldgesondheidsorganisasie van die VVO vrygestel is, toon dat na bewering ongeveer 500 miljoen mense iaarliks deur watergeassosieerde siektes beïnvloed word en dat meer as 10 milioen van hierdie mense uiteindelik as gevolg van hierdie siektes sterf. Hierdie sterfgevalle moet egter in perspektief gesien word omdat dit in gebiede voorkom waar besoedelde of onbehandelde water gedrink word.

Gelukkig beskik ons vandag - ook in Suid-Afrika – oor die nodige tegnologie om rouwater op so 'n wyse te behandel en te ontsmet, dat dit nie 'n gesondheidsgevaar vir die mens inhou nie. Mikrobiologiese kontaminasie is nog steeds belangrikste gesondheidsrisiko, maar waar hierdie aspek op 'n stadium waterkwaliteit oorheers het, is daar met verloop van tyd meer aandag aan anorganiese en later organiese chemiese verbinding gegee. Tot en met die sestigerjare was die klem in verband met organiese verbindings op die kontaminasie van die waterbron, terwyl in die afgelope jare veral aandag gegee word aan byprodukte wat tydens die ontsmettingsprosesse ontstaan. Die rede waarom die mikro-organiese verbindings in die geheel soveel aandag kry, is hoofsaaklik omdat die effek van hierdie verbindings op die gesondheid van die mens, as gevolg van 'n inname oor 'n lang periode, nog 'n onbekende faktor is.

DIE WNK SE BENADERING TEN OPSIGTE VAN DRINKWATERGEHALTE

Volgens dr Thys Pieterse, senior adviseur van die WNK, is daar by sommige van die RSA se oppervlaktewaterbronne waaruit drinkwater berei word, 'n verswakking in gehalte. Dit word teweeggebring deur besoedeling, herhaalde hergebruik van water met 'n gepaardgaande opbou van besoedelstowwe en die toenemende getal chemikalieë wat op die mark kom. Dit mag gebeur dat sommige van hierdie chemikalieë in die wateromgewing kan beland. Daar is dus 'n groot verantwoordelikheid op die navorser om kennis te bekom van die voorkoms, konsentrasie en bepaling van die besoedelstowwe en van die tegnologie om hulle te verwyder.

Die oorhoofse doelstelling met die navorsing van die WNK in verband met drinkwater is om kennis ten opsigte van drinkwatergehalte te versamel en om 'n tegnologie te help ontwikkel, sodat water voorsien kan word wat aan alle kwaliteitsnorme voldoen, nie 'n gesondheidsrisiko het nie, en teen 'n billike prys gelewer kan word.

Die klem van die WNK se navorsing in hierdie verband val op die volgende:

- die ontwikkeling van die nodige tegnologie van waterbehandeling;
- ondersoeke na die voorkoms en konsentrasie van kontaminante (mikrobiologies en chemies);
- die invloed van watergehalte op die mens (byvoorbeeld epidemiologiese studies); en
- verkryging van data wat 'n bydrae tot die daarstelling van kwaliteitsnorme kan maak.

Die WNK het sedert sy ontstaan verskeie navorsingsprojekte in verband met die tegnologie van waterbehandeling ondersteun. Hierdie navorsing het veral in verband gestaan met waterherwinning. Saam hiermee is ook navorsingsprojekte oor gesondheidsaspekte van waterherwinning ontwikkel en ondersteun. Hierdie navorsing gaan nog steeds voort. Daar word egter nou ook klem gelê op ondersoeke na die voorkoms en konsentrasie van kontaminante in drinkwater waardeur 'n bydrae gemaak kan word tot die daarstelling van gehaltenorme.

KWALITEITSKRITERIA VIR DRINKWATER

Volgens dr Pieterse is die aangeleentheid van kwaliteitskriteria ingewikkeld omdat die navorsers met 'n komplekse biologiese sisteem te doen het. Die invloed van 'n spesifieke stof op die metabolisme en algemene gesondheid van die mens word byvoorbeeld nie net bepaal deur die hoeveelheid wat per dag ingeneem word nie, maar ook oor watter tydperk, in watter vorm en die invloed van ander stowwe daarop. Verder kan die mens se ouderdom, geslag, gesondheid- en voedingstatus asook sy omgewing en genetiese herkoms ook 'n rol speel.

Dr Pieterse sê in Suid-Afrika bestaan daar nie wetlike norme vir drinkwaterkwaliteit nie. Die Suid-Afrikaanse Buro vir Standaarde se Spesifikasie vir Water vir Huisehoudelike Gebruik (SABS 24 – 1984) word egter algemeen as 'n erkende riglyn in hierdie verband aanvaar. Die Departement van Nasionale Gesondheid en Bevolkingsontwikkeling het die oorhoofse verantwoordelikheid ten opsigte van die gehalte van water vir

menslike gebruik en dus vir die daarstelling van drinkwatergehaltenorme. Hierdie Departement ondersteun reeds etlike jare 'n navorsingsprojek by die Nasionale Instituut vir Waternavorsing (NIWN) van die WNNR wat handel oor gesondheidsaspekte van watervoorsiening. Daar word gepoog om 'n reeks estetiese, fisiese, mikrobiologiese, anorganiese en organiese chemiese norme te ontwikkel.

Op grond van hierdie navorsing het die NIWN onlangs 'n verslag gepubliseer met die titel: Proposed aesthetic/physical and inorganic drinking-water criteria for the Republic of South Africa. Hierdie voorstelle, 'sowel as voorstelle vir mikrobiologiese norme, is deur die Departement van Nasionale Gesondheid en Bevolkingsontwikkeling in beginsel aanvaar en dit geniet verdere aandag met die oog op die toepassing daarvan.

In die genoemde NIWN-publikasie word estetiese, fisiese en anorganiese chemiese norme op drie vlakke vir 56 determinande voorgestel, naamlik 'n aanbevole waarde, 'n maksimum toelaatbare grens en 'n krisisgrens. Hierdie laasgenoemde krisiswaarde is 'n nuwe benadering en het nie 'n ekwiwalent in ander internasionale of nasionale standaarde nie. Teenoor die SABS-spesifikasie se ongeveer 23 determinande word hier 56 aanbeveel, die vermeerdering is veral ten opsigte van anorganiese chemiese verbindings.

Daar bestaan nog nie riglyne vir organiese chemiese verbindings in drinkwater in Suid-Afrika nie, maar dit geniet aandag. As gevolg van die komplekse aard daarvan, sal dit egter nog geruime tye duur voordat riglyne in hierdie verband beslag sal kry.

MIKRO-ORGANIESE VERBINDINGS IN DRINKWATER

In die algemeen word organiese verbindings as mikro-organiese verbindings of mikro-besoedelstowwe beskou omdat hulle in mikrogram per liter of laer konsentrasies voorkom. Die totale organiese konsentrasie is gewoonlik in die orde van 'n paar milligram per liter.

Daar word beraam dat daar wêreldwyd in 1985 ongeveer 7 miljoen chemikalieë

bekend was wat of sinteties was of in natuurlike produkte voorkom. Hiervan is tussen 70 000 en 90 000 in die daaglikse omloop en meer as 'n 1 000 nuwe chemiese verbindings kom elke jaar op die mark. Die kompleksiteit van die aangeleentheid word verder beklemtoon as besef word dat daar reeds sowat 700 chemiese verbindings in drinkwatervoorrade geïdentifiseer is, waarvan 600 organiese verbindings is. Baie van hierdie verbindings kom ook in die finale water voor. Met die moderne gesofistikeerde apparaat is dit moontlik om hierdie verbindings in baie kleiner konsentrasies as vroeër aan te toon. Dit is dus waar dat van die verbindings waarskynlik nog altyd in die water voorgekom het

Dr Pieterse wys daarop dat ten spyte van die groot getalle organiese verbindings wat reeds in drinkwater geïdentifiseer is, moet daar besef word dat hierdie bekendes maar net ongeveer 10 persent van die organiese fraksie verteenwoordig. Die res, dit wil sê 90 persent van die organiese fraksie, is nog onbekend en hoofsaaklik polêre verbindings wat met die huidige analitiese tegnieke nog nie geïsoleer en geïdentifiseer kan word nie. Hierdie onbekende terrein lê in 'n groot mate nog braak en sal in die toekoms verdere aandag moet geniet.

KWALITEITSKRITERIA VIR ORGANIESE VERBINDINGS

Die wêreldgesondheidsorganisasie het in 1984 riglyne vir 20 organiese verbindings voorgestel en die EEG-lande is besig om meer en meer organiese verbindings by hulle lys te voeg.

Behalwe vir individuele verbindings (byvoorbeeld benseen 10 $\mu g/\ell$ en chloroform 30 $\mu g/\ell$) word die organiese verbindings meesal in groepe saamgevat vir insluiting in die kriteria, byvoorbeeld insekdoders en verwante verbindings (elk 0,1 $\mu g/\ell$), ens.

Dit is ook nie net in die EEG-lande waar streng regulasies in verband met organiese verbindings neergelê word nie, maar ook in die VSA. So byvoorbeeld het die Environmental Protection Agency (EPA) onlangs wetgewing voorgestel vir agt vlugtige chemiese ver-

bindings (waaronder trichloroetileen en koolstoftetrachloried, albei 5 $\mu g/\ell$ as "maximum contamination limits"); asook "recommended maximum contamination limits" vir 37 ander verbindings.

Van die groepe wat veral aandag geniet is die vlugtige organiese stowwe (veral trichloroetileen, tetrachloroetileen, vinielchloried, 1,2-dichloroetaan, 1,1,1-trichloroetaan, koolstoftetrachloried en chloroform).

'n Ander groep verbindings wat ook baie aandag geniet is die trihalometane.

TRIHALOMETANE IN DRINKWATER

Trihalometane (THM) is organiese verbindings wat vorm tydens die ontsmetting van water met chloor (chloroform, bromodichlorometaan, dibromochlorometaan en bromoform word in hoofsaak gevorm). Die voorlopers van THM is natuurprodukte, veral humus- en fulviensuur. Die teenwoordigheid van THM in water het die afgelope jare baie aandag gekry veral vanweë die bevindings dat van hierdie verbindings moontlik mutageniteit en karsinogeniteit tot gevolg kan hê. Dr Pieterse sê daar is nog heelwat meningsverskille oor die presiese gevare van THM maar die effek op die mens se gesondheid as gevolg van 'n inname van THM oor 'n langtermyn, is in 'n groot mate nog onbekend. In die lig van die potensiële gesondheidsrisiko oor 'n langtermyn is dit belangrik om die teenwoordigheid van THM en hulle voorlopers in water te beperk. Verskeie lande het norme vir THM daargestel, byvoorbeeld in die VSA is dit 100 μ g/ ℓ , in Duitsland is die norm 25 μ g/ ℓ en in Nederland nie meer as 1 μ g/ ℓ vir elk van die trihalometane nie. Suid-Afrika het nog nie riglyne in hierdie verband nie, maar die Waternavorsingskommissie het onlangs 'n ooreenkoms met die WNNR aangegaan waarvolgens die NIWN ondersoek instel na die voorkoms en konsentrasie van THM in Suid-Afrikaanse drinkwater. Inligting wat hieruit verkry sal word, sal die omvang van die probleem kan kwantifiseer en sal 'n bydrae kan maak tot die daarstelling van gehalteriglyne, indien nodig, vir THM in water. Dit kan ook 'n invloed hê op die inset ten

opsigte van die tegnologie om hierdie verbindings en hulle voorlopers uit water te verwyder.

MUTAGENE

Die WNK het ook 'n navorsingsprojek oor die isolering en identifisering van mutagene in drinkwater by die NIWN van stapel laat loop.

Volgens dr Pieterse geniet navorsing oor mutagene vandag wêreldwyd aandag. Mutagene is verbindings wat die frekwensie van mutasievorming in die DNS-molekuul verhoog en karsinogese tot gevolg kan hê. Hierdie verbindings kan in die water voorkom, maar dit kan ook ontstaan tydens die chlorering van water. Daar is bewerings dat van al die organiese verbindings dit dalk net mutagene is wat 'n nadelige gesondheidseffek op die mens kan hê.

Volgens dr Pieterse is een metode om meer omtrent mutagene te wete te kom, om die mutageniteit tydens 'n isoleringsproses te volg, die mutageenfraksie te isoleer en die spesifieke verbinding(s) te identifiseer.

Wanneer hierdie verbindings wel deur die NIWN geïsoleer en geïdentifiseer is, sal hulle toksisiteit bepaal word en daar sal gepoog word om 'n kwantitatiewe bepaling van die verbindings te ontwikkel. Daarna kan die presiese voorkoms van die mutagene bepaal word en ondersoek ingestel word na die verwydering van hierdie verbindings tydens die waterbehandelingsprosesse.

GEBALANSEERDE BENADERING

Volgens dr Pieterse is dit uiters belangrik dat 'n gebalanseerde benadering ten opsigte van drinkwatergehalte gevolg word. "Aan die een kant van die spektrum is daar gedagterigtings dat die mikro-organiese verbindings as gevolg van hulle lae konsentrasies weglaatbaar klein is. Aan die ander kant van die spektrum is daar gedagterigtings wat weer buite verhouding op die potensiële gevaar van hierdie verbinding wys. Die antwoord lê êrens tussenin. Dit blyk ook dat die finansiële implikasies van waterbehandeling om voorsien-

ing te maak vir die verwydering van soveel ongewenste stowwe al meer en meer word. Daar kan na die uiterste gegaan word soos byvoorbeeld die geval met sekere waterowerhede in Europese lande. Hulle vervang tans pypleidings om veilige waardes vir lood te bewerkstellig; installeer fasiliteite om nitrate te verwyder; soek alternatiewe metodes vir chlorering; gebruik geaktiveerde koolstofkolomme; ondersoek alternatiewe koaguleringsmiddels om

aluminium te vervang, ens, ens. Wanneer al hierdie aksies in oënskou geneem word, kan die vraag inderdaad gevra word of daar nie dalk 'n nuwe benadering nodig is in verband met probleme van waterkwaliteit en gesondheid nie, omdat dit dalk te duur kan word om water van 'n aanvaarbare kwaliteit te produseer, terwyl eintlik net 'n klein gedeelte van water vir huishoudelike gebruik as drinkwater gebruik word!"

GIFTIGE STOWWE OPGESPOOR

'n Nuwe draagbare toksisiteitsdetektor wat algemeen gebruik sal word om skadelike stowwe in water vinnig en betroubaar te bepaal, word tans deur die Nasionale Instituut vir Waternavorsing (NIWN) by die WNNR ontwikkel.

Dié instrument sal die resultaat van navorsing wees wat nou die stadium bereik het waar die NIWN besig is om 'n prototipe laboratoriummodel van die instrument om te bou tot 'n draagbare model wat vir veldtoetse gebruik sal word.

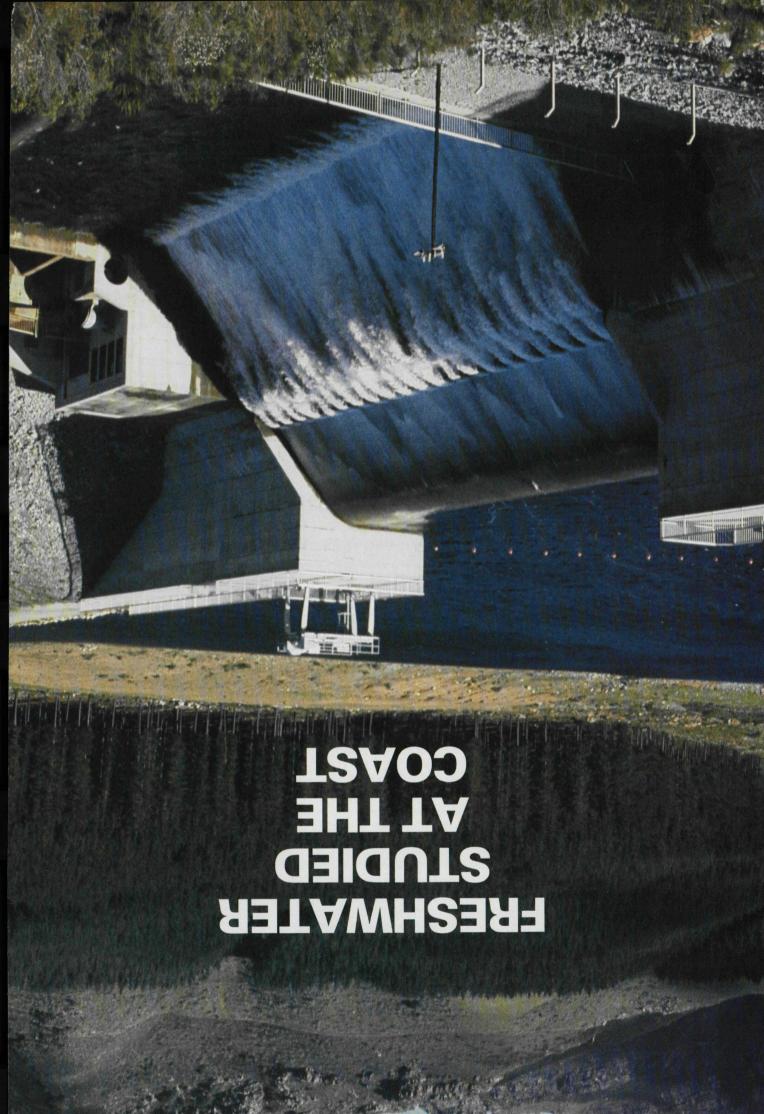
Hierdie navorsing vorm deel van 'n omvattende navorsingsprogram van die NIWN oor biologiese waaktoetsing vir water. 'n Bedrag van nagenoeg R40 000 is deur die Waternavorsingskommissie beskikbaar gestel ten einde 'n bydrae te maak vir die afronding van die navorsing en die toepassing daarvan in die praktyk.

Dr Thys Pieterse, senior adviseur van die Waternavorsingskommissie, sê dit is belangrik dat noukeurig op die gehalte van drinkwater gelet word en dat gereelde waaktoetsing van die gehalte onderneem word. "In die lig van die toenemende getal chemiese verbindings wat in omloop kom en die gevaar dat van hierdie verbindings in water kan beland, word waaktoetsing – veral vinnige biologiese toetse vir moontlike toksisiteitsgevaar – al belangriker."

Dr Pieterse sê daar bestaan vandag verskeie biologiese toetse vir die bepaling van toksisiteit in water, soos byvoorbeeld die biowaaktoetsing met vis. "Hierdie metodes is egter duur en tydrowend en daar is gevolglik 'n behoefte aan 'n vinnige, sensitiewe en goedkoop manier van waaktoetsing."

Die NIWN doen reeds verskeie jare navorsing oor die biologiese waaktoetsing van water. As deel van dié navorsing word 'n metode ontwikkel wat gebaseer is op die inhibering van spesifieke ensiemsisteme deur chemiese stowwe. Die ensieme wat gebruik word, straal tydens 'n biochemiese reaksie 'n hoeveelheid lig uit wat gemeet kan word. 'n Afname in liguitstraling dui dan op die moontlike teenwoordigheid van skadelike verbindings in die water.

'n Kommersiële instrument wat op die bogenoemde beginsel berus, bestaan reeds in die handel, maar dit kos nagenoeg R80 000. Dié hoë koste word hoofsaaklik veroorsaak deur die gebruik van fotovermeniqualdigers en fotoelektriese selle in die instrument. Dit is ook nie vir algemene gebruik, soos byvoorbeeld veldwerk geskik nie. Die NIWN het gevolglik 'n nuwe konsep vir die bepaling van die liguitstraling ondersoek, naamlik die gebruik van moderne vaste toestand elektroniese tegnologie. Die navorsing word in verskilllende fases uitgevoer en die NIWN het reeds 'n prototipe laboratoriummodel van die nuwe toksisiteits-detektor gebou. Tans word gewerk aan die ombouing van hierdie apparaat tot 'n draagbare model wat vir veldtoetse gebruik kan word.





Bottom-coring in Langrivier. This technique was developed to measure accumulations of organic matter within the stream bed.

It may come as a surprise to some readers of the Bulletin to learn that an active inland waters Research Unit is alive and well at a coastal University renowned for its marine research. On September 3, 1986, the University of Cape Town gave official Research Unit status to a group of workers within the Zoology Department, in recognition of their collaborative research over the preceding four years. From very small beginnings in 1981, the Unit has grown to 11 staff and 8 postgraduate students in 1986. In this article Professor Bryan Davies, Director of the Freshwater Research Unit, reports on the aims and activities of the group.

he raison d'etre for the Unit is the growing water crisis in our country, which we firmly believe will reach "critical mass" within the next decade or so. The major focus of our research has been river functioning and catchment management, with the conviction that without a firm understanding of catchment and river system processes, water quality control and future water supply will become increasingly difficult to sustain. We are of the opinion that projects aimed at providing a basis for understanding ecological processes in rivers, in particular (especially since rivers supply impoundments with their water and also receive the discharge from impoundments), are the most likely to provide managers with a longterm armoury of understanding for decision making.

The Unit handles some R120 000,00 of research funds for 5 main programmes in 1987, all provided through the Foundation for Research Development. In addition, we have some private funds for a local catchment study. The major study sites have centred on the

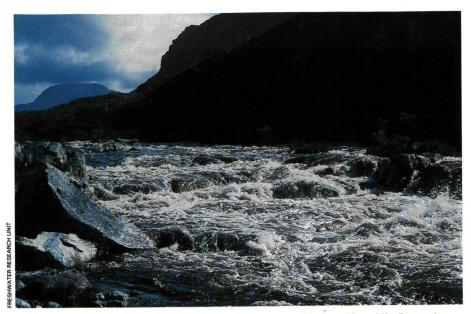
catchments of the upper Eerste River in the Jonkershoek Mountains near Stellenbosch; Langrivier, Biesievleirivier and Swartboschkloof. The Langrivier programme comes to end in July and has given us a valuable insight into mountain stream processes. Eleven papers are in preparation on the system and two are already in press. These papers will describe the physico-chemical processes, the biological attributes of the system, the way in which energy available to the system is utilised by it and, perhaps the most difficult at the time (in terms of comfort!), the flood characteristics of the system and related physico-chemical and biological responses. Swartboschkloof as a project is important in so far as it will examine the changes that take place in a fynbosdominated headwater stream during and after burning of the entire catchment by the Department of Forestry. The burn is due in March 1987 and we already have a two year data base on the "normal" functioning of the system for burn- and post-burn comparison.

Privately funded work on the entire Eerste River catchment is scheduled for

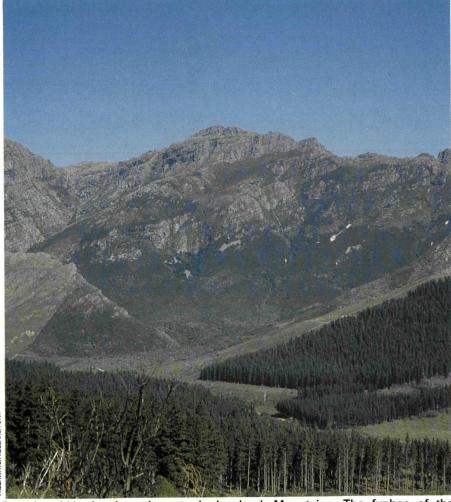
completion shortly and will provide local planners and land-users with some basis for understanding the problems of the stressed lower reaches of the system. Another "whole catchment" study involves the examination of the effects of impoundments upon the Palmiet River, with special reference to the proposed and controversial "Hangklip" Dam scheme, which would flood part of the Kogelberg State Forest Reserve. This project has been running for a year now and is beginning to give some important leads into the way in which an acid, "black water" river recovers from the physico-chemical and biological impacts of multiple impoundment. Recent theoretical developments (mainly based on American systems) can be tested within the framework of this project, and the funding agency has had the foresight to link the Palmiet programme with a sister project run by the Institute for Freshwater Studies at Rhodes University, which is examining similar processes within the multiplyimpounded Buffalo River in the eastern Cape.

Two other exciting developments centre on work designed to synthesise information on Inter-basin Water Transfer Schemes, and a project which will produce an inventory on the Wetland ecosystems of the Cape. Readers are aware of the enormous schemes to transfer water from catchment to catchment within South Africa (the Orange-Sundays-Great Fish tunnel and canal scheme, and the gigantic Lesotho Highlands scheme, for example), but surprisingly, there is little information available on the potential and actual ecological impacts of such water transfers. We will be looking at such projects on a world-wide basis with the object of identifying potential impacts and assessing ways and means in which we in South Africa can circumvent some of the more serious of these impacts. In the case of the Wetlands study, the excellent work that has already commenced in Natal has given us the basis for a survey of the fast-disappearing systems of the Cape. Our general knowledge of the past and current extent of Wetlands is extremely poor, to say the least, and a survey is urgently needed to try to assess the rate of disappearance (and the reasons

W-A-T-E-R R-E-S-E-A-R-C-H



The lower Palmiet River in spate near the proposed Lower Hangklip Dam site.



Swartboschkloof sub-catchment, Jonkershoek Mountains. The fynbos of the valley (over twenty years old) will be completely burned in March/April, 1987.

for their disappearance) of these invaluable ecosystems.

In addition to these main programmes, we have also maintained an active interest in several of the larger coastal vleis near Cape Town. Zandvlei, is in particular, a very heavily utilised lake (urban and industrial development of the catchment, lake-side Marina development and recreational uses), with serious management problems. Ongoing research has produced four publications on various aspects of the management and functioning of the system and we hope to sustain our interest through post-graduate student projects. One of the more interesting post-graduate projects which is nearing completion is looking at the relationship between the natural fynbos vegetation and the chemistry and biology of the zooplankton communities of a number of small western-Cape vleis. This project is working on the assumption that the vegetation of the catchments surrounding such vleis has a very significant effect upon the chemistry and hence the biology of each system.

Over the past few years some 30 publications have come from staff of the Unit. Anyone interested in any of our programmes, or who would like to receive reprints of publications of the Unit can do so by writing to me. We welcome further contacts!



Professor Bryan Davies, Director, Freshwater Research Unit, Zoology Department, University of Cape Town, Private Bag, Rondebosch, 7700.

WASTEWATER TREATMENT AND POLLUTION CONTROL

by K A Murray

1987 367 PP HARD COVER

ISBN 0 908356 55 2

CONTENTS

Historical Introduction/History of Sewage Purification Methods from 1986 onwards/Historical Development of Sewage Disposal Methods in South Africa/Chemical and Bacteriological Aspects of Sewage and Sewage Purification Processes/South African Organizations Dealing with Wastewater Treatment Problems/Overseas Organizations/South African Contribution to the Developing Field of Wastewater Purification/Problems Encountered in the Mining Industry in South Africa in Relation to Sewage Disposal/Practical Aspects of Wastewater Treatment and Pollution Control in South Africa/Water Rights/Provincial and Local Authorities: Responsibilities and Authority/Discharge of Purified Effluents into Watercourses/Analytical Methods/River Water Usage: Adverse Effects Caused by Sewage Effluent, Industrial Seepage, Runoff and Atmospheric Discharge/The Hierarchical Use of Water in South Africa: Portents for the Future/Control of Pollution from Industrial Effluents (Major Water-using Industries/Disposal of Solid, Toxic and Hazardous Wastes/Marine Pipelines for Disposal of Sewage and Interactable Industrial Wastes/The Use of Land for the Disposal of Intractable or Poor Quality Effluents/Treatment of Sewage and Disposal of Effluent from Small Communities, Caravan Parks, Seaside Resorts, Hostels, Hotels, etc./Water Boards and their Functions.

This is a comprehensive study of Wastewater Treatment and Pollution Control in South Africa. Enlightening facts concerning the historical development of various sewage systems and the disposal methods previously in use, provide a solid background for the detailed description of modern day wastewater treatment.

South African organizations concerned with the matter at hand, are reviewed. The reader gains insight into the specific function of each organization and the part it plays in researching and developing possible solutions to this problem. The important role played by South Africans in this development, is underlined.

"Wastewater Treatment and Pollution Control" will be found of assistance to students at universities and technikons, wastewater treatment and pollution control personnel, in fact all persons who in the practice of a variety of disciplines are concerned with the disposal of sewage and industrial wastes and the prevention of pollution of the water environment – P E Odendaal (WRC).

Publication date: February 1987.

PRICE R30.00 INCL

Obtainable from:

Water Research Commission P O Box 824 PRETORIA 0001 Republic of South Africa

Please se	nd me:
	— copies entitled
	iter Treatment tion Control"
NAME: ADDRES	S:
	— POSTAL CODE:
I hereby	include a cheque/postal
order for	the amount
of R —	
	SIGNATURE

DATE

SALINITY NEWS

During the last few years the Hydrological Research Institute has, on behalf of the Department of Water Affairs, undertaken a number of investigations into existing and envisaged water resource salinity problems.

Current trends in the requests for such investigations would seem to indicate that the work of the Institute's salinity teams will continue for many years to come.

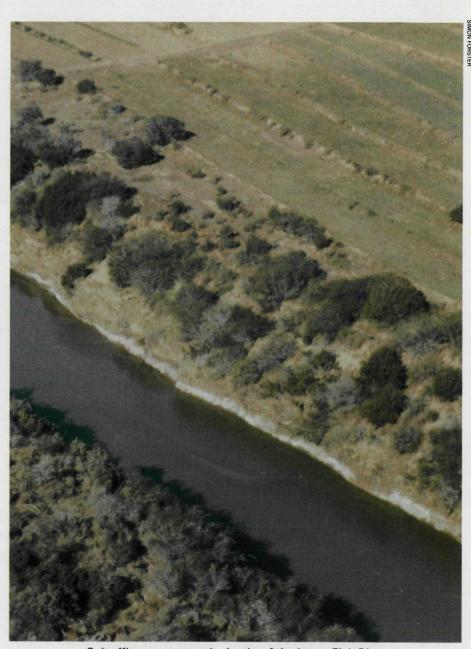
The purpose of SALINITY NEWS is to provide scientists, engineers and interested persons with a regular update of the scope and status of the Institute's salinity research. Further information on any of the projects and reports referred to in SALINITY NEWS can be obtained from:

The Director
Hydrological Research Institute
Private Bag X313
PRETORIA
0001

THE OPERATIONAL MODELLING OF THE ORANGE-FISH/SUNDAYS TRANSFER SCHEME

Orange-Fish/Sundays transfer system comprises a complex network of tunnels, dams, diversion structures and canals which will, in a few years time, extend from the Hendrik Verwoerd Dam to Port Elizabeth. The efficient operation of such a system has in the past proved a formidable task, and has been complicated by the fact that water quality has had to be considered concurrently with water quantity. Within the next five years the operational problem will be further aggravated when both the De Mist Kraal Weir and the Fish-Ecca Tunnel are commissioned. The De Mist Kraal Weir will greatly increase the transfer rate of water to irrigators in the lower Sundays River, whilst the Fish-Ecca Tunnel leading to the Glen Melville Dam will supply the newly developed Tyefu Irrigation Scheme in the Republic of Ciskei.

Salinity is a major problem in the Fish and Sundays rivers, and in order to ensure envisaged crop yields it is important that the dissolved salt content of the transferred water is kept to a minimum.



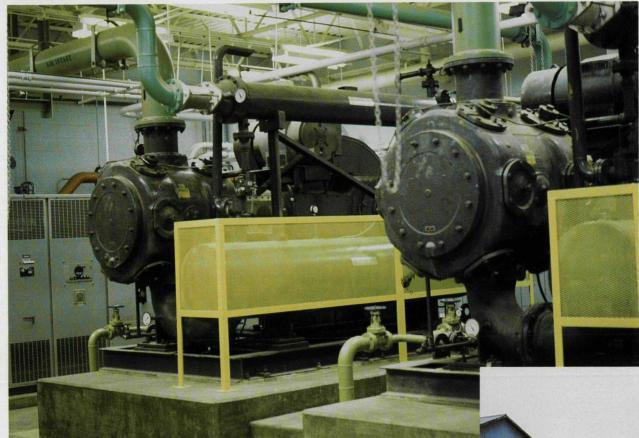
Salt efflorescence on the banks of the lower Fish River.

The Hydrological Research Institute at Cradock has recently embarked on a three year project to develop a decision support system to aid the efficient operation of the scheme. The decision support system, which is essentially a micro-computer based operational model, is being developed in close co-operation with the Department's operations engineers in the Eastern Cape. The software will assist engineers in selecting appropriate release volumes and rates which it is hoped will result in a suitable supply water quality and minimum water wastage.

The dynamics of water and salt movement along more than 550 km of river channel will be simulated on the basis of detailed information gathered during controlled test releases into individual parts of the scheme. The first of these, a four day release of 50 m³/s from Elandsdrift Dam to Fort Brown, was carried out in May 1986.

The decision support system for the Orange-Fish/Sundays scheme will be the first application of computer simulation techniques to the day-to-day operation of a Departmental water scheme. Although this particular software will not be transferable to other schemes, the principles, approaches and experience gained will be invaluable when similar modelling applications are considered.

During a recent study tour to the USA to investigate the composting of sewage sludge Mr Hannes Nell, Head of the Technical Support Services Division of the National Institute for Water Research in Bellville, had the privilege of visiting the first of the full-scale Dual Digestion plants in the USA at Hagerstown, Md. Mr Nell reports on the visit.



he firm establishment of secondary wastewater treatment facilities in the United States in recent years has led to a corresponding increase in the application of biological sludge digestion processes. Biological sludge digestion is a cost-effective and energy-efficient means of achieving stabilization and reduction of waste solids from a wastewater treatment plant.

The two general types of biological sludge digestion processes in common use today are aerobic and anaerobic. The Dual Digestion System combines the advantages of both these processes. Dual Digestion consists of a short

retention time (about one day) autothermal aerobic digestion system using high-purity oxygen, followed by an anaerobic digestion step with a retention time of approximately ten days.

Full-scale Dual Digestion facilities are operating at three treatment plants in the USA, while three more systems are currently being constructed.

The process began development in the late 1970s and bench- and pilot-scale testing indicated that autoheating of sewage sludge from biological respiration was feasible and that solids destruction was comparable to conventional biological solids stabilization processes. The technology was demon-

The state of the s

SA Waterbulletin April 1987

S·L·U·D·G·E D·I·G·E·S·T·I·O·N





strated at full-scale at the Hagerstown Wastewater Treatment Plant (Hagerstown, Md.) in 1980. Since then, systems have been installed at Nutbush Creek Wastewater Treatment Plant (Henderson, NC) and Lackawanna Sewage Treatment Plant (Lackawanna, NY).

The Hagerstown Wastewater Treatment Plant serves approximately 41 000 persons in the city and its surrounding metropolitan area, including numerous commercial and industrial concerns. Located south of the City of Hagerstown, Maryland, on the banks of Antietam Creek, the facility boasts one of the oldest secondary treatment systems in the United States. Built originally in 1924, an extensive construction program to upgrade the plant is presently underway. The nominal 36 Mℓ per day plant consists of manually cleaned bar screens with 75 mm openings, an aerated grit chamber, grease trap, four diffused air aeration trains with a total capacity of 10,5 Me and a total of five secondary clarifiers (only four in active use). Effluent disinfection is provided by two chlorine contact chambers having a combined capacity of 1 M\ell which are equipped with an automated chlorine residual analyzer, controller and recorder. The underflow from the primary and waste stream from the secondary clarifiers is pumped to the Dual Digestion plant after thickening to approximately 6 per cent solids.

The first step of the Dual Digestion system is a high rate autothermal aerobic digester contained in an insulated, covered, concrete tank of cylindrical geometry. The tank is 3,5 m in diameter with a maximum sludge sidewater depth of 7,3 m and a minimum free-board height of 0,6 m. An adjustable external telescoping valve and overflow box maintains the liquid height in the aerobic digester at a depth of 6 m creating a reactor volume of 74 000 ℓ which includes the volume of the drainage well at the bottom of the tank.

High purity oxygen is introduced into the aerobic reactor by means of static coarse bubble diffusers located at the bottom of the tank. Oxygen transfer from the gas to the liquid phase is enhanced by means of a rotating high shear device which breaks up the oxygen gas bubbles as they rise through the sludge. The use of high purity oxygen minimizes the volume of water saturated gas (mainly carbon dioxide and oxygen) which is vented to the atmosphere. This low gas volume also minimizes latent and sensible heat losses from the aerobic step and allows the desired operating temperature to be maintained more efficiently. The major mode of temperature control in the first step is by adjustment of the oxygen feed rate and thus the extent of heat producing biological oxidation which occurs. Typically only 5 to 15 per cent of the volatile solids content of the sludge need be metabolized to produce the required quantity of heat depending on the desired operating temperature (55°C). The second step of the Dual Digestion System consists of a high rate anaerobic digester heated and partially digested sludge from the autothermal aerobic pretreatment step. The anaerobic reactor completes the stabilization process by further breaking down volatile matter into carbon dioxide (35 per cent) and methane gas (65 per cent). An existing fixed cover anaerobic digester with a single 15,2 m diameter tank and a sidewater depth of 7,6 m (nominal capacity of 1,8 M ℓ) is used. In order to keep anaerobic hydraulic retention times in a reasonable range yet maintain a gas seal over the mid-depth influent sludge pipe, the reactor is operated at slightly more than half of its total volume. The reactor cover is sealed to prevent gas leakage at this reduced liquid level. Operating temperature is maintained at 37°C. A 6 kW pump is used for sludge wasting and recirculation mixing.

Operational data of the Hagerstown plant is compared with similar data from the plants at Lackawanna and Henderson in Table 1.

DISCUSSIONS

During discussions with Mr Rick Thomas, Manager of the Water Pollution Control Division of the City of Hagerstown and Mr Bob Semler, Plant Superintendent, the following points were highlighted:

- ☐ Since all biologically active materials are enclosed, no fly problems were encountered at the plant.
- No adverse effect due to the presence of the industrial effluents were found at Hagerstown. However, this aspect needs further research.
- ☐ The temperature control in the first stage digester is effected by regulating the oxygen input.
- ☐ The temperature is controlled in the second stage digester by regulating temperature loss from the first stage digester effluent by means of a heat exchanger (sludge to water).
- To prevent foaming in the first stage digester a solids content preferably 6 per cent is required.
- ☐ The aerobic digester was insulated with a spray-on plastic foam.
- Odours in the off-gas from the aerobic digester are removed by filtering the gas through an active carbon filter. Condensate in this filter is very corrosive.
- ☐ Except for the automatic tempera-

ture control system, the plant has proved to be electrically and mechanically highly reliable.

- □ Except for training at the plant by the superintendent, no special training is given to the operators.
- The aerobic digester is fed intermittently; but this is not the best method and continuous feeding is recommended.
- ☐ Foaming is not a problem on the aerobic digester anymore (due to higher influent solids concentration), but the second stage digester has developed foaming problems recently. The cause has not yet been established.
- Mixing of the second stage digester content by recirculation of sludge at a rate that will give four volume replacements per day should be sufficient.

CONCLUSIONS

Full-scale operating data at Hagerstown have confirmed the basic design criteria and demonstrated that Dual Digestion is an energy-efficient and easily operated process of sludge reduction and stabilization. The inherent stability of the process has been demonstrated. Results confirm that Dual Digestion can operate with no chemical addition over a wide range of operating conditions and sustain shock loadings without upset. The demonstrated low retention times confirm the small tankage reauirements which in turn, minimize both capital cost and land requirements.

TABLE 1: OPERATIONAL DATA OF THREE DUAL DIGESTION PLANTS

	Lackawanna	Hagerstown	Henderson
Reason for implementation	Reliability	Cost and energy	Environmental benefits and reliability
Start-up date	February 1983	June 1980	December 1982
Average daily wastewater flow	0.20/0.30	0.35/0.35	0.18/0.37
(design average/peak m³/s)		0	Our rear setimeted studge
Secondary treatment process	Oxygen activated sludge	Oxygen activated sludge	Oxygen activated sludge 4410
PSA system capacity (kg/d)	Primary and secondary	Primary, secondary, cheese	Primary, trickling filter
Solids type (influent)	Filliary and Secondary	whey, septage	
Solids thickening process (influent)	Gravity	Dissolved air flotation	Dissolved air flotation
Feed mode	Continuous	Intermittent	Intermittent
Design detention time	1.17/7.4	0.9/12.0	1.25/10.4
(Step I/Step II, d)		Dieta and frame filter press	Drying beds
Solids dewatering process (effluent)	Centrifuge and/or drying bed	Plate-and-frame filter press Farmland	Landfill
Ultimate sludge disposal	Landfill Gas engine for PSA	Scrubber and compressor	Gas engine for PSA
Biogas use	compressor for building heat	vehicle fueling system	compressor

NOTE: PSA = Pressure Swing Absorption Oxygen Plant

HYDROLOGICAL RESEARCH REPORTS

NOW AVAILABLE FROM WATER RESEARCH COMMISSION

	Report No.	TITLE, AUTHOR & PAGES	No Required
This six-volume hydrological report series printed in 1981	WATER RESOURCES	PRICE: R45,00 per volume.	
has been well received and widely used. By 1984 practically all volumes	HRU 8/81	"SURFACE WATER RESOURCES OF SO AFRICA – DRAINAGE REGION C: THE VAAL BASIN" by B J Middleton, WV Pitman and D C Midgley	Part I: 180 pp
were sold out and, because of the de- mand, the WRC en- tered into a contract with Steffen,	HRU 9/81	"SURFACE WATER RESOURCES OF SO AFRICA – DRAINAGE REGION UVWX: THE EASTERN ESCARPMENT" by W V Pitman, B J Middleton, and D C Midgley	
Robertson and Kirsten Inc to reprint the series.	HRU 10/81	"SURFACE WATER RESOURCES OF SO AFRICA – DRAINAGE REGIONS A and B LIMPOPO – OLIFANTS" by B J Middleton, W V Pitman and D C Midgley	
	HRU 11/81	"SURFACE WATER RESOURCES OF SO AFRICA – DRAINAGE REGIONS D and F ORANGE RIVER/NAMAQUALAND" by W V Pitman, B J Middleton, and D C Midgley	
All the errors in the	HRU 12/81	"SURFACE WATER RESOURCES OF SO AFRICA – DRAINAGE REGIONS MNPOR THE EASTERN CAPE" by S A Lorentz, R M Robertson, and B J I W V Pitman and D C Midgley	ST: Part I: 180 pp
original that were listed in the "Addendum to the Surface Water Resources of South Africa" have	HRU 13/81	"SURFACE WATER RESOURCES OF SO AFRICA – DRAINAGE REGIONS EQHJKL THE WESTERN CAPE" by D J Potgieter, W V Pitman, B J Middle and D C Midgley	.: Part I: 180 pp
been corrected in the	Each of the above volu	mes is in two parts where Part I is the text and	Part II is an Appendix.
reprint. In addition, typographical errors and errors reported	HRU 79/1	"UPDATING AND MODIFICATION OF FL PLAIN MODELS" – 46 pp: HRU MANUAL SERIES Price: R5,00	OOD
by users have been remedied. Appendices D & F1	HRU 2/79	"A NUMERICAL HYDRAULIC MODEL OF PONGOLA FLOOD PLAIN" – 18 pp by W V Pitman and H W Weis Price: R5,00	Province of the second
are reprinted two-to- a-page to reduce bulk. The original	HRU 1/81	"APPLICATION OF ILLUDAS TO STORM DRAINAGE DESIGN IN SOUTHERN AFR – 148 pp: by M D Watson Price: R16,00	
page numbers, how- ever, are retained.	HRU 7/81	"TIME-AREA METHOD OF FLOOD ESTIN FOR SMALL CATCHMENTS – 174 pp: by M D Watson Price: R22,00	MATION
PLEASE ORDER NOW!	HRU 7/75	"MATHEMATICAL FLOOD PLAIN MODE VOLUME 1 by H W Weiss and D C Midgley Price: R22	
LIMITED STOCKS AVAILABLE	HRU 3/76	"MATHEMATICAL FLOOD PLAIN MODE VOLUME 2 by H W Weiss and D C Midgley Price: R22	

Prices are inclusive of GST, Postage and Packing (for orders within South Africa) are free. All orders must be prepaid. Cheques payable to the: Water Research Commission, please.

SA Waterbulletin April 1987



ESTIMATING FLOODS FROM SMALL CATCHMENTS

An interim report to the Water Research Commission entitled Antecedent soil moisture in design runoff volume estimation will help hydrologists and engineers to estimate floods from small catchments.

The report, prepared by the Agricultural Catchments Research Unit of the Department of Agricultural Engineering, University of Natal, Pietermaritzburg, was written by S J Dunsmore, R E Schulze and E J Schmidt. Copies of the report are now available, free of charge, from the Water Research Commission, P O Box 824, Pretoria 0001.

The South African Institute of Civil Engineers (1983) estimated the annual costs of building hydraulic structures on small catchments in South Africa at approximately R300 000 000. The expenditure due to overdesign and re-

pairs of these structures is estimated to be a considerable proportion of this amount. The improvement of design flood volume and peak discharge estimation procedures is therefore vital.

It is usually due to the economics of design that engineers use simplified models involving averaged values for an entire catchment of spatially variable factors such as rainfall, slope and soil values. Since no practical model can account for all causative factors with certainty, situations arise where one or more methods present good results for some events, and yet cannot represent the runoff process adequately for other events on the same catchment. Similarly, the use of a different method may improve these predictions while at the same time deteriorating other estimates which were satisfactory initially. Hence, the choice of the design method is critical and often a problem.

One characteristic common to most design methods, however, is the assumption that the design flood will have the same return period as the design storm which produces it. The use of average catchment conditions in many methods is based on the premise that a design flood with a return period approximately equal to the design storm will be produced. It has, however, been long realised that this will not necessarily be the case in practice. Average catchment conditions are difficult to define on ungauged catchments and factors such as initial and continuing abstractions from the rainfall depth may cause the return periods of the design storm and the resulting flood to differ.

Many researchers have proposed that antecedent catchment wetness is one of the major factors influencing runoff generation from a rainfall event. The ex-

Ten-day short course on the PLANNING AND OPERATION OF WATER RESOURCE DEVELOPMENT PROJECTS

University of Pretoria: 6th — 16th July, 1987

Please complete and return to: Mrs Nellie le Roux Department of Civil Engineering University of Pretoria PRETORIA

Tel (012) 420-2978

NAME: (Prof./	Dr/Mr/Mrs/M	s/Miss)	
ORGANISATIO	N:		
1000500			
			Postal Code
	Telephone:		Telex:
			payable to University of Pretoria
SIGNATURE:			DATE

POST CARD

Postage Stamp Required

Mrs Nellie le Roux Department of Civil Engineering University of Pretoria PRETORIA 0002

TECHNOLOGY FORUM — S445 Effluent Treatment and Chemical Recovery by Electrically Driven Membrane processes CSIR Conference Centre, Pretoria — 29 June 1987

NAME: (Prof./Dr/Mr/Mrs/Ms/Miss) ORGANISATION: ADDRESS:	
Postal Code Telephone No	
I am a bona fide full-time student at University and my registration fee of R60 is enclosed	
SIGNATURE: DATE:	
I am interested in exhibiting related products or equipment I shall require transport from the Boulevard Hotel	YES NO YES NO

^{*} PLEASE NOTE – cheques should be made payable to the National Institute for Water Research S445, and returned with this card to the National Institute for Water Research, P.O. Box 395, Pretoria. 0001

POST CARD

Postage Stamp Required

Mrs R Oellermann/Mr P Coombs
National Institute for Water Research
P O Box 395
PRETORIA
0001



Professor R E Schulze

tent of its significance, especially under design conditions, is as yet not well quantified. In current design procedures the antecedent wetness is either represented as a partial function of antecedent rainfall, such as in the SCS model, or indirectly by a constant such as in the Rational method. These representations which are then considered as constants on each catchment, have been shown to vary from storm to storm and much of this variation has been attributed to the inadequate representation of the antecedent catchment wetness.

In this study, two hydrological models for use on small catchments have been selected for comparison of their simulated daily runoff volume output for "design" events with corresponding observed daily runoff volume. Although an estimate of "design" peak discharge is usually also required, it is generally assumed that there is a close association between the peak and the runoff volume and the results of this study are thus not limited to runoff volume determinations alone. The SCS model was chosen as it has been adapted for use in South Africa and is at present one of the more popular models in design flood estimation. The ACRU model was selected as it utilises the basic SCS runoff volume procedure and also because it applies a conceptually based and more complex representation of moisture on daily runoff volume dethe soil moisture balance. By comparing the output from the two models wetter. On the arid catchments a large

of catchments representing humid, subhumid and arid regions, a better understanding of the relationship between rainfall, runoff and antecedent soil moisture may be obtained.

The ability of these two models to simulate daily runoff volume accurately was evaluated using long term (> 29 years) daily rainfall and runoff volume data obtained for six small agricultural catchments located in the USA, having widely ranging climatic and land use characteristics. For five of the six catchments under study the ACRU model performed significantly better than the SCS model. The exception was for an arid catchment upon which sparse land use information was available and possible errors in the data set were evident. The SCS model, when using an assumed average response function, performed better than when an adjustment to the response function due to antecedent precipitation depth was made. This illustrated the inadequacy of the presently applied adjustment procedure in the SCS model.

There was little association between rankings of observed daily rainfall and resulting daily runoff depths indicating that the assumption of the T-year return period flood being the result of the T-year return period storm, inherent in current flood estimation procedures, does not provide a sound basis for hydrological design. Extreme runoff series based on simulated annual maximum daily runoff volume obtained using the ACRU model, utilizing its moisture budgeting procedures to account for catchment wetness, provided close agreement with observed flow series and allowed for more accurate estimates of design runoff depths than the SCS based methods.

A statistical analysis of the significance of the role of antecedent soil moisture in daily runoff response was undertaken. The results indicated that for the humid and sub-humid catchments, soil moisture had a bigger influence on the daily runoff volume from storms of relatively low rainfall amount than in the more extreme rainfall events, and that the influence of soil creased as initial conditions became to recorded runoff events on a number proportion of events fell on a dry catchment and moisture status then played only a small role in determining the runoff response characteristics.

CONCLUSIONS

It was concluded that the assumption of equal return periods for a design storm rainfall and its resulting flood volume does not provide a sound basis for risk analysis on small catchments. The application of a moisture budgeting model such as the ACRU provided more accurate estimates of daily runoff volumes than the widely used SCS model, which does not account realistically for catchment wetness. The application of such a moisture budgetting model, using representative daily rainfall and catchment information to generate a flood series (to which a frequency distribution can be fitted) provides a more sound and accurate method for the estimation of design daily runoff depth.

RECOMMENDATIONS FOR FUTURE RESEARCH

In view of the markedly improved estimates of daily design runoff depth obtained using moisture budgeting procedures in the USA, it can be concluded that similar research encompassing a wide variety of study regions, is warranted. Ideally this should be undertaken using South African data with an ultimate aim of identifying regional trends of moisture status prior to desian storms. The development of suitable techniques of technology transfer to present the research findings to the end user would assist in the application of design flood procedures presently used in this country.

The application of a distributed model would assist in interpreting the importance of antecedent soil moisture on runoff response on a heterogeneous catchment of variable runoff response areas and mechanisms which cannot be identified by means of a lumped model.

Copies of this report - Antecedent soil moisture in design runoff volume estimation - are obtainable on request, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001.



BESOEK

gewese Die Minister van en Waterwese, Omgewingsake wyle mnr J W E Wiley, vergesel van die Adjunk-Minister, mnr J A van Wyk, het in Januarie vanjaar die Waternavorsingskommissie besoek. Tydens die geleentheid is inligtingsessie oor die 'n werksaamhede van die WNK vir die ministers aangebied. Op die foto verskyn van links: mnr PE Odendaal, uitvoerende direkteur, WNK; wyle mnr JWE Wiley, gewese Minister van Waterwese; mnr J A van Wyk, Adjunk-Minister van Waterwese en dr JP Kriel, voorsitter van die WNK.



INLIGTINGSDAG

Die WNNR se Nasionale Instituut vir Waternavorsing het in Februarie vanjaar 'n inligtingsdag oor hipertrofie en waterbehandeling in Schoemansville by die Hartbeespoortdam aangebied. Onderwerpe soos eutrofikasie, die monitering van THMs en die gebruik van Hartbeespoortdam as 'n rouwaterbron is onder andere bespreek. Afgevaardigdes het ook die geleentheid gekry om tydens 'n bootrit eerstehands met die alge van die Hartbeespoortdam kennis te maak.



SA Waterbulletin April 1987

AANGESTEL

Ilse Lombard is onlangs in die pos van assistent-redakteur by die SA Waterbulletin aangestel. Sy is 'n oud-student van die Universiteit van Pretoria waar sy die graad BA met hoofvakke Afrikaans-Nederlands en Duits voltooi het. Sy het ook 'n Hoër Onderwysdiploma aan Unisa verwerf. Sy volg Marietta Theron op wat vroeër vanjaar by die Waternavorsingskommissie bedank het om verder in fotografie aan die Technikon in Pretoria te studeer.

OBITUARY

A well-known figure in the field of water research, Dr Julian Hemens of the National Institute for Water Research in Durban passed away suddenly at the end of last year after suffering a stroke. Dr Hemens was born in 1926 in England. He emigrated to South Africa in 1958 and spent five years at the NIWR's Bellville regional laboratory doing research on biological treatment of wine distillery wastes. While there he attended the University of Cape Town for an honours degree which he obtained First Class. This was followed by a PhD thesis on Studies on the Biological Extraction of Plant Macronutrients from Sewage Effluents. In Natal he headed a group of chemists and biologists who conducted surveys on a number of the major estuaries of Natal from Kosi Bay to the Umtamvuna on the Transkei border. Later his work included surveys of natural lakes in the wilderness areas of northern Natal. These surveys constituted the first comprehensive investigations on these systems before any development started.



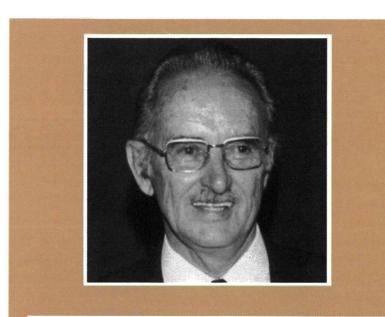


AWARDED

The University of the Witwatersrand recently conferred the honorary degree of Doctor of Science in Engineering on one of South Africa's leading figures in hydrology and water resources. Professor Desmond Midgley. Prof Midgley was a member of the Water Research Commission from 1971 to 1980. He was also the director of the Wits Hydrological Research Unit for 25 years. Prof Midgley's research into floods and droughts has formed the basis for South Africa's present planning in the field of Water resources.



SA Waterbulletin het onlangs 'n foto van professor TJ Britz van die departement mikrobiologie, UOVS ontvang van die buitelandse besoekers wat verlede jaar die suksesvolle Anaërobe Simposium vir Bloemfontein bygewoon het. Op die foto verskyn van links: mnr Dick Joubert, departement mikrobiologie, UOVS; prof Trevor Britz, departement mikrobiologie, UOVS; dr C Prévot, Sociétieé Degrémont, Frankryk; dr Eric Senior, Universiteit van Strathclyde, Skotland; prof Dick Speece, Drexel Universiteit Philadelphia, VSA; mnr Bill Ross, NIWN, Bellville.





WATERNOOD NA SNEEU

Terwyl Suid-Afrikaners oor 'n gebrek aan water kla weens te min reën, kla die Britte deesdae oor te min water weens die hewige sneeustorms in die land. Die Engelse tydskrif Water Bulletin berig dat gebarste pype 'n ernstige watertekort in groot dele van England veroorsaak het.

Baie water is vermors en reser-

voirs het so leeggeloop dat in plekke soos Cornwall van tenk-waens gebruik gemaak moes word om water aan die inwoners te voorsien. 'n Woordvoerder van 'South West Water' het 'n beroep op die publiek gedoen om water spaarsamig te gebruik. Waar waterpype lek, moet die inwoners die afsluitkrane toedraai om

verdere vermorsing te voorkom.

In London is die toestand kritiek. Ongeveer negentig gebarste hoofpype word elke dag aangemeld. Waterverbruik het met 25 tot 30 persent gestyg as gevolg van die lekkasies en tenkwaens voorsien in baie gebiede water aan die inwoners.

Water Bulletin (London) 231



THE CONSERVATION OF SOUTH AFRICAN RIVERS

Edited by J H O'Keeffe

This report presents the proceedings of a three-day workshop at Midmar Dam designed to establish a consensus view of river conservation and to provide professional conservationists, managers and planners with a set of guidelines. These indicate what is known about the ecology of South African rivers, what options are available for monitoring and managing them, what legislation is available for controlling the exploitation of rivers and what research priorities should be implemented to increase our understanding of river ecology.

1986 117 pages Price Free of charge

South African National Scientific Programme Report No. 131

Available from the Foundation for Research Development, CSIR, P O Box 395, Pretoria 0001. Contact person Louise Botten, telephone (012) 869211 x 3634.

MEASUREMENTS AND CONTROL IN WATER DESALINATION

Edited by N Lior, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, Philadelphia, PA, USA.

This book describes both fundamental and applied aspects of measurements and control in all of the water desalination processes. In Part 1 (Fundamentals), the researcher, developer, and



scientist will find information on the basic aspects of measurement and control in membranes and in evaporating flows, and experimental methods for the determination of the properties of saline water. This part opens with a chapter on the technical and economic implications of measurement and control errors in water desalination, and thus provides a foundation for the quantitative determination of cost-effective error limits and the resulting choice of instrumentation and control equipment and methods.

In Part 2 (Applications), designers, builders, and operators of desalination plants will find the essential information about measurements and control in all common types of distillation, reverse osmosis, electrodialysis, in exchange, and freeze desalination plants, as well as about measurement and control related to corrosion, and scale, and feed and product water composition.

1986 464 pages

Price \$112,00 ISBN 0 444 4261 X

Available from Elsevier Science Publishers, P O Box 211, 1000 AE Amsterdam, the Netherlands.

CLIMATIC CHANGE AND VARIABILITY IN SOUTHERN AFRICA

By P D Tyson, University of the Witwatersrand, Johannesburg

Although a great deal is known about the extent and the atmospheric modulation of climatic change over long periods and the variability climates over shorter periods of time in the northern hemisphere, less is known of southern hemisphere conditions, particularly in subtropical regions where the occurrence of droughts is endemic. Subtropical atmosperic circulations provide the coupling between the circulation of tropical and temperate latitudes and control the climatic variability of vast semi-arid areas of the earth

affected by the semi-permanent high pressure cells of the general atmospheric circulation. The extent to which Southern Africa's predominantely subtropical climate has responded differentially to both tropical and temperate variations in atmospheric circulation during the present century and in earlier times provides the focus of CLIMATIC CHANGE AND VARIABILITY IN SOUTHERN AFRICA.

Climatic change over a period of three thousand million years is examined, with greatest emphasis being placed on variations in rainfall over the period of the meteorological record. The circulation of the atmosphere in the southern hemisphere in particular is considered. Various statistical, climatological and meteorological approaches are used to identify the manner in which wet and dry spells enduring from day to decades are modulated by different components of the atmospheric circulation. These components are shown to range from the general, e.g. the Walker Circulation and the Juthern Oscillation, to regional, e.g. the occar e of coupled 1-temperate cloud-band trou ce zones. A circuodel is proposed to ain present-day extended wet and dry spells and

1986 220 pages Price R40,00 & GST ISBN 0 19 570430 4

subcontinent.

is shown to have palaeo-

climatic implications for the

Available from Oxford University Press, Harrington House, Barrack Street, Cape Town. 8001. Tel (021) 457 266.

SA Waterbulletin April 1987

TURN POLLUTION INTO PROFIT

Technology forum on effluent treatment and chemical recovery by electrically driven membrane processes

This technology forum is organized by the National Institute for Water Research (NIWR) of the Council for Scientific and Industrial Research (CSIR) in conjunction with the Department of Chemical Engineering of the University of the Witwatersrand. Secretarial services will be provided by the Liaison Group of the NIWR.

WHERE AND WHEN

CSIR Conference Centre, situated on the eastern outskirts of Pretoria, on Monday, 29 June 1987.

WHO SHOULD ATTEND

Chemical engineers, scientists, entrepreneurs and students of modern wastewater treatment technology.

ACCOMMODATION

BOULEVARD HOTEL – Single room with bath, bed and breakfast : R48,50 per night

Telephone: (012) 26-4806
Delegates requiring hotel
accommodation are requested to mention this technology forum when making
their reservations

TRANSPORT

Free transport will be provided between the appointed hotel and the Conference Centre

SA Waterbulletin April 1987

PROGRAMME

	SESSION 1: Principles of Electrically Driven Membrane Processes CHAIRMAN: DR. C.F. SCHUTTE, WATER RESEARCH COMMISSION
08h30 - 08h40 :	Welcome: Dr. D.F. Toerien, Chief Director, NIWR
08h40 - 09h10	General description of membrane processes: Dr. B. Verbaan, University of the Witwatersrand
09h10 - 09h30	: Physical chemistry of ion-ex- change membranes : Mr. W.G.B. Mandersloot, CSIR
09h30 - 10h00 :	Ion-exchange membranes – preparation and characterization Dr. B. Green, Mintek, Mr. J.J. Schoeman, NIWR
10h00 - 10h30 :	Mathematical modelling of membrane processes: Prof. A.W. Bryson, University of the Witwatersrand
10h30 - 11h00 :	TEA SESSION 2: Applications of Electrically Driven Membrane processes CHAIRMAN: DR. G.L. DALTON, CONSULTANT
11h00 - 11h20 :	Concentration of effluents with electrodialysis and other membrane processes: Mr J.J. Schoeman, NIWR
11h20 - 11h40 :	Electrodialytic generation of chemicals: Dr. B. Verbaan, University of the Witwatersrand
11h40 - 12h00 :	Recovery of caustic soda from caustic effluents: Mrs. A.E. Simpson, University of Natal
12h00 - 12h30 :	Electrodialysis in South Africa : Mr. R. Jones, Process Plant
12h30 - 14h00 :	LUNCH
	SESSION 3: Legislation, Industrial Requirements and Needs CHAIRMAN: Dr. B.M. VAN VLIET, NIWR
14h00 - 14h15 :	Water pollution legislation – views on brine disosal and desalination: Department of Water Affairs
14h15 - 15h15 :	Potential for effluent treatment and chemical recovery in the South African industry: Contributors from industry will be invited
15h15 - 15h45 :	TEA
15h45 - 16h45 :	Panel discussion – Identification

of needs and requirements of in-

COCKTAIL PARTY

dustry

5 minutes for discussion in each case

Times indicated above for presentation of papers include

16h45 - 18h15 :

Avis Rent-a-Car will allow a 10% discount on reservations made by delegates attending the technology forum.

Delegates should make their own arrangements with :

Miss Charmaine O'Connell

Avis Rent-a-Car P.O. Box 1743 JOHANNESBURG. 2000

Telephone: (011) 28-2555

SOCIAL FUNCTION

Delegates are invited to attend a Cocktail Party at the Conference Centre at the conclusion of the technical programme

FEES

Registration fee for delegates R120
Registration fee for bona fide students R 60

EXHIBITION

Products and equipment relating to the theme of the technology forum will be exhibited.

REGISTRATION

Delegates who register before 31 May 1987 will receive summaries of papers through the post. Other delgates will receive summaries at registration

ENQUIRIES AND INFORMATION

Please address all enquiries and requests for further information to:

> National Institute for Water Research P.O. Box 395 PRETORIA 0001

Telephone: (012) 86-9211 ext. 2231 (Mrs. R. Oellermann/ Mr. P. Coombs)

Telex: 3-21312 SA



WASTE MANAGEMENT

A conference entitled Waste management conference, Focus on the West, will be held at Colorado State University from 1 – 3 June 1987.

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

WATER QUALITY

A short course will be given at Colorado State University on the design of water quality monitoring networks, from 8 – 12 June 1987.

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

WATER QUALITY

The first IAWPRC international symposium and exhibition on systems analysis in water quality management will be held in London, UK, from 30 June to 2 July 1987.

Enquiries: Dr M B Beck, Watermatex 87, IAWPRC, 1 Queen Anne's Gate, London, SW1H9BT, England.

FRESHWATER ECOSYSTEMS

An international conference on the biomanipulation of natural and artificial freshwater ecosystems will be held at Lake Kinneret, Tiberias, Israel, from 2 to 7 August 1987.

Enquiries: The Organising Committee, International Conference on Freshwater Ecosystems, PO Box 3190, Tel Aviv.

IUGG 1987

The 19th general assembly of the International union of Geodesy and Geophysics will be held at the University of British Columbia, Vancouver, Canada, on 9 to 22 August 1987.

Enquiries: Conference Secretariat, c/o Venue West, 801-750 Jervis St., Vancouver, B.C. Canada V6E2A9.

WATER REUSE

The fourth international symposium on water reuse will be held in Denver, Colorado from 2 - 7 August 1987.

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

HYDROLOGICAL SCIENCES

A symposium combining the Biennial Symposium on the Ground Water Division of the Geological Society of Southern Africa and the third National Hydrological Symposium of the South African National Committee for the International Association of Hydrological Science (SANCIAHS) will be held on 6 to 9 September 1987 at Rhodes University in Grahamstown.

Second circulars and registration forms are available from the Organising Committee, Hydrological Sciences Symposium, Department of Geography, Rhodes University, PO Box 94, Grahamstown, 6140.

DESALINATION

The 3rd world congress on desalination and water reuse organised by the International Desalination Association (IDA) will be held in Cannes, France, from 14 to 17 September 1987.

Enquiries: Mrs Lucie Cohen, Societe de Chimie Industriella 28 rue Sanint-Dominique, 75 007, Paris, France.

OZONE

The 8th ozone world congress will be held from 15 to 18 September 1987 in Zurich, Switzerland, Papers and posters invited

Enquiries: International Ozone Association, Swiss Committee, c/o Wasserversorgung Zürich, Hardhof 9, Postfach, CH – 8023 Zürich. Telephone: 01/435-2111, Telex: 822060.

PROTECTION OF PIPES

The 7th international conference on the internal and external protection of pipes will be held in London, England from 21 to 23 September 1987. Papers invited.

Enquiries: Lorraine Grove, Conference Organiser, 7th Pipe Protection, BHRA, the Fluid Engineering Centre Cranfield, Bedford, MK43 OAJ, England.

AGROHYDROLOGY

An international Symposium on recent developments in agrohydrology will be held in Wageningen, the Netherlands from 29 September to 1 October 1987.

The topics, introduced by keynote speakers, will be:

- Effects of drainage on crops and farm management
- Water conservation and water harvesting
- Hydrology of nature reserves
- Reuse and disposal of drainage water from irrigated areas.

Enquiries: IAC Bureau OCC, P O Box 88, 6700 AB Wageningen, The Netherlands.

PHOSPHATE REMOVAL

An international specialised conference on biological phosphate removal from wastewaters will be held in Rome, Italy, from 5 to 7 October 1987.

Enquiries: Dr R Ramadori, IAWPRC International Specialised Conference, IRSA-CNR, Via Reno 1, 00198 Rome, Italy.

OFF-FLAVOURS

The second international symposium on off-flavours in the aquatic environment will be held in Kagoshima, Japan, from 12 to 16 October 1987. Papers are invited.

Enquiries: Professor T Motohiro, Faculty of Fisheries, Kogishima University, 4-50-20, Shimoarata, Kagoshima 890, Japan.

GROUNDWATER

The United Nations international symposium and workshop on groundwater economics will be held in Barcelona, Spain, from 19 to 23 October 1987.

Enquiries: Curso international de hidrologia subterranea, Beethoven, 15 – 3°. 08021 Barcelona, Spain.

SA Waterbulletin April 1987

Ten-day short course on the Planning and operation of water resource development projects University of Pretoria : 6th – 16th July, 1987

The course will be presented by the Department of Civil Engineering of the University in conjunction with the Department of Water Affairs, and will be under the auspices of the Hydraulics Division of the South African Institution of Civil Engineers.

Course leader Professor WJR Alexander.

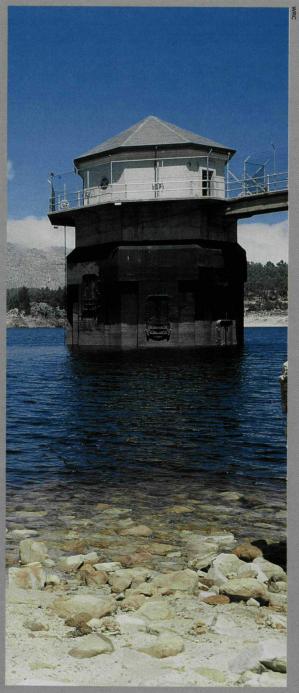
BACKGROUND

The water resources of Southern Africa are approaching the limits of maximum economic utilization in many regions and the quality of the water supplies is deteriorating. The risks of not being able to meet the full demand are increasing, and the periods during which restrictions on the use of water have to be imposed are increasing in frequency, length and severity.

Most of the large water resource development projects have multiple sources serving multiple user groups each with its own tolerance limits to shortages in supply and poor quality water. Negotiations regarding water rights and the transfer of water across regional and international boundaries is becoming increasingly important. Many of the factors that have to be taken into account such as environmental concerns and the effect of poor quality water on human health and crop production are difficult to quantify, while in other cases the achievement of one objective can only be at the expense of another (eg flood protection vs hydro power).

The advent of inexpensive microcomputers has provided users with a powerful tool for rapidly and accurately exploring and quantifying a wide range of alternative solutions to a particular problem.

The course will cover all major aspects of water resource development and management. The morning sessions will begin with



authoritative overviews by invited speakers, followed by lectures on the theory and application of the various methods. A suite of computer programs will be provided, and during the afternoon sessions participants will have the opportunity of using the programs to solve typical water resource planning and operation problems.

PRACTICALS

All practicals will be carried out on Olivetti M24 microcomputers running GW-Basic under MS-DOS. Each participant will have a microcomputer for his/her exclusive use during the course. Discs with the programs will be provided. No prior knowledge on the use of microcomputers is required.

FURTHER DETAILS

The cost of the course is R950 per person. This includes a set of the course notes, a suite of computer programs on a floppy disc, lunches and morning teas. It does not include accommodation or transport. The number of participants will be limited by the number of available microcomputers. Acceptance will be on a first come first served basis so early registration is advised. For a copy of the course programme and any further details please contact:

Mrs Nellie le Roux Department of Civil Engineering University of Pretoria PRETORIA 0002 Tel (012) 420-2978

