SA waterbulletin

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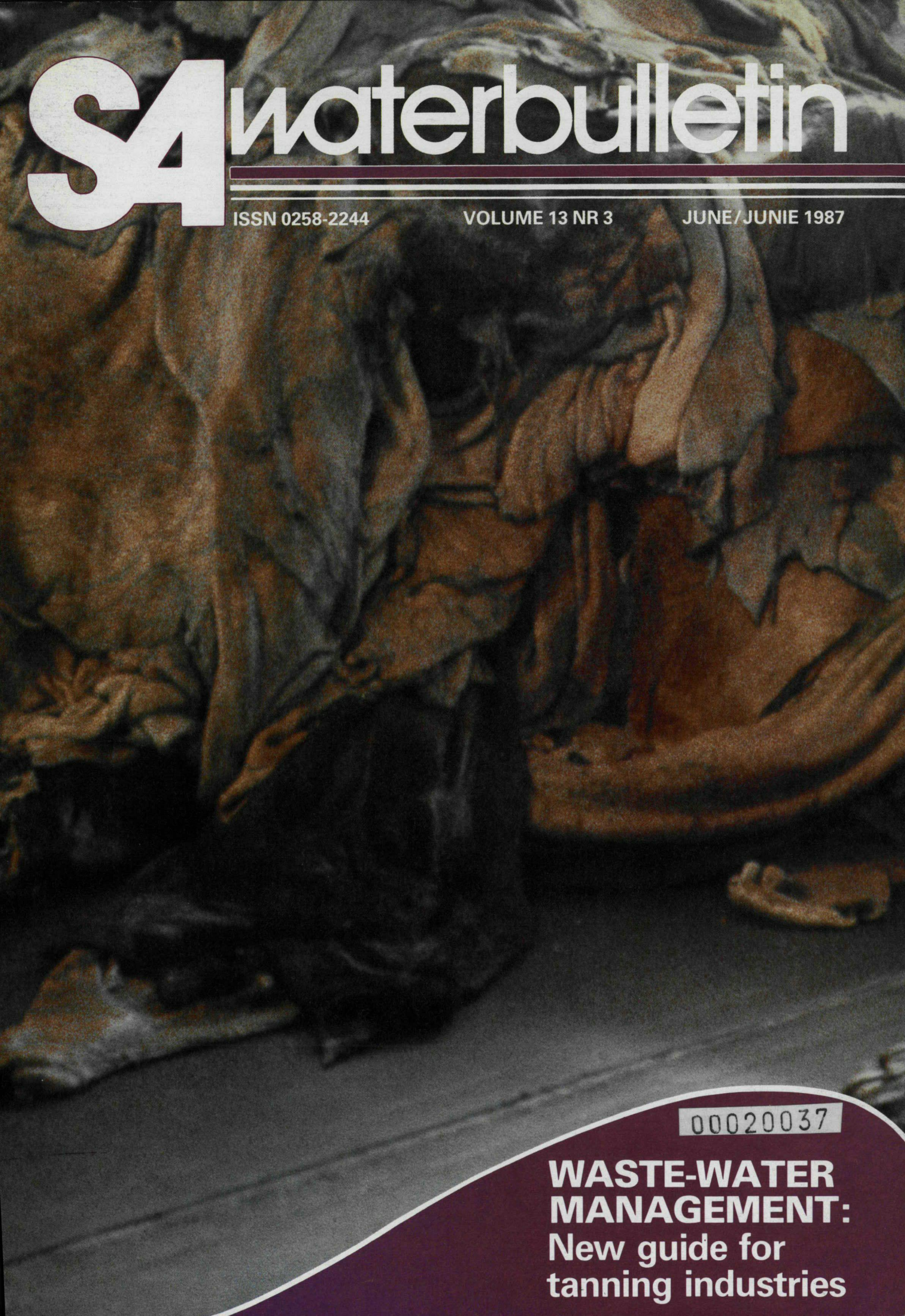

WASTE-WATER MANAGEMENT: New guide for tanning industries

'n Simposium aangebied deur die Afdeling Wis- en Natuurkunde van DIE SUID-AFRIKAANSE AKADEMIE VIR WETENSKAP EN KUNS

water vir oorlewing

Doelstelling

Dit is die doel van hierdie simposium om 'n wye spektrum van aktiwiteite op die gebied van watervoorsiening en -beplanning vir die toekoms aan te sny, ten einde belangstellende wetenskaplikes en professionele persone, asook die wyer publiek in te lig oor dit wat alles gedoen word om volgehoue watervoorsiening in die toekoms te verseker. Die gedagte met die simposium is om die vakspesialis se aktiwiteite en die omvangryke projekte wat tans by verskillende instansies nagevors en beplan word deur middel van hierdie simposium wyer bekend te stel.

Wie teenwoordig moet wees

Almal wie se oorlewing afhanklik is van 'n volgehoue voorsiening van voldoende water.

Openingsrede

Sy Edele mnr G J Kotzé, Minister van Omgewingsake en van Waterwese.

Gassprekers

Die volgende toonaangewende navorsers en beplanners sal praat oor die gegewe onderwerpe.

Mnr P E Odendaal (Uitvoerende Direkteur: Waternavorsingskommissie) **Optimale waterbenutting as navorsingsdoelwit in die RSA.**

Prof D C Midgley (Consulting Engineer and ex-Director of the Hydrological Research Unit, University of the Witwatersrand) **Inter-state water schemes of the future.**

Dr D F Toerien (Hoofdirekteur: Nasionale Instituut vir Waternavorsing, WNNR) **Watertegnologie: 'n Sleutel vir die toekoms.**

Mnr H J Best (Hoofdirekteur: Watergehalte, Departement Waterwese) **Regsmeganisme en owerheidsbeleid in die beheer en voorkoming van waterbesoedeling.**

Dr P J T Roberts (Senior Scientific Adviser: Water Research Commission) **Research on the feasibility of rainfall stimulation as an unconventional source of water for South Africa.**

Mnr J R Vegter (Direkteur: Geohidrologie, Departement Waterwese) **Dolomitiese waterdraers in grootmaat waterberging en -voorsiening.**

Mnr J van Rooyen, (Adjunkhoofingenieur: Beplanning, Departement van Waterwese) **en Dr M S Basson** (Raadgewende Ingenieur: Bruinette, Kruger & Stoffberg) **Die Vaalrivierstelselontleding: Jongste tegnologiese ontwikkeling ten opsigte van waterbronbeplanning.**

Prof P van Rensburg (Departement Geografie, Randse Afrikaanse Universiteit) **Langtermyn reënvaltendense oor Suider-Afrika.**

Datum en tyd

21 Augustus 1987 om 9h00

Vergaderplek

Suid-Afrikaanse Akademie vir Wetenskap en Kuns, Hamiltonstraat, h/v Ziervogelstraat, Pretoria.

Koste

Die registrasiefooi van R20,00 per persoon sluit in 'n stel uitgebreide samevattings van die referate, oggend- en middagtee, middagete en 'n skemeronthaal, wat gedeeltelik deur Bruinette, Kruger en Stoffberg, Raadgewende Ingenieurs, geborg word.

Registrasie

Indien u graag die simposium wil bywoon, voltooi asseblief die Registrasiekaart in hierdie Bulletin (of 'n fotokopie daarvan) en stuur dit tesame met die Registrasiefooi van R20,00 aan mev A R Swart, Suid-Afrikaanse Akademie vir Wetenskap en Kuns, Posbus 538, Pretoria 0001, sodat dit haar **op of voor** 7 Augustus 1987 bereik.

Navrae

Verdere navrae kan gerig word aan:

Mev A R Swart
Suid-Afrikaanse Akademie vir Wetenskap en Kuns
Posbus 538
PRETORIA 0001
Tel: (012) 28-5082

of

Prof G von Gruenewald
Departement Geologie
Universiteit van Pretoria
Tel: (012) 420-2454.

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SA waterbulletin

Animal hides at a tannery. See article on page 8.

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.

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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 erkenning van die bron.

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51ste Vergadering van die Waternavorsingskommissie

Die Waternavorsingskommissie het op 4 en 5 Mei hulle eerste vergadering van die jaar in Stellenbosch gehou. Die Kommissie het ook die geleentheid gebruik om verskillende WNK-ondersteunde projekte aan die Universiteit van Stellenbosch en by ander instansies te besoek.

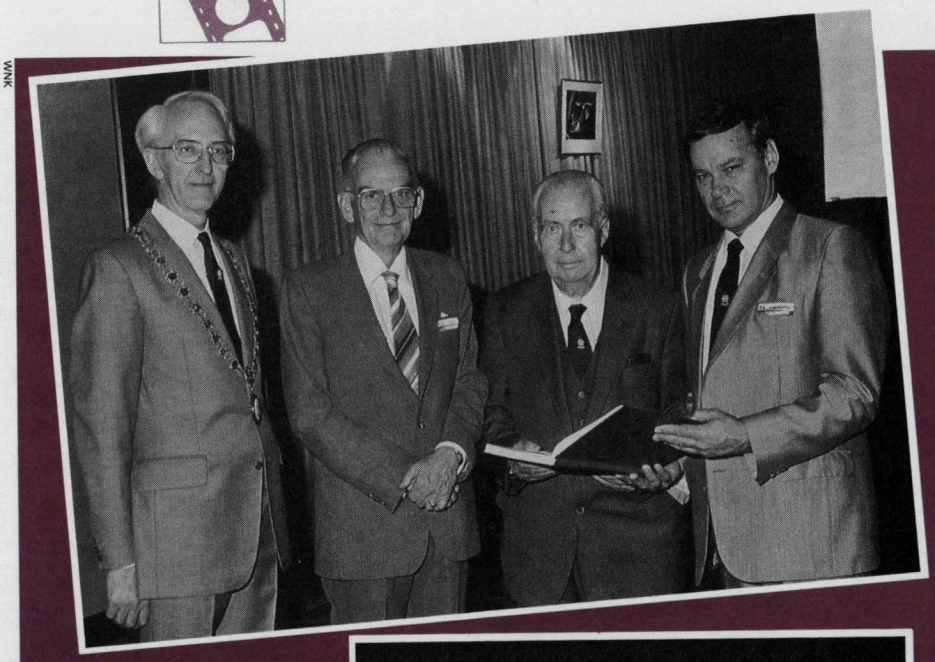
1 Die Nasionale Navorsingsinstituut vir Oseanologie van die WNNR bied 'n uitstalling aan ter illustrasie van die navorsing oor die wegdoening van afvalwater in die see.

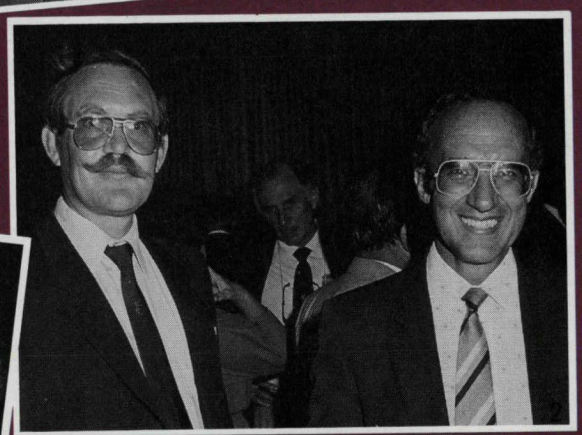
2 Besoek is ook afgelê by die Bintech-aanleg waar tru-osmosemembrane vervaardig word.

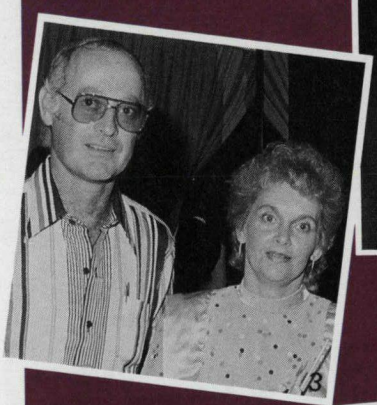
3 Kommissielede en personeel van die WNK geniet middagete as gaste van prof J W R de Villiers, waarnemende rektor van die Universiteit van Stellenbosch.

4 Prof Ron Sanderson van die Instituut vir Polimeerwetenskap aan die Universiteit van Stellenbosch verduidelik 'n deel van die navorsingsprogram oor die ontwikkeling van polimere.

The Institute of Water Pollution Control (Southern African Branch) celebrated its 50th year in May at the Elizabeth Hotel in Port Elizabeth where the Institute's biennial conference was held. The conference was attended by more than 360 delegates from all over Southern Africa and was officially opened by the Institute President from the United Kingdom Mr R Hattersley. The Port Elizabeth conference marked the end of an era for the Southern African branch because of the merge of the IWPC on 3 July 1987 with the Institute of Public Health Engineers (IPHE) and the Institution of Water Engineers and Scientists (IWES) into the new Institution of Water and Environmental Management (IWEM). The objectives of IWEM are far broader than those of the IWPC in that they embrace environmental management including environmental conservation in relation to water, building, services, solid waste disposal and land reclamation. The members of the Southern African branch now have the difficult task of deciding whether to reform as a Southern African branch of IWEM or to form an independent local Institute tentatively named the Water Institute of Southern Africa (WISA).







1 From left: Mr R Hattersley, IWPC's Institute President (UK), Mr D W Osborne, Chairman IWPC, Dr K A Murray author of the book Wastewater Treatment and Pollution Control and Mr P E Odendaal, Executive Director Water Research Commission. Mr Odendaal, presented a special copy of Dr Murray's book, published by the Water Research Commission, to the author.

2 Mr J C van Garderen (left) and Mr G H du Plessis, both from Sastech Water Research.

3 Mr and Mrs K Stander, Department of Water Affairs.

4 From left: Dr R E Loewenthal, UCT, Mr P Little, Ninham Shand, East London, Mr and Mrs J Abbott, Wits Civil Engineering.

SA participates in German Fair

The South African water industry in collaboration with the RSA Department of Trade and Industries recently participated in the Hannover Industrial Fair in West Germany. This annual Fair is one of the largest industrial exhibitions in the world. The Fair comprises 28 exhibition halls and covers a variety of subjects. Hall 7 at the Fair in which the SA exhibition was located deserves special mention, as it houses Hannover's Innovation Market for research and technology. This unique Market attracts more than 400 000 visitors every year.

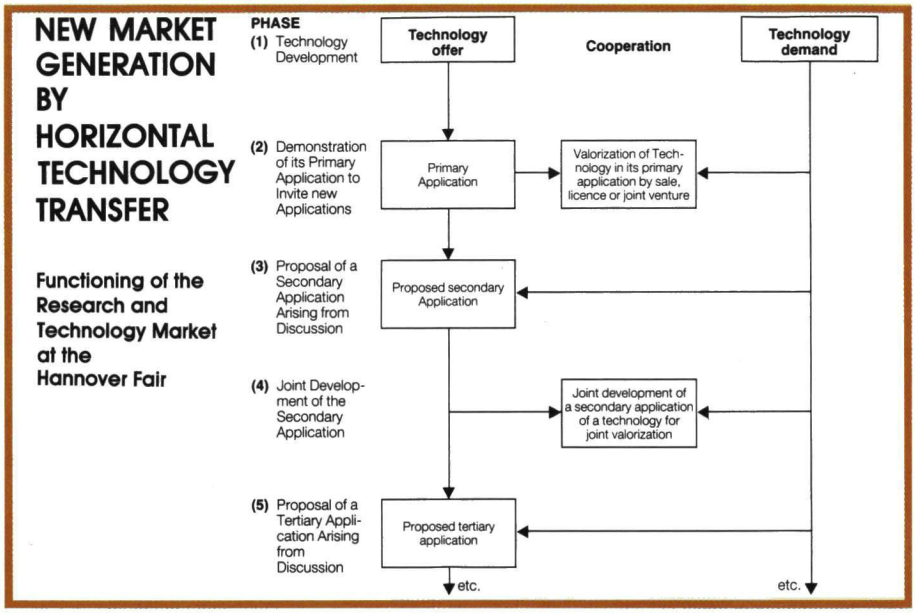
The idea behind the Innovation Market is to establish dialogue between the scientist and the industrialist. Technology is not transferred on paper – the scientist is presented with the opportunity of exhibiting the technology to the industrialist, i.e. he "markets" the result of his basic research and its technical development. Unless this technology is "marketed" the researcher might never know the full potential for industrial applications. The industrialist on the other hand is always looking for new ways to improve his old products or to create new services, processes or products. Dialogue between the exhibitor and the visitor serves to bridge the gap for future cooperation.

The German chemical group Bayer has been a pioneer in benefitting from this potential. Another chemical group

has tested the application spectrum of capillary membranes with great success. They established that dialogue with visitors at the Market has led to at least 600 recorded application proposals every year, from industrialists with established market access.

The South African exhibition attracted much attention. One of the highlights was Bintech's demonstration of reverse osmosis technology as well as cross-flow micro filtration. Water reclamation technology which was developed in Windhoek and Port Elizabeth also aroused much interest, as did the dynamic membrane technology from Stellenbosch and the fluid membrane technology from Potchefstroom.

Other South African exhibitors were Mono Pumps, Explochem, Diomed and Atlas Filters.



Visiting the South African exhibition at the Hannover Fair in West Germany were from left: Mr W R Retief, South African Ambassador to Bonn, Prof J O G Kirchner, Institute for Groundwater Studies, UOFS and Dr P J T Roberts, Senior Adviser, WRC.

SABS

waste-water management maximised

The Water Research Commission has reviewed and approved the following report for publication: A guide to waste-water management in the tanning and fellmongering industries

This effluent management guide for the tanning and fellmongering industries of South Africa has been prepared jointly by the Consultants (Binnie & Partners) and the Leather Industries Research Institute (LIRI) on behalf of the Water Research Commission (WRC). The guide summarises the findings of effluent surveys and treatment trials carried out at various local tanneries and fellmongeries over the period 1977 to 1984, and develops these findings into effluent treatment design criteria that may be followed in practice. For some selected options, examples of full-scale design are given.

The effluent characterisation studies and surveys carried out showed that the overall effluent volumes generated by the industry are approximately equal to the water consumption which ranges from 3 to 15 cubic metres per ton of raw material handled. The effluents arise as discrete fractions with widely differing polllutant characteristics at the various processing stages. If these effluent fractions are combined, the resultant final effluents are generally alkaline, and contain high levels of organic pollutants, suspended solids, dissolved solids, sulphides and, in some cases, chromium.

Due to their high pollutant levels, discharge of these effluents to public watercourses is not practicable because of the very high degree and cost of on-site pretreatment that would be required. Viable disposal routes, which in each case still require a degree of on-site pretreatment, are to land (for example by irrigation, evaporative ponding or lagooning) or to sewer (if the effluent acceptance standards of the local authority can be met, or are relaxed by arrangement).

In existing practice, the degree of on-site pretreatment carried out ranges from a minimal level (for example partial removal of gross suspended solids before discharge to evaporation ponds or sludge lagoons) to multi-stage pretreatment (including mechanical aeration, chemical dosing and air flotation before discharge to municipal sewer or spray irrigation). Air flotation (AF) may be either dissolved air flotation (DAF) or induced air flotation (IAF).

Because of the widely differing and mutually interactive nature of some of the effluent fractions, and the fact that most of the total pollutant load in terms of particular parameters (for example suspended solids) is concentrated in a few of these effluent fractions, it was concluded in some cases that the most cost-effective pre-treatment system was to apply suitable conventional low-cost treatment to the heavily polluted effluent fractions only. This reduced the pollutant strength of these streams to approximately the same level as the balance of the (less polluted) effluent. A qualitatively better level of effluent quality could then only be obtained by applying more sophisticated and expensive effluent treatment technology.

The conventional, relatively low-cost effluent treatment unit processes studied included physico-chemical options such as gravity settling, aeration, chemical dosing and air flotation (AF), biological processes such as activated sludge (AS) and high-rate biofiltration (HRFB), and combinations of these unit operations in series. Sludge treatment options investigated in pilot plant trials included gravity thickening, chemical conditioning, heat conditioning, and dewatering by decanting centrifuge or on sludge drying beds.

An overall conclusion derived was that irrespective of the type of tannery or fellmongery and of the eventual degree of on-site pretreatment required, the performance of the overall effluent treatment scheme was enhanced by simple first-stage processes such as grease removal and primary settling. A secondary conclusion in this regard was that this was in some cases most effective if effluent segregation was maintained to this stage, and selected effluent fractions only (containing in some cases for example 95 per cent of the suspended solids load in 40 per cent of the total effluent volume) were given such first-stage treatment.

Second-stage treatment investigated

for combined fellmongery effluent consisted of mechanical aeration followed by AS treatment at various operating conditions. At suitable loading rates, purification efficiencies of better than 80 secondary (post AS) gravity clarifier stage was indicated to be necessary to ensure that suspended solids concentrations in the final treate effluent remained consistently below typical municipal limits for discharge to sewer.

Pilot-scale studies on the treatment of tannery effluents were conducted at chrome, mixed (chrome and vegetable tanning) and wet-blue tanneries. Second-stage effluent treatment processes studied covered biological treatment (AS; HRBF), physico-chemical treatment (chemical dosing; secondary gravity settling; AF; vibratory screening), and, in some cases, combinations of these processes. Various treatment routes for combined and segregated effluents from chrome and wet-blue tanneries were investigated and compared. The principal conclusions were as follows:

- ☐ Strong effluents or effluent fractions from chrome tanneries (for example limeyard effluents or wet-blue effluents) require pretreatment (such as settling and aeration) and primary treatment (such as chemical dosing and DAF) before consistent, effective purification efficiency can be obtained in biological treatment processes (AS or HRBF).
- ☐ Weaker combined effluent from chrome tanneries can be successfully treated in biological processes (such as AS or HRBF) after simple pretreatment such as settling and aeration. Approximately two-thirds of the organic matter could be removed in this way, but higher removals of organic matter and dissolved solids could be attained if a primary treatment stage (such as chemical dosing and AF) was also incorporated.
- ☐ Similar results were obtained when treating wet-blue effluent (simulated at a chrome tannery) by a combination of settling, aeration, chemical dosing and DAF, followed by biological treatment (activated sludge or HRBF). The final treated effluent strength was somewhat higher than when treating combined chrome tannery effluent, and overall percentage reductions in organics and dissolved solids were somewhat lower.
- ☐ Physico-chemical treatment of wet-blue effluent from a wet-blue tannery by settling, aeration, chemical dosing and DAF showed that high removal efficiencies (and correspondingly low final treated effluent strength) could best be obtained by selective pretreatment of the strong, chemically interactive de-hairing and pickling effluents.
- ☐ Where chrome liquor recycling is practised in tanneries or fellmongeries, this should be counterbalanced by lime liquor recycling and/or recovery in order to minimise the acid dosing requirements in AF systems.
- ☐ When treating total mixed tannery or fellmongery effluents by AF, if effective clarification of the suspended solids load can be achieved by IAF this is preferable to DAF, since the foaming experienced when recycling treated effluent becomes an asset in the former (IAF) system rather than an operational difficulty as experienced in DAF systems.
- ☐ Effective handling and disposal of the various sludges from tanneries was best accomplished by collecting such sludges in suitable designed settling tanks and dewatering thereafter on drying beds, rather than by using mechanical methods (screens, centrifuges, etc).

Overall, it is concluded that conventional physico-chemical and biological treatment processes, when applied at suitable loading rates in the correct sequences, can substantially reduce the nett pollutant load discharged from tanneries and fellmongeries. In several cases, the treated effluent quality was good enough to permit internal recycling of selected streams to selected processes, thereby reducing water and chemical usage and also the magnitude of the resultant effluent problem. However, the use of these combined physico-chemical and biological effluent treatment technologies does not purify tannery or fellmongery effluent sufficiently for direct discharge to public watercourses.

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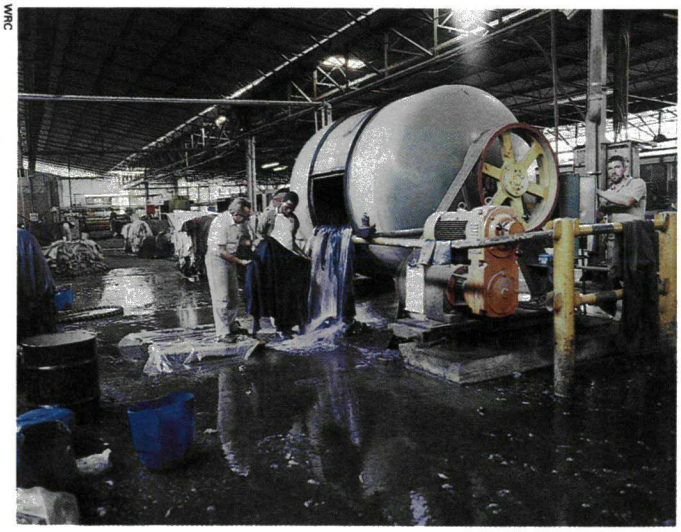

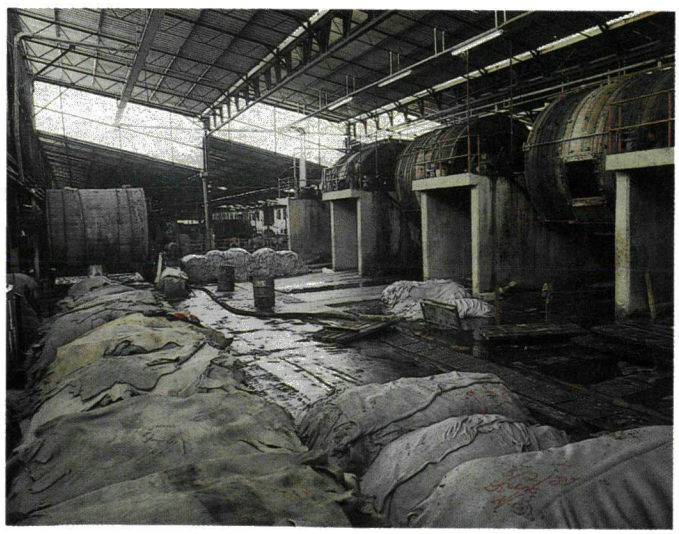

This report can be obtained free of charge from: The Water Research Commission, P O Box 824, Pretoria, 0001.

effects of reclaimed water

report report

This report, written by M Isaäcson, A R Sayed and W Hattingh, records the results of the studies undertaken by the South African Institute for Medical Research during the decade 1974 to 1983 inclusive. The report first deals with the microbiological surveillance of the reclaimed water and the conclusion is drawn, on the basis of more than 4 000 samples tested, that reclaimed water conformed to generally accepted quality standards laid down for domestic water supplies. From a virological point of view, the source of reclaimed water, i.e. human waste water, was shown to be consistently contaminated with potentially pathogenic viruses, in contrast to the untreated conventional surface water sources. The water was regularly tested at different stages in the reclamation process. Viruses became progressively fewer in number and have been consistently absent from the final stages in the process.

On the basis of the microbiological studies the conclusion is drawn that the reclaimed water is fit for human consumption.

Epidemiological studies were expanded in 1976 and embraced both potential short-term (mainly infectious) and long-term (mainly non-infectious chronic) effects.

The short-term effects considered were the potentially waterborne infectious diseases with particular reference to diarrhoeal diseases and viral hepatitis. Long-term effects included conditions such as cardiovascular disease and malignant neoplasms. Cardiovascular disease has elsewhere been related to water quality, especially 'hardness' of water, while malignant neoplasms have been attributed to the presence of certain carcinogenic chemical substances. This study was carried out primarily by a method which employed the in-depth documentation of all episodes of the disease concerned in the case of diarrhoeal disease and hepatitis. The mortality studies employed death certificates and hospital records as the main data source. All

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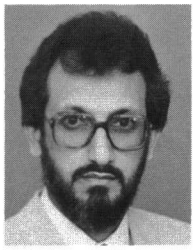
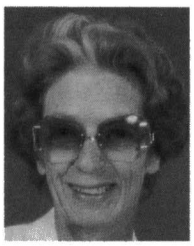

VAN KALKER

A R Sayed

M Isaäcson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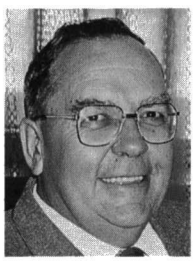

WRC

W Hattingh

data were coded and entered in a computerized database.

DIARRHOEAL DISEASES (DD)

Altogether more than 15 000 episodes of DD were investigated during a continuous period from 1 August 1976 to 31 March 1983. The commonest bacterial causes of DD were *Salmonella* and Shigella which comprised over 80 percent of all isolates i.e. about 16 percent of all cases and the paucity of laboratory isolates underlines the importance of the epidemiological studies. Virus studies yielded insufficient data. DD prevalence was entirely related to socio-economic factors and not to the nature of the water supply. In two socio-economically similar groups of Windhoek residents, those receiving reclaimed water had a consistently equal or lower DD incidence than those receiving water from conventional sources only.

Hepatitis B, which is not a waterborne infection, was nevertheless studied. This was found to be far more common than is generally appreciated. Almost half of all jaundiced black and coloured patients had evidence of prior infection with HBV whilst the corresponding rate in whites was 19,8 percent. The bias introduced by studying only jaundiced people was appreciated and the HBV prevalence in the general population may be considerably lower.

VIRAL HEPATITIS

Almost 1 000 jaundiced patients were investigated during this study. Of these, 282 were investigated utilizing the full battery of both hepatitis A (HAV) and B (HBV) markers. It was shown that 91,1 percent of blacks and 87,2 percent of coloureds, all of whom were on the conventional water reticulation system, had hepatitis A in the past, in contrast with only 52,3 of whites, some of whom received reclaimed water. When whites living in reclaimed water areas were compared with whites living in conventional water areas, a total of 17 with acute HA (IgM positive) were recognized in the former and 14 in the latter during the period of study (1980-1982). It was concluded that hepatitis A prevalance in Windhoek was unrelated to water supply but a direct consequence of general environmental conditions and personal hygiene. It was also found that in only 2,2 percent of all jaundiced black patients, the jaundice was due to hepatitis A, in contrast with 36,1 percent of jaundiced white patients. This study supports other workers who have concluded that hepatitis A was a **rare** cause of jaundice in black Africans.

MORTALITY PATTERN

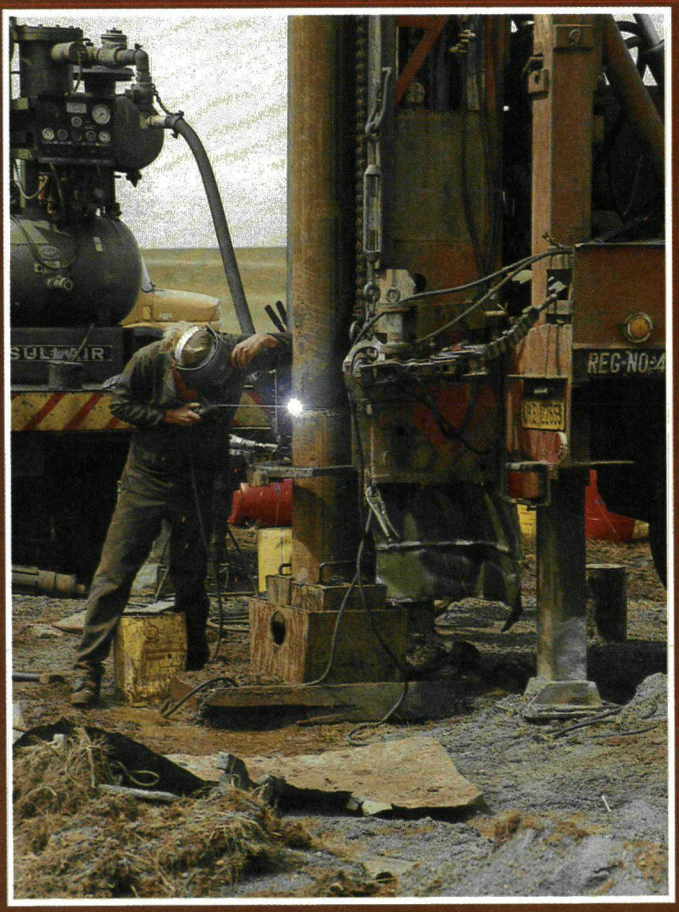
A total of 3 000 deaths which occurred in Windhoek was studied. Several thousand additional deaths of persons referred from centres outside Windhoek were excluded on the basis of bias due to selection for serious or unusual diseases and complications. The small size of the Windhoek population (75 000 to 100 000 during the study period) necessitates this study to be continued for cause-specific mortality data to become meaningful. Nevertheless at this stage it is clear that the usual differences related to socio-economic conditions, stress-factors etc., are operative also in Windhoek. More than 60 percent of all deaths in whites were due exclusively to cardiovascular disease and malignant neoplasms. The leading cause of death in blacks and coloureds was diarrhoeal disease with tuberculosis as another important cause. Cancer of the lung was the commonest of all malignancies in all population groups and was only slightly exceeded by carcinoma of the oesophagus in blacks. No attempt has been made to relate mortality to water supply and it is the researchers' opinion at this stage that it is highly unlikely that this will be possible within the foreseeable future. On the other hand, sudden unrecognized defects in water supply or in other environmental factors giving rise to chronic tissue damage may well first reveal themselves through a marked alteration in the mortality pattern. If for this reason alone, the mortality study must be continued.

In conclusion, the authors of this report are of the opinion that within the limits of the epidemiological studies done, no adverse effects on health attributable to the consumption of reclaimed water could be demonstrated. This conclusion is further supported by the study on the health effects of the indirect reuse of reclaimed water by the County Sanitation Districts of Los Angeles County in Whittier, California. They concluded that no viruses could be detected in chlorinated reclaimed water. An evaluation of health and vital statistics over a period of 12 years showed that residents of the area that received reclaimed water experienced no increase rates of infectious diseases, congenital malformations, infant and neonatal mortality, low birth weight, cancer incidence or deaths due to heart disease, stroke, cancers of the stomach, rectum, bladder or colon, or all cancers combined, when compared to residents of two control areas that did not receive reclaimed water.

A report entitled: Studies on health aspects of water reclamation during 1974 to 1983 in Windhoek, South West Africa/Namibia, was recently released by the Water Research Commission in Pretoria.

daar's water!

In Suid-Afrika word grondwater nie normaalweg grootskaals ontgin om as alternatiewe bron vir watervoorsiening te dien nie. Die rede hiervoor is die afwesigheid van uitgestrekte, primêre grondwaterdraers.



Alhoewel grondwater slegs in 15 persent van die totale waterverbruik van Suid-Afrika voorsien, is 70 persent van die oppervlakte van die RSA geheel afhanklik van grondwater. Dit sluit onder andere nagenoeg 100 dorpe in wat uitsluitlik grondwater gebruik.

Hierteenoor word in lande soos Oostenryk, Holland en Denemarke grootliks van grondwater gebruik gemaak om in hulle waterbehoeftes te voorsien. In Amerika vorm grondwater ongeveer 40 persent van die totale waterverbruik.

Die Departement van Waterwese is tans besig met die tweede fase van die grootste grondwatereksplorasieprojek wat nog ooit in Suid-Afrika onderneem is. Die doel van die "dolomitiese noodwatervoorsieningskema" is om in tye van langdurige droogte aanvullende water aan die hele PWV-gebied te verskaf deur die pypnetwerk van die Randse Waterraad.

Volgens dr M P Mulder, adjunk-direkteur van Geohidrologie by die Departement van Waterwese, is daar besluit om met die eksplorasieprojek voort te gaan nieteenstaande die goeie reën wat die afgelope seisoen op baie plekke in die land aangeteken is. Die watervlak van die damme wat water verskaf aan die PWV-gebied, is steeds laag en alternatiewe waterbronne moet ondersoek word. Die besluit of voortgegaan sal word met die werklike ontginning van die grondwater en aansluiting by die RWR-netwerk sal in Maart 1988 geneem word.

Die Departement van Waterwese is verantwoordelik vir al die aanvoorwerk wat vir dié projek gedoen moet word. Met behulp van die geologiese/geofisiese veldopnames word boorplekke bepaal. Nadat die gate geboor is, dit van voerings voorsien is en die potensiaal getoets is, word die resultate verwerk vir die beplanning van die ingenieurswerke sodat die Randse Waterraad of betrokke munisipaliteit die water kan ontgin.

'n Verseëlde boorgat in die Delmas/Bapsfonteingebied.

Daar is reeds in 1984 begin met boorwerk in die eerste fase in die volgende gebiede: Suid van Pretoria; Tarlton, wes van Krugersdorp; Zuurbekom in die verre Wesrand; Delmas/Bapsfonteingebied. Die tweede fase wat moontlik in Augustus vanjaar voltooi sal word, sluit verdere gebiede soos die Klipriviergebied suid van Johannesburg (Vereeniging/Meyerton), asook gebiede in die Verwoerdburg, Kemptonpark en Midrand munisipale gebiede in.

In drie van die gebiede wat deel uitgemaak het van die eerste fase, is boorgate tot 'n beperkte mate reeds in gebruik geneem vir noodaanvulling. Dit is in die Zuurbekomgebied waar die water deur die Randse Waterraad ontgin word; in Pretoria waar die munisipaliteit self van die gate oorgeneem en ontwikkel het in Erasmia, Valhalla en in die Rietvleigebied bokant die Rietvleidam. Verwoerdburg munisipaliteit het ook twee boorgate oorgeneem en begin gebruik.

Om die geskikste plek vir die boorwerk te bepaal, word geofisiese ondersoeke onderneem en kaarte opgestel deur die Direktoraat van Geohidrologie in samewerking met konsultante. Dié kaarte en bestaande geologiese kaarte asook topografiese gegewens en plaaslike geologie word gebruik om geskikte areas en boorplekke te kies.

Dr Mulder het verwys na die knelpunte wat op regsgebied ten opsigte van grondwaterbesit bestaan. Onder die huidige wetgewing word alle grondwater as privaatbesit beskou. Dit behoort aan die eienaar van die grond en dit is dus nie vir die staat moontlik om dit na goeddunke te ontgin nie. Die staat kan egter sekere grondregte verkry vir die oprigting van 'waterwerke' en die Departement maak nou van dié prosedure gebruik voordat met boorwerk begin word. Volgens dr Mulder is daar geen waterarm lande in die wêreld waar alle grondwater sondermeer as privaatbesit beskou word nie. Hy meen dat 'n aanpassing van die wet dringend noodsaaklik is.

Om 'n gat in dolomiet te boor, voering te installeer en pomptoetse uit te voer, kos ongeveer R60 000. Om 'n boorgat werklik te ontgin en in gebruik te neem (kragvoorsiening, aan moederlyne te koppel ens.) is 'n duur proses en sal in die omgewing van R300 duisend tot R400 duisend per boorgat kos. Die boorwerk word aan ervare boorkontrakteurs opgedra wat oor die nodige toerusting en deskundige kennis beskik om met sukses in die uiters moeilike dolomitiese lae te boor.

Die mate van sukses wat met die boorwerk verkry is, het merkbaar toegeneem. Waar voorheen ongeveer 50 persent sukses behaal is, het dit gestyg tot sowat 80 persent. Hier word gepraat in terme van lewering van meer as 25 liter per sekonde (= 16 000 g.p.h.). Waar die lewering swakker is, word dit nie vir hierdie projek as ekonomies beskou om die boorgat te ontgin nie.

Die potensiaal van die gate word bepaal nadat die gat van 'n voering voorsien is. Hidrologiese pomptoetse word deur kontrakteurs gedoen en hidrogeoloë bepaal dan wat die medium- en langtermynlewering van die gat sal wees. Alle boorgate word verseël.

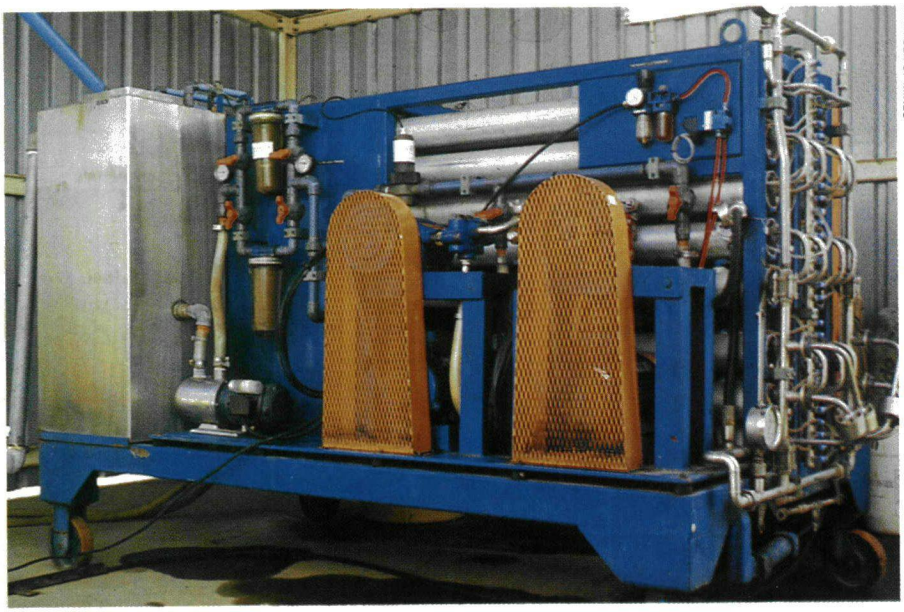
Die veiligheidsaspek word deurgaans sterk beklemtoon by hierdie projek, as gevolg van die moontlikheid van sinkgate. As die onttrekking van water die grondwatervlak drasties beïnvloed, kan dit sinkgate in sekere omstandighede aanmoedig. Die mate waarin water onttrek kan word, word bepaal deur die diepte van die watervlak en die pompaftrekking. Ondersoeke deur staatsinstansies asook sekere myne, het getoon dat waar die watervlak 30 tot 40 meter onder die grondoppervlak is, sinkgate geen gevaar inhou nie. As die watervlak in onverweerde dolomiet voorkom, is die gevaar ook uiters gering.

Alhoewel daar om veiligheidsredes gepoog word om nie naby beboude gebiede te boor nie, is dit nie altyd moontlik om hierby te hou nie. Die gate word egter sorgvuldig deur hidroloë gemoniteer en as die grondwater sodanig daal dat dit 'n gevaar vir sinkgatvorming kan inhou, sal daar dadelik oor die verdere ontginning van die water besin moet word.

Die hele projek is gerig op die voorsiening van water aan die PWV-gebied as 'n noodsituasie in die toekoms sou ontstaan. Indien dié gebied 'n ernstige watertekort sou beleef, sal daar dan 'n uitkoms wees danksy die tydige beplanning van die Departement van Waterwese.

mine water desalination demonstrated

Electrodialysis and reverse osmosis pilot plants being evaluated for the desalination of mine service water were demonstrated to the mining industry during May this year. This demonstration took place during a seminar organized by the Chamber of Mines Research Organization in collaboration with the Beatrix gold mine of the Gencor Mining Group. Results and experience gained with these processes to date were reported and the potential for their application to desalinate mine water was highlighted.



CHAMBER OF MINES

Tubular Reverse Osmosis pilot plant (0,4 ℓ/s).

The Chamber of Mines Research Organization in collaboration with the Gencor Mining Group initiated a pilot plant research and development programme during 1986 to evaluate cost effective techniques for the desalination of mine service water. This water is usually of a poor quality because of various salination mechanisms operative in mines, i.e. the oxidation of pyrite, intrusion of saline fissure water, salts derived from explosives and salt dissolution during the processes of rock washing and dust suppression. Reasons for wanting to desalinate mine waters include severe corrosion of and scale formation in the service water circuit, reclamation of service water for re-use or compliance with effluent discharge requirements.

There are many desalination processes available in the market, but not all of these are suitable for the desalination of mine water. The Chamber undertook a desk feasibility study and came to the conclusion that tubular reverse osmosis (RO), seeded reverse osmosis (SRO), electrodialysis reversal (EDR) and freeze desalination (FD) held significant potential as mine water desalination processes. As a result, pilot scale testing of these selected processes was commenced.

During early 1986 the Chamber entered into an agreement with the Water Research Commission (WRC) and the Gencor Mining Group to evaluate an electrodialysis reversal (EDR) process at the Beatrix gold mine near Theunissen in the Orange Free State. A 1,6 ℓ/s EDR pilot plant, (manufactured by IONICS which are locally represented by Process Plant), was supplied by the WRC and test work started in May

1986. Concurrently, the Chamber of Mines Research Organization also entered into an agreement with Bintech (Pty) Limited and Gencor to evaluate the tubular reverse osmosis (TRO) process at the Beatrix gold mine. Bintech supplied a 0,4 ℓ/s TRO pilot plant and test work on this unit started in July 1986.

ELECTRODIALYSIS REVERSAL PROCESS EVALUATION

This unit incorporated pretreatment for suspended solids removal in the form of flocculation, sand filtration and 10 μm cartridge filtration. This level of suspended solids pretreatment was required to ensure a feed turbidity of less than 1 NTU. A further pretreatment step was the addition of potassium permanganate to the feed stream to oxidise any iron and manganese in the water to prevent membrane fouling. The process did not require control of the feed water pH or temperature which were around 6 and between 28°C and 34°C, respectively.

This pilot plant was operated for more than 5 000 hours with an average salt rejection of about 80 per cent, based on total dissolved solids. The product water recovery was varied during the operating period but averaged around 80 per cent. The product water had a chloride concentration of around 360 mg/ℓ and is therefore considerably less corrosive than the feed water (chloride concentration 1 750 mg/ℓ). In addition the sodium concentration was reduced from 1 380 mg/ℓ in the feed water to 190 mg/ℓ in the product water. This made the water suitable for human consumption based on the SABS specifications for maximum allowable sodium chloride content. The product water from this unit would also be suitable for use in hydropower systems.

The study identified that apart from the iron there were two other ions present in the feed water that could cause problems within the unit, i.e. barium and manganese. Both were present at around 0,6 mg/ℓ in the feed. Methods to overcome these problems in commercial scale plants were identified.

View of EDR & TRO pilot plants at Beatrix Gold Mine with head gear in the background.

TUBULAR REVERSE OSMOSIS PROCESS EVALUATION

This pilot plant incorporated very little pretreatment in terms of suspended solids and iron removal from solution. The unit was fitted with a sponge-ball cleaning system which during each reversal cycle flushed silt buildup from the membrane surfaces. The process required pH control (pH between 5 – 6) and temperature control (<27°C) of the feed water. It was necessary to control these parameters since high values of pH and temperature increased the rate of membrane hydrolysis and therefore reduced membrane life.

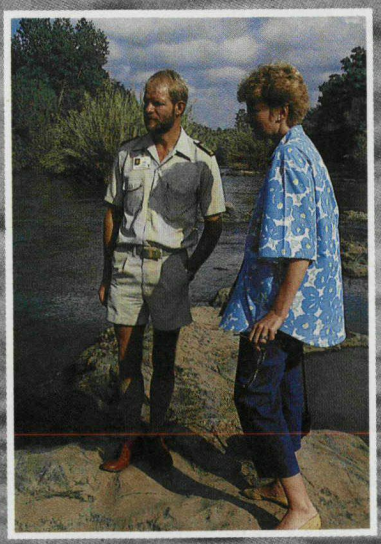
The process reduced the chloride concentration in the feed water from an average of 1 730 mgℓ to 280 mgℓ in the product stream, thereby significantly reducing the water's corrosion potential. The sodium concentration was reduced from 1 300 to 150 mgℓ, making it suitable for use in hydropower systems as well as for human consumption based on SABS specifications for sodium cloride content.

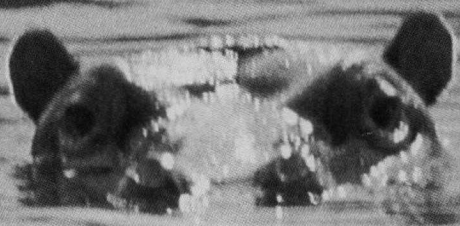
A point of concern identified by the study was the amount of wear experienced in the system's high pressure pumps. For commercial scale plants it was suggested to install sand filters ahead of the reverse osmosis units to improve the life of the pumps, and as a result leave the sponge balls with less silt to contend with, thereby improving membrane performance.

POTENTIAL BENEFITS TO INDUSTRY

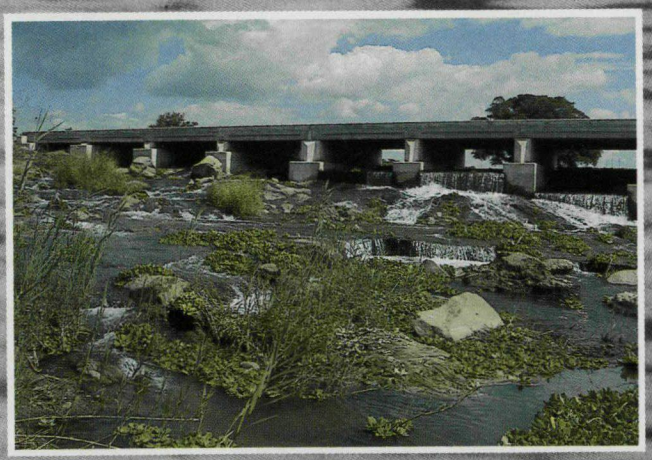
The availability of desalination processes which have been technically proven on a mine service water, high in sodium chloride but with a low calcium sulphate content, now opens the possibility for full scale application. This could result in the production of less corrosive mine service water, reclamation of mine service water for re-use, production of potable water and, if necessary, effluents from mines which will meet anticipated future strict effluent discharge standards.

The Chamber of Mines Research Organization's test programme at the Beatrix gold mine will come to an end in July 1987. At that stage cost estimates will be made and detailed reports will be compiled on the results obtained.





Wildtuin se riviere – "'n bedreigde spesie"



die seekoeipaadjie slinger tussen digte oewerplante deur tot aan die rivier. Groot bruin hompe lê bewegingloos in die blink water van die kuil. Skielik snork een van die ou grotes en 'n fyn sproei skiet die lug in. Nuuskierigheid laat die ander seekoeie lui naderspoel. Die veldwagter wys ingenome na een wat groot gaap en dan, as die kameras begin kliek, sy mond nóg groter oopmaak . . .

'n Besoek aan so 'n seekoeigat is een van die hoogtepunte vir die toeris wat deur die Nasionale Krugerwildtuin ry. Tog meen waterwetenskaplikes en natuurkenners dat die moontlikheid vandag bestaan dat hierdie kuile vol seekoeie in die toekoms 'n seldsame gesig kan word . . .

FOTO'S: (Heel links bo) Mnr Freek Venter, senior navorsingsbeampte by Skukuza, saam met Ilse Lombard van die WNK. (Links bo) Wateronkruid in die Krokodilrivier. (Links) 'n Damwal in die Sabierivier. Die klippe dien as 'n natuurlike visleer.

Die rede hiervoor is dat die seekoeie asook baie van die ander diere, visse, voëls en plante in die Wildtuin, die hele sogenaamde rivier ekosisteme, tans bedreig word weens die toenemende besoedeling in die gebied se riviere en die mens se inmenging in die werking van die natuur.

Volgens mnr Willem Gertenbach, beheernavorsingsbeampte by Skukuza, is die seekoeie byvoorbeeld afhanklik van diep kuile vir beskutting gedurende die dag. 'n Groot aantal van die kuile het egter al so toegeslik geraak dat die diere moes wegtrek na ander plekke. Die damme wat hoër op in die riviere buite die grense gebou is, is deels hiervoor verantwoordelik: natuurlike vloede word deur die damme gestuit, die kuile spoel nie oop nie en die water wat wel deurkom, dra soveel sediment dat die kuile mettertyd heeltemal toeslik.

Die gevolg is dat die bruikbare kuile oorbevolk word en gevegte onder die diere dikwels voorkom. Die gebied om die kuil word dan ook so oorbewei dat die seekoeie snags al hoe verder moet soek om genoeg kos te kry. Later is die weiplek so ver van die kuil af dat die seekoeie kan vrek van verhongering of selfs blootstelling as hulle nie die kuile kan haal voor dit te warm word nie.

Mnr Gertenbach sê voorts dat die opdam van die riviere en die gevolglike uitskakeling van natuurlike vloede ook nadelig kan wees vir sekere vissoorte wat tydens vloede migreer en deur die vloede gestimuleer word om te broei.

Die opdamming van riviere is egter maar een van die Wildtuin se probleme met water. Versouting, eutrofikasie, nywerheidsuitvloeisels en plaagdoders speel ook 'n al hoe groter rol in die verandering van die Park se waterhabitat.

Om dié waterprobleme van die Krugerwildtuin aan te spreek het die Departement van Waterwese onlangs in samewerking met die Nasionale Parkeraad 'n dinkskrum by Skukuza gehou. Verskeie instansies en persone wat 'n bydrae kan lewer om wetenskaplike oplossings vir die Wildtuin se waterprobleme te vind is by die weeklange werksessie betrek.

Volgens mnr Gertenbach het belanghebbendes diep onder die indruk gekom van die ernstige toestand van die riviere in die Wildtuin asook van die groot gebrek aan navorsingsresultate wat nodig is om vir die toekoms te beplan.

Mnr Fred van Zyl, adjunk-hoofingenieur beplanning by die Departement van Waterwese en lid van die Departement se "Wildtuinkomitee", sê die Departement is deeglik bewus van die probleme wat die riviersisteme in die Krugerwildtuin ondervind.

Hy sê die toenemende ontwikkeling in die gebiede wes van die Wildtuin veroorsaak dat die waterverbruikers daar al hoe meer water benodig. Dit noodsaak die Departement om sekere riviere op te dam – ook van dié wat deur die Krugerwildtuin loop. Die snelle ontwikkeling van nywerhede en die landbou in die gebied lei verder ook tot die besoedeling van baie van die riviere waarop die Wildtuin vir sy voortbestaan aangewese is.

Volgens mnr Van Zyl onderskei die Departement van Waterwese nagenoeg agt tipes waterverbruikers waarvan die Natuur, en in dié geval die Wildtuin, een is. By elkeen van hierdie verskillende verbruikersektore word die bestaande navorsing en data ingespan om presies vas te stel wat elke verbruiker se waterbehoeftes is sodat 'n "billike toedeling" vir elkeen gemaak kan word.

Die probleem met die Wildtuin is egter dat die Departement nie oor genoeg data beskik om te bepaal wat die Wildtuin se werklike waterbehoeftes is nie. Daarom is navorsing dringend nodig om antwoorde te vind op vrae soos die volgende:

Hoeveel water het die Natuur nodig om die verskillende ekosisteme in stand te hou?

Wat moet die kwaliteit van dié water wees?

Hoe moet die water verskaf word om die natuurlike kenmerkende vloei van die riviere so min as moontlik te beïnvloed? en

Wat moet die temperatuur van die water wees wat verskaf word?

"Intussen moet die beplande ontwikkeling buite die Wildtuin egter ook voortgaan", sê mnr Van Zyl.

"Die ontwikkelings wat nodig is vir die vooruitgang van die ander verbruikersektore kan nie summier gestaak word totdat die uitgebreide navorsingsprogramme wat in die Krugerwildtuin uitgevoer moet word, voltooi is nie.

"Die Departement van Waterwese het hom immers verbind om die lewenskwaliteit van àl sy verbruikers te verbeter en daarom is die ontwikkelings in die ander verbruikersektore essensieel."

Mnr Van Zyl sê die Braam Raubenheimerdam is byvoorbeeld buite die Wildtuin in die Krokodilrivier gebou om in die besproeiingsbehoeftes van die boere langs die rivier te voorsien.

Vanweë die dam is daar nou meer water in die Krokodilrivier as vantevore en die Wildtuin is verseker van 'n konstante vloei. Die Wildtuin is egter nie noodwendig beter daaraan toe nie want die natuurlike laag- en hoogvloeie van die rivier is in só 'n mate verander dat die ekologie moontlik skade kan ly. Die navorsing wat die Departement bepleit moet dit moontlik maak om presies te bepaal hoe die riviersisteem deur die veranderde vloei beïnvloed word.

Een van die nadele van die besproeiingsontwikkeling wat reeds geïdentifiseer is, is dat dit die waterkwaliteit van die Krokodilrivier aantas. Soute en ander nutriente wat vanaf die besproeiingslanderye in die rivier uitloog, verryk die water met die gevolg dat wateronkruid soos hiasinte en waterslaai deesdae oral in die Krokodilrivier floreer.

Dit blyk dus duidelik dat indien die Wildtuin saam met die ander verbruikersektore sal moet meeding vir sy regmatige aandeel in die beperkte beskikbare waterbronne in die gebied, sy aansprake op wetenskaplike navorsing en data gegrond sal moet wees.

Mnr Van Zyl sê dit is vandag moontlik om te bepaal hoeveel water vir menslike gebruik, nywerheidsontwikkeling en landboudoeleindes nodig is, maar dit is nog nie moontlik, hoofsaaklik weens 'n gebrek aan gerigte navorsing, om te bepaal wat die Natuur, en spesifiek die Krugerwildtuin, nodig het nie. Die Departement van Waterwese erken egter die Natuur se reg as 'n waterverbruiker. Dit beteken nie dat hulle net wil weet hoeveel water die Natuur benodig nie. Die Departement wil ook weet hoe die Natuur die water wil hê, wanneer hy dit wil hê en wat die kwaliteit van die water moet wees.

Die Departement van Waterwese probeer intussen 'n mate van buigbaarheid inbou in nuwe watervoorsieningstelsels wat ontwikkel word, sodat voorsiening gemaak kan word vir vereistes wat deur die navorsing aan die lig mag kom.

Mnr Van Zyl meen dat die navorsing bemoeilik word vanweë die feit dat elke rivier uniek is en data wat oor een rivier

ingewin word nie noodwendig op 'n ander rivier van toepassing is nie. In oorsese lande is reeds studies gedoen oor die riviersisteme maar die eienskappe van die riviere in Suid-Afrika verskil só dat die inligting nie vir die plaaslike wetenskaplike direk toepaslik is nie.

Die Parkeraad is intussen reeds besig met 'n navorsingsprogram wat die volgende insluit:

Meetplate word op al die permanente strukture soos brûe en damme aangebring en die veldpersoneel word ingespan om gereeld die vloei van riviere te meet en so data op te bou van die riviere se gedrag.

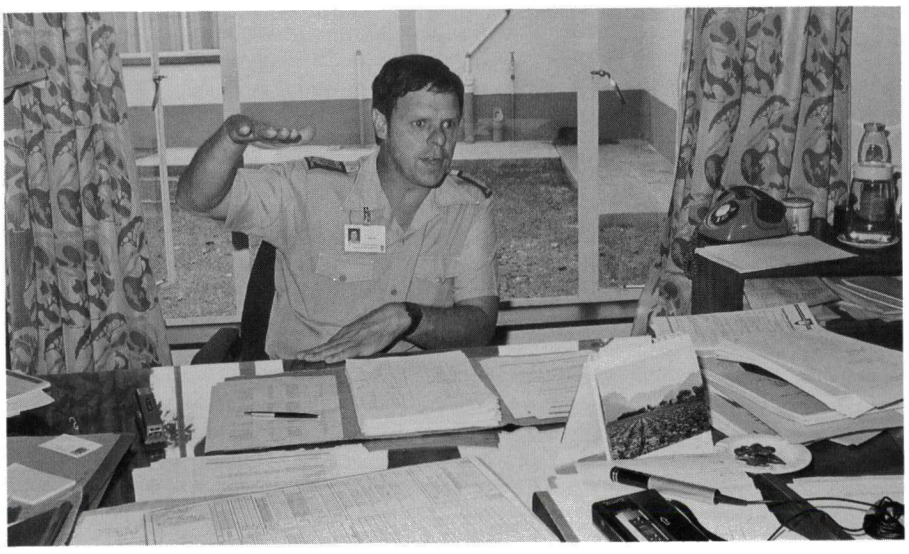
Gereelde waaktoetsing van die waterkwaliteit sal ook gedoen word om moontlike probleme te identifiseer.

'n MSc student is aangestel om 'n studie te maak van die vislewe in die riviere en dit te vergelyk met die inligting wat in 1965 ingewin is. Die student is ook verantwoordelik vir die opstel van 'n langtermyn waaktoetsingsplan sodat veranderings in die riviersisteme vasgestel kan word. Dele van die rivier word tans deur bodemkundiges soos mnr Freek Venter, senior navorsingsbeampte by Skukuza, bestudeer om vas te stel of die grondvog voldoende is vir die instandhouding van die rivieroewerplantegroei.

Die Wildtuin se vliegtuig word ook ingespan. Die vliegtuig beskik oor 'n gesofistikeerde kamera wat lugfoto's neem wat met behulp van 'n video-opnemer versyfer kan word om sekere data weer te gee. Dié proses kan jaarliks herhaal word om veranderings te moniteer.

Navorsing wat reeds afgehandel is, is gedoen deur 'n span wetenskaplikes van die Nasionale Instituut vir Waternavorsing onder leiding van dr Mark Chutter. Dit was 'n ondersoek na die bentiese fauna in twee riviere in die Wildtuin, die Letaba en die Shingwedzi en het oor 'n periode van drie jaar gestrek. "Die navorsing sal dien as 'n basislyn waarna in die toekoms terugverwys sal kan word," sê mnr Gertenbach.

DEPARTEMENT VAN WATERWESE



WNK

(Heelbo): Die Departement van Waterwese se "Wildtuinkomitee". Van links: O Rossouw, A Olivier, C Bruwer, F van Zyl, A Slabbert, P Blersch en A Botha.

(Bo): Mnr Willem Gertenbach, beheernavorsingsbeampte by Skukuza, in die Nasionale Krugerwildtuin.

KOSTES

Die waternavorsing wat nog in die Krugerwildtuin gedoen moet word, is 'n duur proses. Volgens mnr Fred van Zyl, is die koste verbonde aan die bou van een meetstasie in 'n rivier ongeveer R640 000. Daarbenewens word mannekrag benodig om die data in te samel, reiskostes van die personeel moet gedra word omdat die navorsingsarea oor so 'n groot gebied versprei is en effektiewe bestuur moet daargestel word om te verseker dat die data betroubaar is, om net 'n paar van die uitgawes te noem. Die Wildtuin se begroting vir navorsing maak nie voorsiening vir so 'n uitgebreide ondersoek nie. Genoegsame fondse sal egter gevind moet word, want die navorsing handel oor die kern van die Wildtuin se ekosisteem – water.

Spanwerk is uiters noodsaaklik om die navorsing op 'n sinvolle manier deur te voer, navorsingsresultate te bespoedig en sodoende praktiese oplossings vir die Wildtuin se waterprobleme te vind. Die ingenieurs van die Departement van Waterwese en die ekoloë het dus besluit dat hulle dié saak gesamentlik sal aanpak sodat 'n billike toedeling van die beskikbare waterbronne vir die gebied gedoen kan word.

Types of thermocouple psychrometers used for measurement of leaf water potential

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The fundamental importance of water potential and its components in all studies of plant water relations is universally recognized. Thermocouple psychrometers provide a valuable tool for accurate and reliable measurement of water potential. A wide range of different types of psychrometers are currently available, although some confusion surrounds the choice of the most appropriate psychrometer as well as the correct procedures and precautions to follow. Psychrometer selection depends on the size and nature of the sample whose water potential is to be measured.

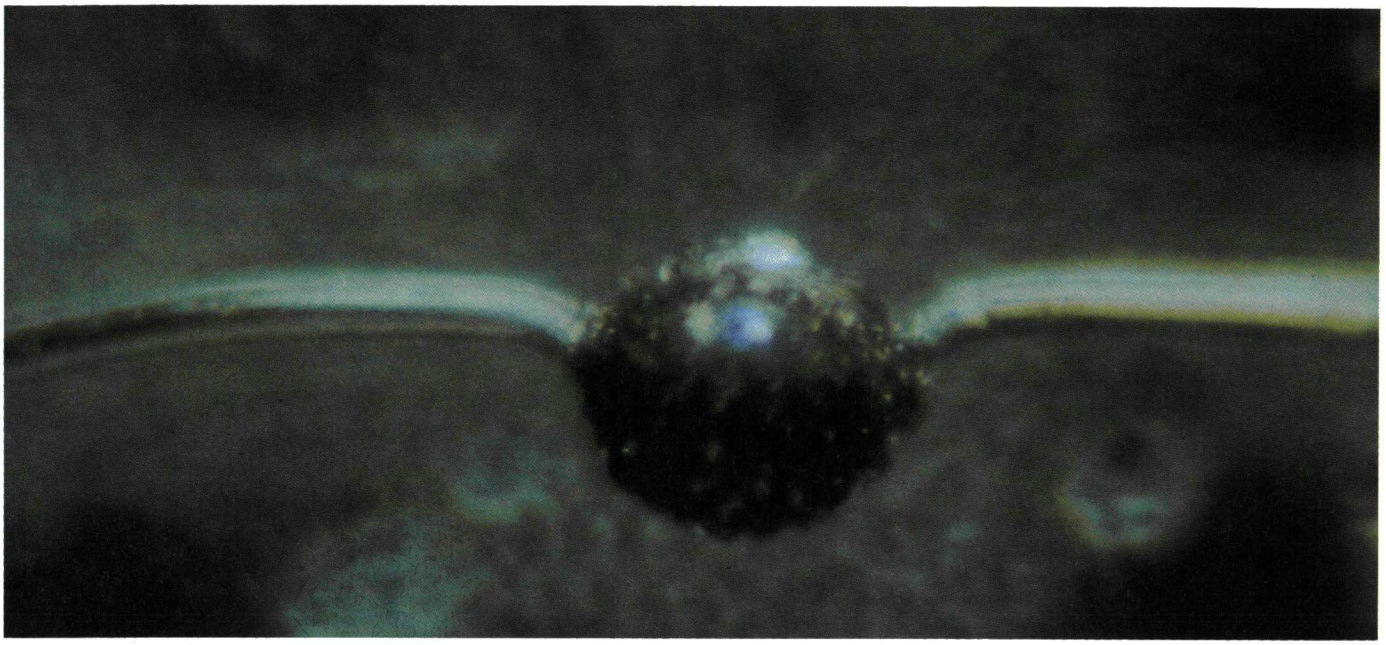
Thermocouple psychrometers are being used increasingly in laboratory and field studies of plant-water relations as they offer a convenient, accurate and reliable means for the determination of water potential in plants, soils and other media. Water potential (a measure of how tightly water is held) of leaves and soils is probably the most effective and widely used index of soil water availability to crops. The psychrometer technique has the added advantage of making possible the determination of the components of water potential when these are required. Many research workers feel that the psychrometer technique should be used as the standard method against which other techniques, such as the Scholander-type pressure chamber, should be calibrated. Results with psychrometers have not always been very satisfactory or reliable probably due to the use of incorrect procedures, inadequate precautions, and poor choice of psychrometer type.

USES OF THERMOCOUPLE PSYCHROMETERS:

Thermocouple psychrometers have been used in many varied situations for research on the water potential of the soil-plant-atmosphere continuum. These include agronomic crops, forests, horticultural tree crops, grasslands, natural ecosystems, foodstuffs and micro-organisms. They have also been used in the analysis of water flow in roots, tree trunks, stems, and leaves. In the atmosphere, psychrometers have been used to obtain measurements for characterizing water vapour transfer mechanisms. Water vapour and liquid movement in porous media including a wide variety of soils, mine dumps materials and snow packs, have also been monitored by means of thermocouple psychrometers.

BRIEF THEORY OF PSYCHROMETERS:

Two types of thermocouple psychrometers have been used for the determination of water potential in plant tissues, namely the Spanner-type and the Richards and Ogata-type, and a number of modifications and advances have been suggested for both types. The Spanner-type psychrometer, however, has certain advantages over the Richards and Ogata instrument and is more widely used. The typical (Spanner) psychrometer consists of a thermocouple sensing junction (usually of chromel-constantan) and one or two reference junctions (copper-constantan and copper-chromel). Generally speaking the Spanner psychrometer measures the relative humidity in a small chamber containing a leaf sample under temperature-controlled conditions. Water is condensed onto the sensing-junction by the application of an electric



Water condensed onto a psychrometer sensing junction during water potential measurement.

cooling current. This Peltier cooling current continues until the sensing-junction temperature is below the dewpoint temperature of the cavity air and condensation occurs. When the current is discontinued, the droplet evaporates and the voltage output is monitored with the aid of a chart recorder. It is also possible to measure the wet bulb temperature depression, which is related to the relative humidity within the cavity, and hence the water potential of the sample at the prevailing temperature.

A thermocouple psychrometer is used for the measurement of both wet and dry bulb temperatures whereas a dewpoint hygrometer measures the dry bulb and the dewpoint temperature. Both techniques use identical sensors but different voltmeter circuitry. Thermocouple psychrometer is often used as a collective term for both psychrometers and dewpoint hygrometers.

TYPES OF PSYCHROMETERS AVAILABLE:

Many different psychrometer designs have been developed and a number of these are now commercially available. These include (1) screen-caged psychrometers with sample chambers, (2) end-window psychrometers with sample chambers, (3) leaf-cutter psychrometers with sample chambers, (4) leaf **in situ** psychrometers, (5) Wescor C-52 psychrometer sample chambers, (6) the SC-10 ten chamber psychrometer, and (7) porous ceramic-shield psychrometers. However, some uncertainty exists as to which design of psychrometers is the most suitable and reliable. The choice of the psychrometer depends on the size and nature of the plant tissue sample whose water potential is to be determined.

The screen-caged psychrometer has the advantage of using larger leaf samples which are placed in the sample chamber so as to surround the screen cage. Measurements of osmotic potential can also be made by freezing the psychrometer assembly after water potential measurement, and therefore, an estimate of turgor potential can be made by subtraction. This psychrometer provides extremely accurate and reliable estimates of leaf water potential, is ideal for both field and laboratory measurements, and is relatively inexpensive.

There are a number of different types of end-window psychrometer including the small leaf disc type (4.5 mm diameter), the larger leaf disc type (9.0 mm diameter), and the leaf-cutter type. This type of psychrometer can suffer from the large evaporative lo-ses associated with the large cut surface relative to the size of the leaf sample, However, this type is extremely useful when limited sample material is available. Measurements of osmotic and turgor potential can also be made.

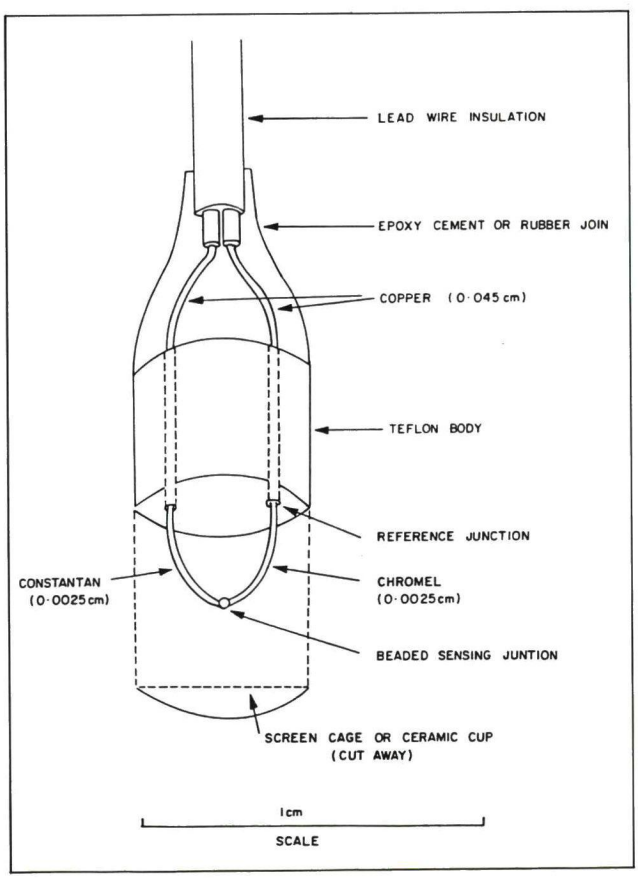
The C-52 psychrometer-sample chamber is one of the older types which also uses leaf discs and therefore has the same problems associated with destructive sampling of small discs. Two different leaf discs (4.5 mm and 7.0 mm diameter) can be used by changing the sample holders in the nylon slide. This psychrometer has application in the laboratory rather the field, and is useful when only a few samples are needed. A measurement of osmotic potential can be obtained by physically crushing the sample to break the plant membranes. They are, unfortunately, relatively expensive.

The **in situ** psychrometer provides the only means of nondestructive measurement of leaf water potential, and therefore measurement of osmotic potential is not possible. These psychrometers have proved to be extremely accurate provided certain precautions are observed, including temperature insulation and careful sealing onto the leaf. It is recommended that this type should be slightly modifield by insulating the housing assembly with foam insulation tape and covering with reflective mylar tape for more accurate temperature

control. The **in situ** psychrometers need to be carefully sealed onto the leaf using a mixture of lanolin and beeswax. The psychrometer and housing assembly can be held in place against the leaf by a clamp and retort stand with careful positioning so as to minimize shading.

More recently, the SC-10A thermocouple psychrometer sample chamber was introduced for the measurement of soil or plant water potential. It equilibrates 9 samples at a time and the large aluminium housing is supposed to minimize temperature gradients and quickly bring samples to equilibrium without the need for a constant temperature water bath. The standard SC-10A uses a chromel-constantan ceramic bead thermocouple although a Peltier-type thermocouple can be supplied on request. The sample cup can take a leaf disc 15 mm in diameter. Measurement of osmotic potential is possible by freezing the leaf tissue and determining the potential of the expressed sap on a filter paper disc.

Although thermocouple psychrometers are mostly used for the measurement of leaf water potential, they can also be used to measure soil water potential directly using either screen-caged or ceramic-types of thermocouple psychrometers. Although the porous ceramic-shielded psychrometer has been used for leaf water potential measurement it is generally used for measurements in the soil. They do, however, need to be calibrated over a range of temperatures prior to field placement, and placed horizontally in the soil at a suitable depth i.e. 30 cm to avoid temperature gradients.



ACCURACY OF PSYCHROMETER MEASUREMENTS:

The accuracy and reliability of psychrometer measurements of leaf water potential has been demonstrated in many studies around the world. Comparisons of psychrometers with Scholander-type pressure chambers for measurement of leaf water potential have generally exhibited very close agreement.

In a field comparison of five commercially available thermocouple psychrometers we observed differences between the various psychrometers and this was attributed to the size of the tissue sample and evaporative losses, mainly from the cut edge. The screen-caged and the thermally insulated **in situ** psychrometers generally gave the most accurate measurements, and the psychrometers using the smallest leaf disc, such as the leaf-cutter type, gave the poorest results.

MEASUREMENT PROCEDURE

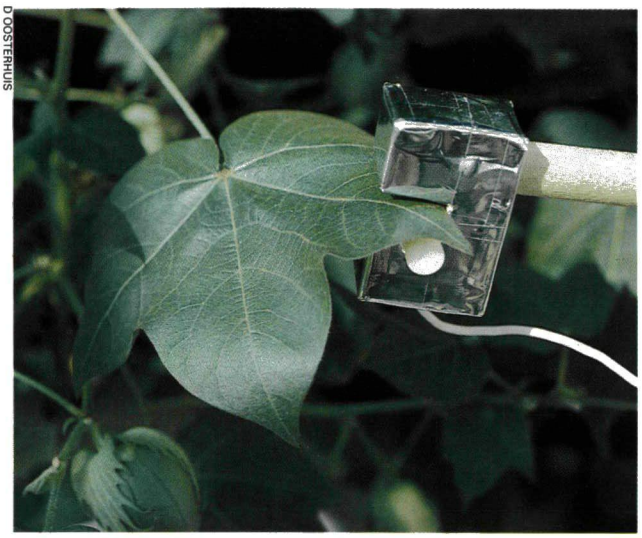
After psychrometer selection, initial preparation entails cleaning, drying, and calibration. The actual measuring procedure involves tissue sampling, equilibration in an isothermal waterbath and recording of the voltage output. Valid water potential measurements depend on the attainment of adequate thermal and vapour pressure equilibration between the leaf sample and the air in the sample chamber surrounding the psychrometer. After an appropriate vapour pressure equilibration time in an isothermal waterbath (4 hours is usually sufficient), water is condensed on the measuring junction by applying a 5 mA cooling current for a 15 s Peltier cooling period. The microvolt output from each psychrometer is measured using an appropriate microvoltmeter and a chart recorder. The output voltage corresponding to the wet bulb temperature indicates the equilibrium water potential of the leaf sample in the psychrometer chamber. The chart recorder allows a more accurate and permanent record of the microvolt output (water potential). The above procedure is repeated, after careful washing and drying of the psychrometer, for each set of measurements made.

After the psychrometers have been placed in the waterbath the recording procedure can be automatd using dataloggers or microprocessor controlled systems that are available commercially. The cooling current and time interval are preset, and the time, temperature, zero offset, and voltage output (water potential) data are automatically recorded and saved in memory for output to a printer or a computer.

PRECUATIONS

The precuations needed in using psychrometers to

avoid unnecessary errors include care in cleaning, careful calibration, and adequate temperature and vapour pressure equilibration. Possible sources of error include thermal and vapour pressure gradients, contamination, electronic noise, errors in measuring temperature, in calibration and in voltage measurement, and incorrect operating procedures. It is essential that researchers thorougly familiarize themselves with the theory and measurement procedures, and the operational techniques which give satisfactory results under their particular conditions. When proper procedures and proven techniques are used, measurement of water potential is simple, reliable and accurate.



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LEAF TISSUE SAMPLING AND SAMPLE SIZE

Since excision of plant tissue is almost inevitable when water or osmotic potential determinations are made using thermocouple psychrometers, the error due to water evaporated from the cut surfaces of the leaf sample is of particular importance and related to the size of the leaf sample. Discrepancies in the leaf water potential can result from small samples and excessive cutting of leaf tissue. The proportion of the cut edge to the size of the sample is crucial and is related to the proportion of cells ruptured during excision to the number of cells in the leaf sample remaining intact. A leaf disc is used with the end-window, leaf-cutter and C-52 psychrometers and a rectangular leaf section about 20 x 100 mm is used in the screen-caged psychrometer assembly. The leaf **in situ** psychrometer covers a circular area on the leaf 5 mm^2 in diameter.

Leaf samples are usually cut from a leaf of uniform size and age, fully exposed to the sun. Prior to leaf sampling, any moisture on the leaf from dew or irrigation must be carefully removed with absorbant paper. With as little delay as possible between excision and sealing in the psychrometer chamber (usually less than 10 seconds), the leaf strips are placed in the screen-caged psychrometer sample chamber with the aid of a stainless steel insertion tool, and the leaf discs are excised and placed in the chamber using a cork borer or rapid disc-sampler. Excessive evaporative losses during leaf sample excision can be prevented by sampling inside a humidified chamber.

COMPONENTS OF WATER POTENTIAL

The components of water potential, osmotic and turgor potential, can also be estimated using thermocouple psychrometers. These parameters provide further insight into the nature and severity of water deficits and are therefore extremely important in understanding plant-water relations. Osmotic potential is due to the presence of dissolved solutes within the cell membranes and their attraction for cell water, and turgor potential is caused by the increase in volume of vacuolar sap within the cell wall and is estimated by subtracting osmotic potential from water potential. Measurements of osmotic potential, using thermocouple psychrometers are made after water potential measurements and subsequent freezing of the psychrometer assembly with the enclosed excised leaf sample in liquid nitrogen to rupture the cell membranes.

SUMMARY

Thermocouple psychrometers provide a reliable, accurate and relatively easy method of determining leaf water potential. Certain procedures and precautions, are, however, necessary to ensure the best results. These include the choice of the most suitable psychrometer, care in cleaning and calibration, the correct operating procedure, prevention of temperature gradients, adequate vapor pressure equilibration, and accurate measurement and interpretation of the voltage output. The choice of the psychrometer depends on the size and nature of the plant tissue sample whose water potential is to be determined. Allowance must be made for an adequate amount of plant tissue in relation to both the area of cut surfaces and the volume of the psychrometer chamber.

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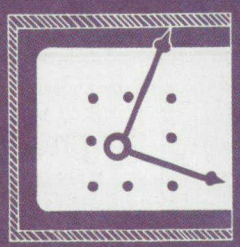
specialist technical groups

In the early 1980s the International Association on Water Pollution Research and Control established a structure for the development of Specialist Technical Groups. This was in response to the increasing demand from the membership for cooperation and exchange of ideas on specialized topics in water pollution control. Since the concept was introduced, many new groups have been formed and additional groups are still in the process of formation. The members of the South African National Committee of the IAWPRC felt that much useful information came to the surface during the deliberations of these various Specialist Technical Groups and appointed a contact person who would be a member of the group and who would report back to the national committee so that people in South Africa could be kept up to date with the latest activities of these various groups. Details are given below of the various Technical Groups in which South Africans are involved together with the names of the Chairman of the Group and the local contact person from whom more information on the Group's activities may be obtained.

SPECIALIST GROUP ON HEALTH-RELATED WATER MICROBIOLOGY

Founded in 1980, this group now has 260 members in 38 countries and the 12 members of the Management Committee represent all areas of the world. The primary objectives are to encourage communication and cooperation in the field of water virology, evaluate the latest information related to viruses in water, avoid overlapping of expensive research and define research needs and priorities. The group publishes a newsletter twice a year and its field of interest includes all health related water microbiology, i.e. virology, bacteriology, parasitology, micology and epidemiology. Group Chairman: Dr. W O K Grabow, National Institute for Water Research, CSIR, P O Box 395, Pretoria, 0001. Telephone (012) 86-9211, Telex 3-21312 SA.



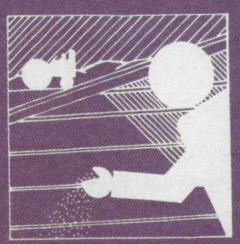
SPECIALIST GROUP ON INSTRUMENTATION FOR ON-LINE MEASUREMENT

This Group was formed in 1981 as a result of three IAWPRC workshops on instrumentation, control and automation for water and wastewater treatment and transport systems.

The main objectives of this group are:

1. To develop a mechanism whereby IAWPRC can collect, collate and disseminate pertinent information on sensors or instrumentation to the international user community.
2. To provide a method of coordinating and encouraging international cooperative ventures relative to these tasks.

Group Chairman: Dr R Briggs, John Taylor and Sons, Artillery House, Artillery Row, London SWIP 1RY. Telephone (01) 2227050. Telex 918873 Taylor G.



SPECIALIST GROUP ON PHOSPHATE REMOVAL IN BIOLOGICAL SEWAGE TREATMENT PROCESSES

This Group was set up following a highly successful seminar on the subject in Pretoria in 1982. The group aimed to serve as a communication link between individual scientists on the scientific and technical aspects relating to phosphate removal in treatment processes. There are plans to establish research needs, organize conferences, seminars and workshops and compile joint publications and guidelines for design and operation. Group Chairman: Professor D Jenkins, Department of Civil Engineering, University of California, 607 David Hall, Berkeley, California 94720, USA. Telephone (415) 5270672. Local contact, Dr H N S Wiechers (Group Secretary), Environmental Engineering Laboratory, Chamber of Mines, P O Box 91230, Auckland Park, 2006. Telephone (011) 726-3020. Telex 426070.

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DIE SUID-AFRIKAANSE AKADEMIE VIR WETENSKAP EN KUNS
21 AUGUSTUS 1987

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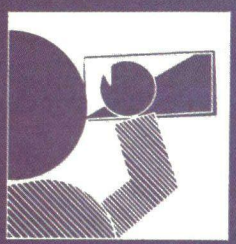
IAHR/IAWPRC JOINT COMMITTEE ON URBAN STORM DRAINAGE

This Committee is a cooperative venture between the IAWPRC and the International Association on Hydraulics Research. The committee aims to:

1. Promote the dissemination and publication of research results in this area of endeavour.
2. Encourage beneficial collaboration with other interests of IAHR and IAWPRC and with external organizations in pursuit of the same goals.
3. Organize international conferences on urban storm drainage and specialized symposia.
4. Promote sessions at biennial conferences of IAHR and IAWPRC.
5. Organize project groups to pursue specific objectives within its area of interest.

Group Chairman: Professor P Harremoes, Department of Environmental Engineering, Technical University of Denmark, Building 115, D K 2800 Lyngby, Denmark. Telephone (2) 884200 extension 5081. Telex 37529 DTHDIA DK. Local contact, Professor D Stephenson, Water Systems Research Programme, Department of Civil Engineering, University of the Witwatersrand, 1 Jan Smuts Avenue, Johannesburg, 2001. Telephone (011) 7162560. Telex 4-27125 SA.

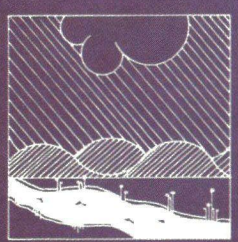


SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT

This Group formed in London in 1983 identifies and coordinates the analysis of key issues requiring a multidisciplinary approach of applied systems analysis. Subjects of particular interest to this group are:

1. Mathematical modelling – system identification, time series analysis and Monte Carlo simulation.
2. Policy analysis, decision theory, the analysis of risk and mathematical programming.
3. Process control, operational estimation and real time forecasting.

Group Chairman: Mr D H Newsome, CNS Scientific and Engineering Services, Tresillian House, 20, Eldon Road, Reading, Berks. RGI 4DL. United Kingdom. Telephone (0734) 597089. Telex 847423 COCR G Attention. CNS. Local contact person, Dr D C Grobler, National Institute for Water Research , P O Box 395, Pretoria, 0001. Telephone (012) 86-9211. Telex 3-21321 SA.



RIVER BASIN MANAGEMENT

This Group held its first meeting at the 12th Biennial International Conference of the IAWPRC in 1984 in Amsterdam. The group intends to facilitate cooperation and coordination, establish research needs, exchange research information and discuss integrated river basin management from the viewpoints of planning, operation management and practical application of research results. Group Chairman: Professor Dr Ing. Eh K R Imhoff, Geschäftsführer des Ruhrverbandes und des Ruhrtalsperrenvereins, Kronprinzenstrasse 37, D-4300, Essen 1, FRG. Telephone (0201) 178308. Telex 0857414 ESN. Local contact, Mr H J Best, Department of Water Affairs, Private Bag X313, Pretoria, 0001. Telephone (012) 299-2910. Telex 322107.

DESIGN AND OPERATION OF LARGE WASTEWATER TREATMENT PLANTS

The activities of this group formed in 1984 have mainly centred around the organization of a series of workshops which up to now have been held in Vienna. The next workshop is due to be held in Budapest in September 1987. The organization of these workshops is a major way in which the group aims to fulfil its objective of encouraging the exchange of information on world-wide developments in wastewater treatment. Group Chairman: Professor Dr Ing. W von der Emde, Institut für Wassergüte und Landschaftswasserbau, Technische Universität Wien, Karlsplatz 13, A-1040, Wien, Austria. Telephone (222) 657641 extension 335. Local contact Mr P G J Meiring, P G J Meiring and Partners Inc. P O Box 28734, Sunnyside, 0132. Telephone (012) 47-1117. Telex 3-20682 SA.

specialist groups

TASTES AND ODOURS IN WATER

This Group was established following the IAWPRC symposium on Off-Flavours in the Aquatic Environment held in Finland in 1982. The aims of the group are:

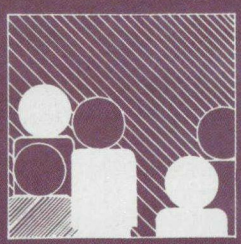
1. To promote international cooperation and research on adverse tastes and odours in water supplies and fisheries.
2. To arrange scientific meetings in the field.
3. To standardize nomenclature in this field of research.

The group is preparing for its second international symposium on Off-Flavours in the Aquatic Environment, which will be held in Kagoshima, Japan in October 1987. The group is drafting a proposed standardization of verbal descriptions of off-flavours commonly found in water. Group Chairman: Dr P E Persson, Federation of Finnish Scientific Societies, Snellmaninkatu 9-11, SF-00170, Helsinki, Finland. Telephone (0)652572. Local contact, Dr F C Viljoen, Rand Water Board, P O Box 1127, Johannesburg, Telephone (011) 833-6650.

ANAEROBIC DIGESTION

Established in June 1985, this group intends to cover the science, technology and engineering applications of anaerobic digestion processes. The specific objectives of the group are:

1. To provide a formal structure within which IAWPRC can respond to the global community on matters relating to anaerobic digestion.
2. Arrange further symposia on anaerobic digestion embracing a broad array of subjects including fundamental science and technolgy as well as applications in the fields of waste and biomass conversion or pollution control and/or energy production.
3. Develop other initiatives supportive of technology development and transfer such as state-of-art reviews, position papers, guidelines and other resource materials. Group Chairman: Dr F G Pohland, School of Civil Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332, USA. Telephone (404) 894 2265. Local contact person, Mr W R Ross, Branch Manager, Bellville Branch Laboratory, N I W R, P O Box 109, Sanlamhof, 7532, Telephone (021) 97-6181. Telex 52-7819 SA.



NEW SPECIALIST TECHNICAL GROUPS

Since the technical groups mentioned above, were established in the early 80's, interest in these groups has grown and various new groups have been composed. These include:

1. Marine Treatment of Wastewater.
2. Flocculation and filtration.
3. Wastewater Reclamation and Reuse.
4. The use of macrophytes in water pollution control.

If you are interested in the activities of any of the specialist technical groups mentioned above, you should get in touch with either the Chairman of the group, the local contact person, or Mr P Coombs, Secretary, SA National Committee of the IAWPRC at N I W R, P O Box 395, Pretoria, 0001. Telephone (012) 86-9211 extension 2231. Telex 3-21312 SA.

Further information on any of the above Specialist Technical Groups may be obtained from: The Secretary of the National Committee, Mr P Coombs, NIWR, P O Box 395, Pretoria. Tel: (012) 869211 x 2231.

VISITOR

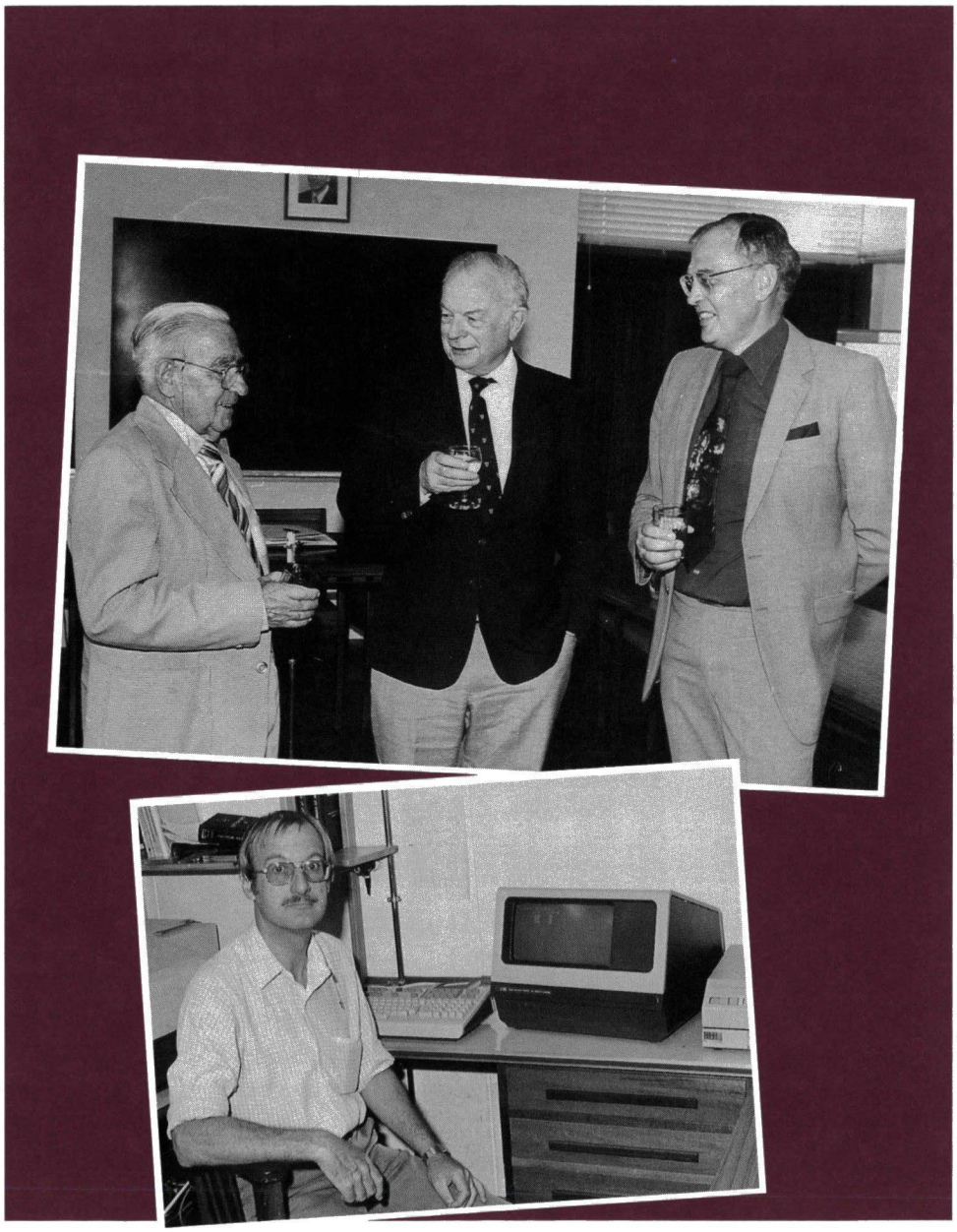
David Newsome, Senior Partner in C N S Scientific and Engineering Services of Reading, England, recently visited South Africa as the guest of the National Institute for Water Research (NIWR) and the CSIR's Foundation for Research Development (FRD). His experience in the public and private sectors covers more than 40 years beginning as a junior assistant engineer with the Derwent Valley Water Board. After graduating at the University of Sheffield, he spent several years on a variety of civil engineering works including the construction of roads, sewers, steelworks and house construction.

In 1974 he was made Director of the Water Data Unit of the Department of the Environment, where he remained until its dissolution in 1982. During this time he became involved in weather radar and was appointed Hydrological Adviser to the UK Permanent Delegate to the World Meteorological Organization.

David Newsome has been associated with the International Association on Water Pollution Research and Control (IAWPRC) since its inception in 1965. His first visit to South Africa was in 1982 when he attended the biennial conference. He is currently Chairman of the UK National Committee of the IAWPRC, Chairman of the Specialised Technical Group on Systems Analysers in Water Quality Management, Chairman of the Organising Committee for the International Conference of the Association to be held in Brighton in June 1988 and he represents the UK on the Governing Board. Some of his experience in the IAWPRC was passed on at a meeting of the SA National Committee which was arranged to coincide with his visit.

In an action-packed week in Pretoria, he presented two colloquia – one at the National Physical Research Laboratory (NPRL) and one at the NIWR, as well as visiting the CSIR radar facility at Houtkoppen, the Water Research Commission, the Department of Water Affairs and the NIWR.

During his second week in South Africa he presented a paper on **Weather Radar, a Tool for Water Resources Management,** at the biennial conference of the Institute for Water Pollution Control (Southern African Branch) in Port Elizabeth. He also delivered a lecture at Rhodes University on **Real Time Monitoring of Water Resources for Operational Management.**



WRC

Dr Piet van Rossum van die Nasionale instituut vir Watervorsing by die WNNR, het in Maart vanjaar sy doktorsgraad aan die Universiteit van Pretoria verwerf. Sy proefskrif het gehandel oor die isolering en identifisering van mutagene in drinkwater. Op die foto sit dr Van Rossum by die NIWN se gas-chromatograaf-massaspektrometer kombinasie vir die bepaling van organiese verbindings in water.

Dr Van Rossum is tans leier van 'n WNK-projek wat handel oor mutagene in drinkwater.

RUSSIANS BENEFIT FROM SA RESEARCH

Prof D Stephenson, a lecturer in the department Hydraulic Engineering at the University of the Witwatersrand recently published a book "Stormwater Hydrology and Drainage" which has now been translated into Russian.

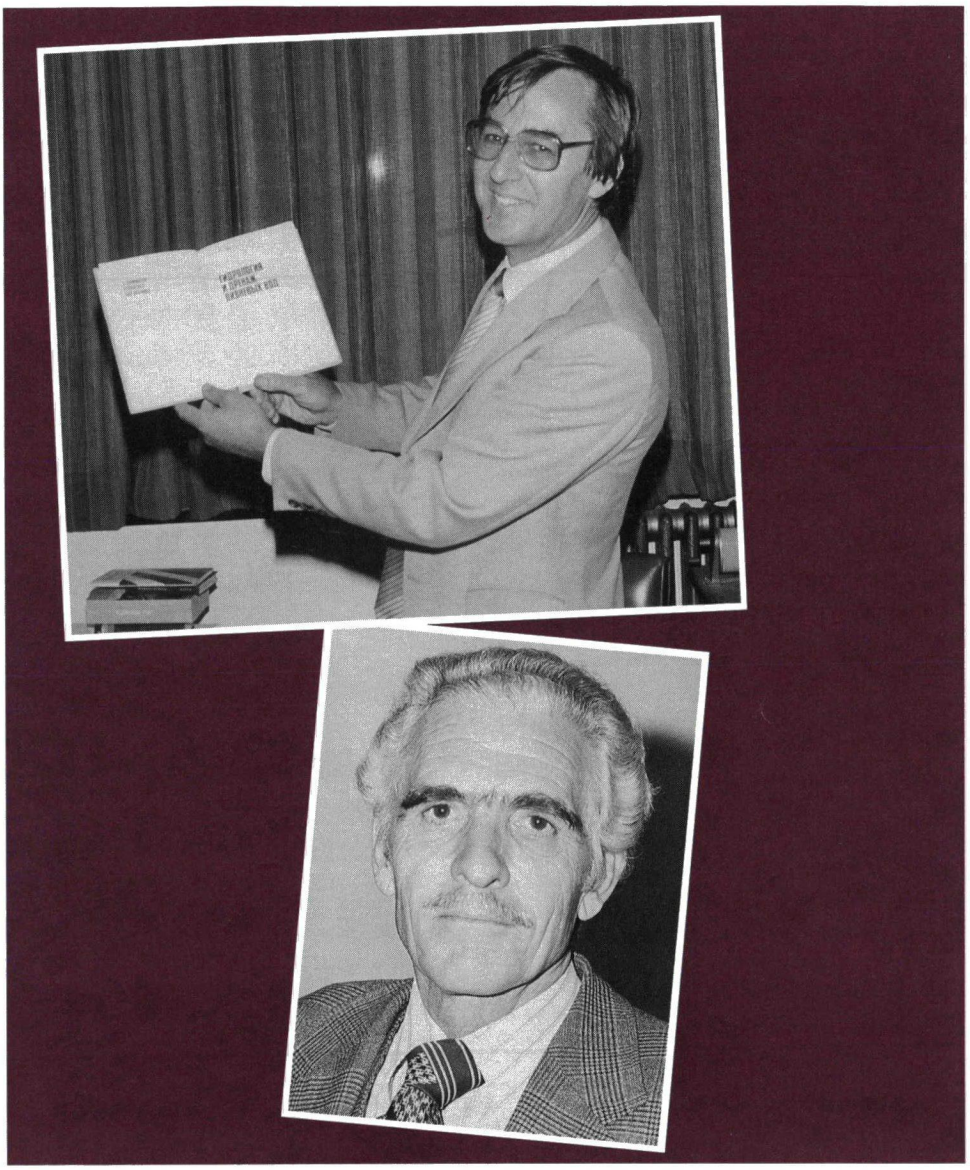
In an interview with **SA Waterbulletin**, Professor Stephenson said that the translation came as a complete surprise to him as he had not been informed about it by his publishers "Elsevier Scientific Publishing Company" in Holland.

According to Professor Stephenson, the Russians are very keen on information regarding hydraulic work as they are known to design some of the largest river diversion schemes and pipelines in the world. In the Preface, which was translated for Professor Stephenson by a Polish friend, it is mentioned that his other works are now standard references in Russia.

The research on which the book is based, was done at Wits University and deals with the design of stormwater drains and channels using methods which are completely new in this field. The research undertaken by Professor Stephenson was based on problems he came across as a practising engineer. He believes that the book was of interest to the Russians because it can be applied directly in practise as a design manual.

"I think the Russians are very engineering or practically oriented as opposed to research oriented. My books are aimed more at practising engineers," says Professor Stephenson.

Examples in the book include a number of South African locations e.g. it describes the distribution of a storm which occurred over Pretoria. South African place names are all translated into Russian and even the Apies River in Pretoria received a brand new Russian name.



WRC

MINISTER AANGESTEL

Mnr G J Kotzé is na die onlangse afsterwe van mnr John Wiley aangestel as die nuwe Minister van Omgewingsake en van Waterwese.

Gert Jeremias Kotzé is op 6 Desember 1928 op Nuwedam in die distrik Piketberg, Kaapprovinsie, gebore.

Hy voltooi sy skoolopleiding aan die Hoërskool Willowmore in 1946 en studeer daarna aan die Universiteit van Stellenbosch waar hy in 1951 die graad B.Comm. behaal. Voor hy hom op die plaas Môreson, naby Malmesbury, as voltydse boer vestig, hou hy skool tot 1961.

As lid van verskeie kutltuurorganisasies en boereverenigings is mnr Kotzé aktief betrokke by gemeenskapsdiens. Hy het uitgebreide sakebelange in die Wes-Kaap en dien in die direksie van 'n aantal maatskappye.

Sy politieke loopbaan begin in 1970 toe hy as Provinsiale Raadslid vir Malmesbury verkies word. In 1974 word hy LV vir Malmesbury en op 2 Augustus 1982 aangestel as Adjunk-Minister van Landbou.

Mnr Kotzé is in 1952 getroud met Helena Catherina Steyn van Malmesbury en die egpaar het drie kinders.

BIOLOGICAL INDICATORS OF FRESHWATER POLLUTION AND ENVIRONMENTAL MANAGEMENT

By J M Hellawell, Monitoring Ecologist, Nature Conservancy Council, Petersborough, UK

The volume reviews the current knowledge of the responses of individual organisms and communities to environmental changes and their use as biological indicators of environmental and other disturbances. It discusses the use of biological indicators for encouraging the ecologically sensitive management of freshwaters in the face of the conflicting demands of today's society.
The first three chapters define the basic principles of hydrobiology and introduce the relevant fundamental ecological principles of community organisation, the factors which affect communities, bioaccumulation of poisons, the toxicological properties of pollutants and the effects of engineering operations and other environmental perturbations on different hierarchies of biological organisations.

The following chapters critically review the effects of environmental stress including physical disturbance, nutrient enrichment and the entry of toxic materials. Data, in the form of tables and graphs for ready comparison, provide a valuable work of reference for the specialist. Laboratory evaluation of pollutants, methods of field assessment and the use of biological surveillance in environmental management, are also explained and discussed. The book also contains a selected but extensive bibliography of approximately 1 000 references.

1986, 23 x 15 cm xiii + 518 pages 89 illus.
Price: £65.00
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HYDROLOGICAL FORECASTING

Design and operation of real-time forecasting systems

By Jaromir Nemec, Director, Hydrology and Water Resources Department, World Meteorological Organisation.

The work starts with an evaluation of the uses of stream forecasting for good water management. It proceeds to examine realtime data collection instruments and methods, telecommunication and telemetry systems, data processing and filing procedures and forecasting hydrological models.

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The last section includes examples of forecasting projects designed and built with the author's participation. The book is essential for all practitioners involved in river forecasting and is ideally suited to use by students of hydrology and water resources engineering.

Contents

Introduction. Components of a Hydrological Forecasting System. Selection of Forecasting Procedures. Forecast Updating and Evaluation. Benefit and Cost Analysis of Hydrological Forecasts. Examples of Design of Hydrological Forecasting. Examples of Managements. References. Annexes. Index.

1986 230 pages
Price £33,25
ISBN 90 277 2259 5

Available from Elsevier Sciences Publishers, P O Box 211, 1000 AE Amsterdam, The Netherlands.

ULTRAFILTRATION HANDBOOK

By Munir Cheryan, Ph.D., Professor, Department of Food Science, University of Illinois, Urbana

This book is the first comprehensive presentation of ultrafiltration science and technology. It covers every aspect from chemistry and structure to applications, including chapters on modeling and process design. A great number of tables and graphs provide reference data and processes and equipment are schematically illustrated. The author comprehensively examines applications such as: Food and beverage processing, chemical processing, pulp and paper, water and wastewater processing, biomedical, pharmaceutical and biotechnology. The final chapter is the appendix, containing a glossary of terms, names and addresses of membrane manufacturers, conversion factors and a listing of journals, books and other publications related to ultrafiltration.

April 1986 369 pages
Price Not available
ISBN 0 87762 456 9

Available from Technomic Publishing AG, Elisabethenstrasse 15, CH-4051 BASEL, Switzerland.

STATISTICAL ASPECTS OF WATER QUALITY MONITORING

Proceedings of the Workshop held at the Canadian Centre for Inland Waters, October 7 – 10 1985.

Edited by A H El – Shaarawi, National Water Research Institute, Ontario, Canada and R E Kwiatkowski, Inland Waters Directorate, Ottawa, Canada.

Topics covered in this Workshop fall into two categories: (1) Methods Development, and (2) the Imaginative Application of Existing Methodologies. Subjects covered include: Time Series, Estimation of Loading, Clustering, Model Development, Censoring Data Analysis, Quality Control and Data Acquisition.

The publication of this book is one step towards identifying appropriate statistical techniques and diagnosing problems in Water Quality Monitoring which require new statistical methodologies. The papers presented in this volume represent international expertise, consolidating detailed information on both conventional and new methods.

1986 512 pages
Price US$112.00
ISBN 0 444 42698 1

Available from Elsevier Science Publishers, P O Box 211, 1 000 A E Amsterdam, The Netherlands

AQUATIC SYSTEMS

A symposium on the modelling of aquatic systems as a tool for water resource management will be held at the CSIR Conference Centre, Pretoria, from 17 to 18 August 1987. Registration fee R70.

Enquiries: Inland Water Ecosystems Section, Foundation for Research Development, P O Box 395, Pretoria, 0001. Telephone: (012) 86-9211 x 3634 (Dr R D Walmsley).

INDUSTRIAL WASTES

An international conference on mining and industrial waste management will be held on 17, 18 and 19 August 1987 at MINTEK in Randburg.

Enquiries: Mr J A Wates, P O Box 61437, Marshalltown, 2107. Telephone (011) 836-2471.

WATER VIR OORLEWING

'n Eendagsimposium met die tema Water vir oorlewing word op 21 Augustus 1987 in die konferensiesaal van die Akademie in Hamiltonstraat, Pretoria, gehou.

Vir meer inligting skakel Pretoria (012) 420-2454.

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 of Grahamstown.

Second circulars and registration forms are available from the Organising Committee, Hydrological Sciences Symposium, Department of Geography, Rhodes University, P O 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 Saint-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.

WATER FOR DEVELOPMENT

A session on the socio-economic aspects of water management and its implications for World Development will be held as part of the IWRA Congress in Ottawa, Canada, from May 30 to June 3, 1988. The conference will also deal with education and training and the value of international aid.

Enquiries: The Secretariat, Sixth IWRA World Congress on Water Resources, University of Ottawa, 613 King Edward Avenue, Ottawa, Ontario, Canada K1N 6N5.

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.

NITROGEN POLLUTION

A specialised conference on nitrogen pollution of water will be held in Brussels, Belgium, from 24 to 28 November 1987. The aim of the conference is to up-date all present knowledge related to nitrogen and water of all kinds.

Enquiries: Dr W J Masschelein, Laboratories CIBE, 764 Chaussee de Waterloo, B-1180 Bruxeelles, Belgium.

WASTE WATERS

An international specialised conference on the microbiology of waters and waste waters will be held in Irvine, California, USA from February 8 to 11, 1988. The conference will be a scientific forum in which the latest research and practise in the microbiology of all aspects of waters and wastewaters will be reported.

Enquiries: Professor David Jenkins, Department of Civil Engineering, 607 Davis Hall, University of California, Berkeley, CA 94702, USA.

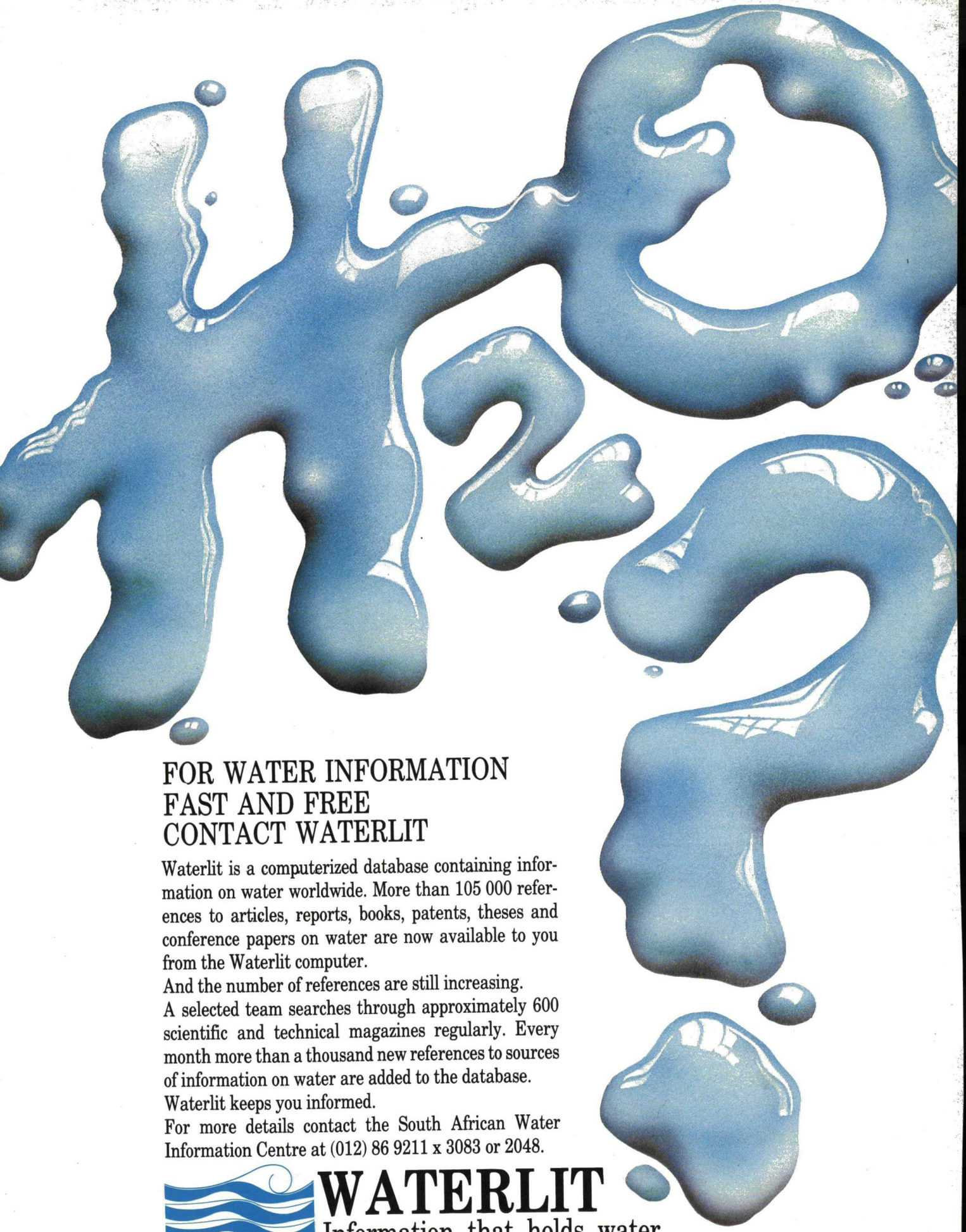
ICA Symposium

Instrumentation Control Automation (ICA) in water and waste-water management

The National Institute for Water Research
The Water Institute of Southern Africa
The Water Research Commission and
the Department of Water Affairs present a symposium on ICA on 19 November 1987 in the CSIR Conference Centre S467.

The program will be made up of various case studies in the application of ICA. These will cover the use of ICA in water purification as well as the treatment of domestic sewage and industrial effluent. Aspects which will receive special attention are parameters measured, equipment available, results obtained and problems encountered.

For more information on this symposium please return the enclosed reply card.



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