

S4 waterbulletin

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WATER POLLUTION

Research leads to new plant for the dewatering of waterworks slurry

GRONDWATER

Wetenskaplikes ontwikkel begraafplaas vir kernafval

AKWAKULTUUR

Baberboer pas visnavorsing toe

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The WRC announces the second impression (1987) of

Agrohydrology and -climatology of Natal by RE Schulze

A study that evaluates the influence of available water on the agricultural potential of Natal.

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The approach used in this survey has been founded on four basic principles:

- ☐ The 'driving forces' of all agricultural growth and potential are the availability of moisture and solar energy, the latter energy index being described by temperature. Analyses of precipitation and temperature therefore form a vital component of this survey.
- ☐ It is the interaction of precipitation and temperature (as expressed through evapotranspiration) on crops with certain growth characteristics and cultivated in soils with given properties that determine the productivity of a given area. These interactions are best analysed by a water balance (i.e. soil moisture budgeting) approach, and a basis for this has been the development of the ACRU Agrohydrological Model.
- ☐ The climatic statistic most commonly available to agriculturalists is the mean annual precipitation (MAP) of a locality. As far as possible agrohydrological and -climatological indices have therefore been related to MAP in maps and nomographs prepared for the user.
- ☐ Climatological variables are measured at irregularly spaced fixed points (e.g. climate stations) but are most frequently required for planning at localities where no measured data are available. The primary agrohydrological variables (precipitation, temperatures, soils information) were therefore estimated by interpolative techniques at intersections on a square grid of side 10 km over Natal. From the 1002 grid point values computer maps were constructed.

The manual consists of two parts: a basic and an applied information section.

*** BASIC INFORMATION SECTION**

Comprises detailed user maps of Natal for

- Rainfall
- Rainfall variability
- Drought indices
- Temperature, showing minimum and maximum temperatures
- Potential evaporation

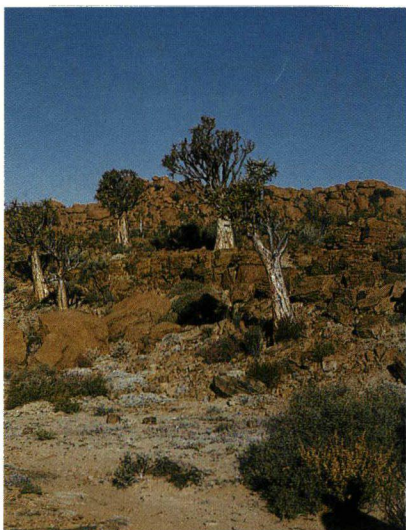
*** APPLIED INFORMATION SECTION**

Deals with

- Agricultural productivity potential within Natal
- Aspects of veld and pasture management and production
- Dry land crop production potential
- Water requirements for irrigation
- Optimum areas for commercial timber production

While scientific methods form the basis of the various analyses undertaken, the endeavour has been to present results at the level of the user, namely, the extension officer, agricultural consultant and the farmer. For this reason nomographs as well as worked examples have been given where relevant.

This manual is best used as a tool for regional, comparative planning and some care has to be exercised in making use of information at farm level.



Boesmanland in die Noordwes-Kaap waar wetenskaplikes 'n wegdoenfasiliteit vir kernafval ontwikkel het. Sien artikel op bladsy 10.

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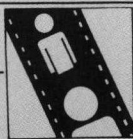
SA Waterbulletin is 'n tweemaandelikse tydskrif oor water en waternavorsing wat uitgegee word deur die Suid-Afrikaanse Waternavorsingskommissie (WNK), 'n statutêre organisasie wat in 1971 by Wet gestig is.

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The annual participants' meeting of the National Research Programme for Waste Management and a symposium on Waste Management was held recently at the Helderfontein Conference Centre, North of Johannesburg.

The symposium was organised by the Foundation for Research Development (FRD) of the CSIR and lasted for three

days. Topics included protection of the environment from chemical, hazardous and toxic wastes; pollution from domestic refuse sites and the utilisation of organic waste.

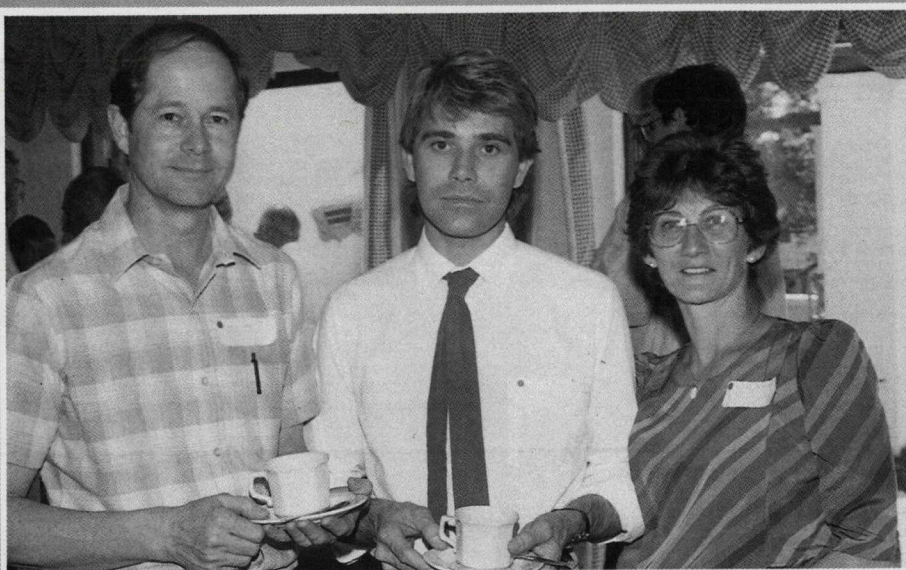
A major theme throughout the programme was the improvement of technology to enable the safe handling, transportation and disposal of waste, in the cheapest possible way.

The control of environmental pollution was addressed with the main focus on the management of leachates from disposal sites. This involves the technology of disposal site design, interactions between waste materials, lining materials and the protection of groundwater resources,

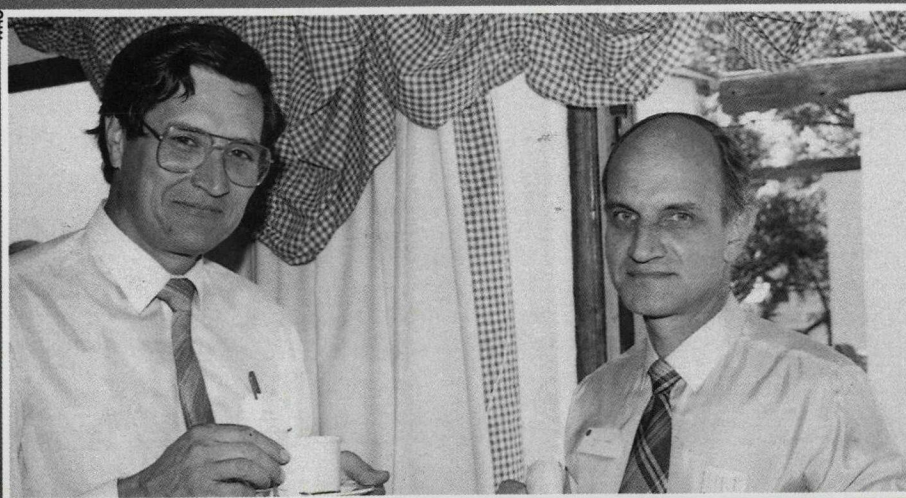
which are likely to become increasingly important sources of water supply.

Much attention was also given to the ongoing search for materials which can be recovered from waste for reuse.

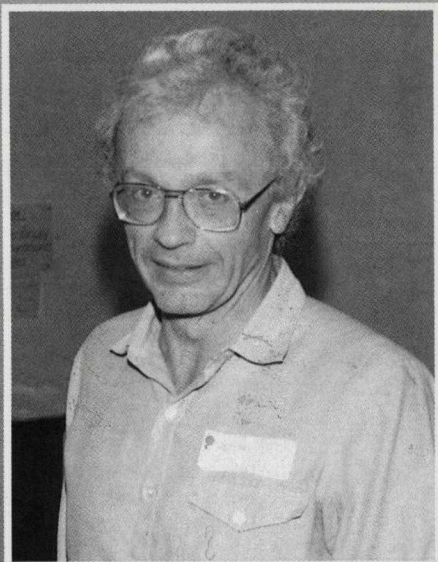
At the conclusion of the symposium, Mr Jaap Malan of the FRD said that the programme had succeeded in evoking different points of view as well as criticism from the participants. He believes that this interaction is important and gives each researcher the opportunity to make a positive contribution to his field of study.



From left: Prof M B Markus (Wits University), Dr T J M Daly (Wits University) and Mrs J M G van Deventer (Wits University).

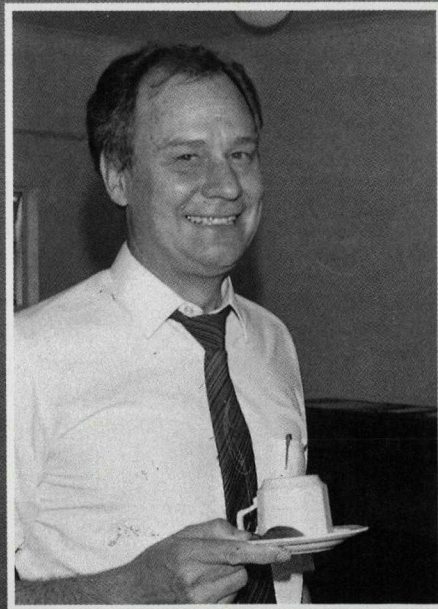


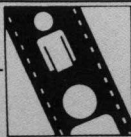
From left: Prof A J Reinecke (University of Potchefstroom) and Mr A Haveman (SATS).



Dr R G Noble (FRD, CSIR)

Prof W A Pretorius (UP).





A symposium on forest and mountain catchment hydrology was held at the Fruit and Fruit Technology Research Institute in Stellenbosch in November. The symposium was organised by the South African Forestry Research Institute of the Department of Environment Affairs to mark the fiftieth year of research in mountain catchments of South Africa.

Researchers in forestry, hydrology and ecology as well as planners and managers of natural resources, were present at the symposium.

Papers presented, dealt with

- trends in the supply and demand of water, timber and other renewable and non-renewable resources
- progress with research and future needs; and
- the systematic integration of knowledge which can be applied to conserve mountain catchments.

Participants visited the Jonkershoek Forestry Research Centre where research on the ecology and hydrology of fynbos, grassland and pine plantation ecosystems is being undertaken.

In his opening address, the Minister of Environment and Water Affairs, Mr G J Kotzé, said that the future lies in integrated catchment management. The challenge will be to increase timber production in South Africa and at the same time decrease the forestry industry's overall demand for water.



From left: Mr S R Juhnke (Jonkershoek FRC) and Mr P H van Niekerk (Department of Water Affairs).



Dr BW van Wilgen from the Forestry Research Centre at Jonkershoek, explains the effect of fire on fynbos ecosystems.



From left: Dr J P Kriel (WRC), Mr P E Odendaal (WRC) and Prof J Mcl Daniel (Rhodes University).



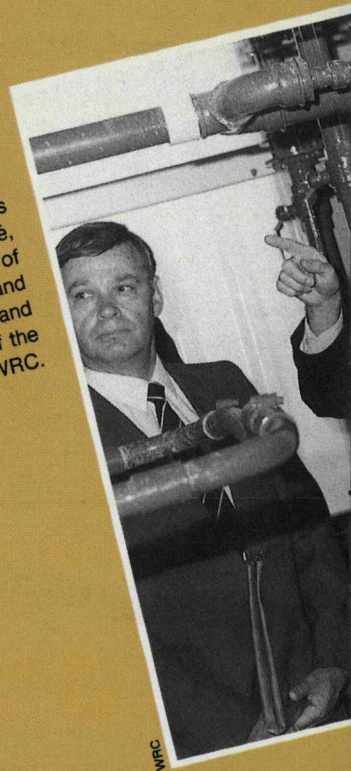
From left: Mr J F Kruger (Forestry Research), Mrs B Marais, Dr P G Marais (Fruit and Fruit Technology Research Institute) and Mr A van der Dussen (Forestry Branch, Department of Environment Affairs).

F·I·L·T·E·R



Tubular filter press (fig. 5). Filter tube array under pressure.

Mr M I Buchan of the Umgeni Water Board explains the new dewatering process to Mr G J Kotzé, the Minister of Environment and Water Affairs, and members of the WRC.



WRC

BREAK-THROUGH

A cost-effective water conservation filter has been developed by the Pollution Group of the Department of Chemical Engineering, University of Natal, under a Water Research Commission grant.

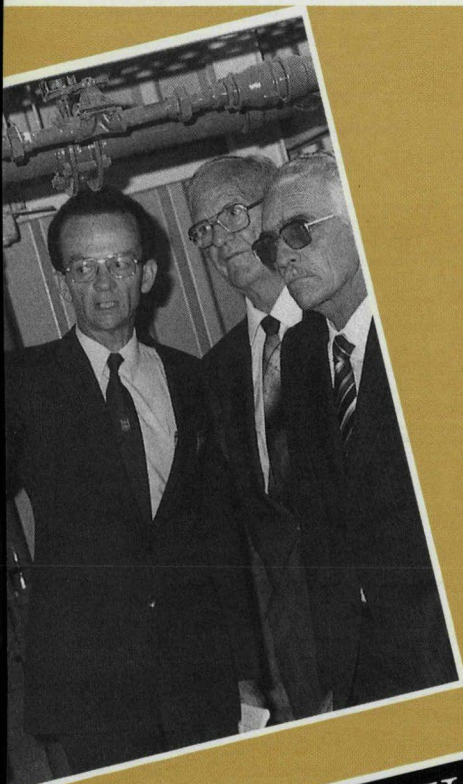
This South African innovation known as the tubular filter press, filters sludges from effluent streams, concentrates the solids

and releases the cleaner water to be used again.

Dr Oliver Hart, Senior Adviser of the Water Research Commission, says the filter press can be used in many operations which require the removal of waste solids from water, but is especially suited for the dewatering of waterworks' slurry, a process which has long been a serious problem at many water works.

The filter concentrates water works' waste sludge from a slurry, at solids concentrations of 10 to 30 g/l, to cake at a solids concentration of 30 to 35 per cent mass/mass.

A prototype of the filter press was constructed under a joint agreement between the Water Research Commission, the Umgeni Water Board and the University of Natal at the Umgeni Water Board's HD Hill



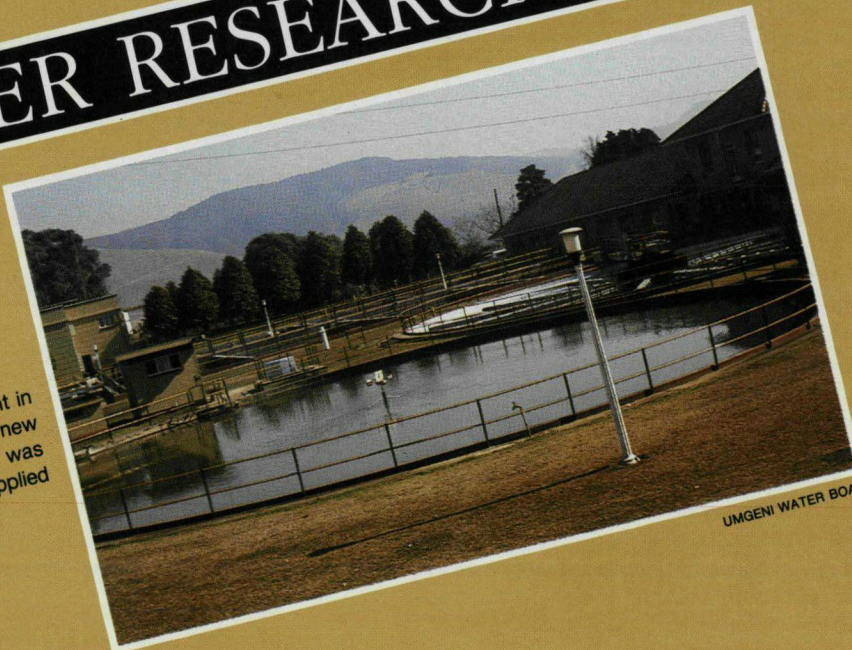
Tubular filter press
(fig 4). View from
the feed end.



UMGENI WATER BOARD

FOR SA WATER RESEARCH

The HD Hill water treatment plant in
Pietermaritzburg where the new
sludge dewatering technology was
applied



UMGENI WATER BOARD

water treatment plant in Pietermaritzburg, and is operating successfully.

The project capital for the prototype with a capacity of 50 m³ a day was provided by the Umgeni Water Board while the process design construction and project management was undertaken jointly by the Umgeni Water Board and the University of Natal.

The unit was designed to treat the

waste sludge resulting from the treatment of 30 000m³/d of surface water from the Henley Dam. A polyelectrolyte with the occasional addition of bentonite is used as the water coagulant. The sludge has a concentration of approximately 15 g/l and a flow of about 50 m³.

The prototype features low capital and operating costs as it is computerised and operates with minimal labour.

At the official opening of the plant the Minister of Environment Affairs and of Water Affairs, Mr G J Kotzé, said it is a known fact in South Africa that for many years some local authorities and water boards discharged waterworks sludge and wash water directly into watercourses. These discharges contain substances which are foreign and harmful to the ecology of rivers. The benthic biota, which are

largely responsible for the process of self-purification in rivers, can also cause problems for consumers downstream of the works, since the sludge load in the water increases and therefore places a bigger load on downstream treatment works.

The Minister said practice of direct discharge is no longer acceptable and the Water Act stipulates that waste waters which originate at waterworks must comply with the prescribed standards for the discharge of industrial effluents. The onus, therefore, is on the authorities which operate water treatment works to carefully consider and investigate sludge handling methods.

He said the characteristics of waterworks sludge will depend on the flocculants which are used in the treatment of the water. Consequently there is no single sludge treatment method which will be appropriate in all cases. Different methods are therefore utilised, such as drying beds, vacuum filtration, centrifuges, filter presses and ponds. Each of these methods has specific cost implications in respect of energy and capital expenditure for equipment and land. Naturally, the ideal would be to find an inexpensive method of dewatering sludge to the point where it can be easily handled and disposed of physically.

Although a thorough cost evaluation still needs to be done, it would seem as though this new tubular filter press technology, developed in South Africa, could meet these requirements. Furthermore, it has the additional advantages that all the capital equipment can be manufactured locally with resultant savings in foreign exchange. The water component of the slurry, which would otherwise have been lost, can now be reclaimed and recycled to the inlet of the purification plant, thereby saving a substantial amount of water. Because of the considerable variation in the nature of sludge, it may not always be possible to apply this technology directly. In some cases it may be necessary to solve a particular problem by combining this technology with other methods.

The Minister said that applications had been lodged for the international patenting of this new technology, and that an agreement had been negotiated for the international commercialisation of the process. He said a large overseas water authority is already actively interested in evaluating this technology, also at prototype scale.

TUBULAR FILTER PRESS DESCRIPTION

A schematic diagram of the process is

given in Figure 1. The tubular filter press consists of a feed tank, a pressure pump, the filter tube array, a filtrate collection tray and sump, a tube flushing and cleaning pump and an automatic cake removal and tube cleaning system.

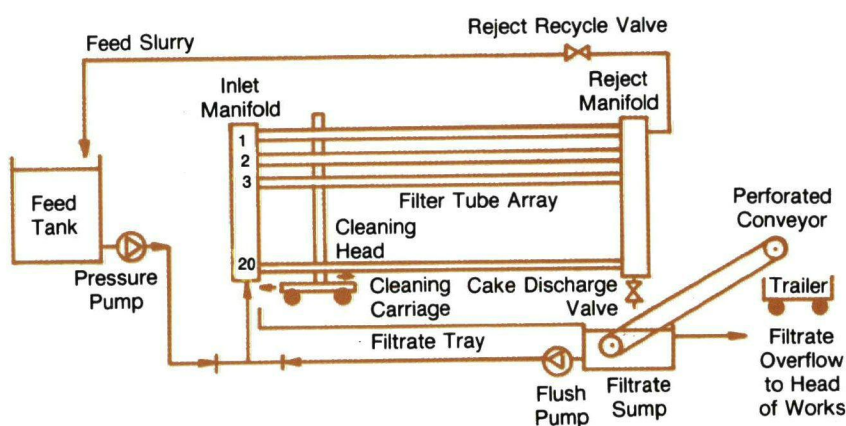


FIGURE 1: Tubular filter press process schematic

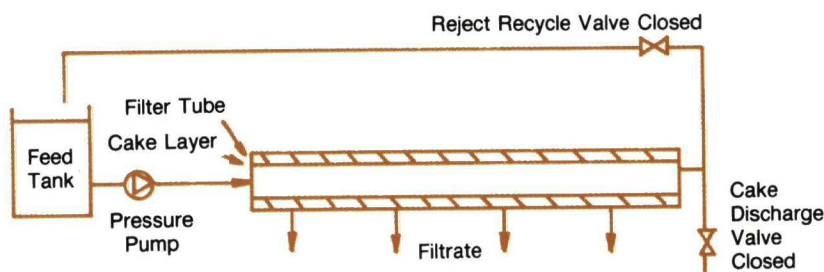


FIGURE 2: Single tubular filter press showing deposition of cake layer

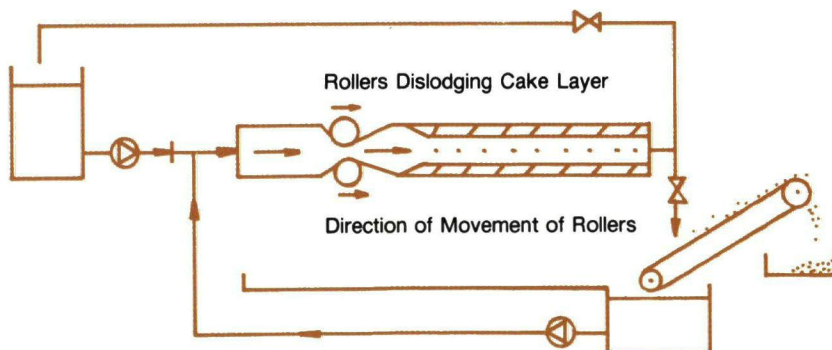


FIGURE 3: Rollers creating a restriction in the tubular filter press tube and dislodging the cake

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COURSE FEES

The fee per delegate for the course will be:

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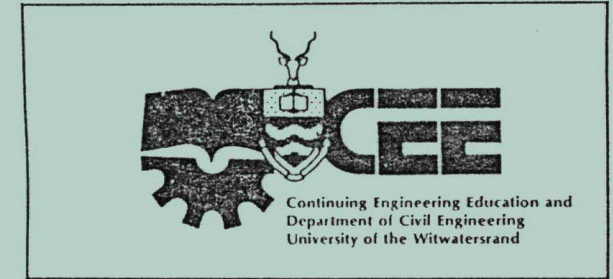
The number of participants is limited and final acceptance will be based on a first come first served fully paid basis.

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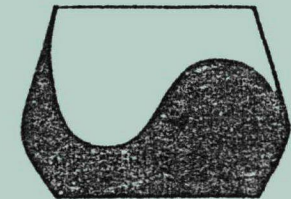
CONVENOR

For technical enquiries
Prof D Stephenson
Department of Civil Engineering
University of the Witwatersrand
Telephone (011) 716-2560



AN INTERNATIONAL SHORT COURSE

WATER RESOURCES IN DEVELOPING AREAS



11 — 13 January 1988

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WHO SHOULD ATTEND?

The course is primarily for practicing engineers engaged or wanting to engage in water resources development in under-developed areas. Be it for irrigation, rural supply, hydro power or industry, water is an inexhaustible resource which can be a catalyst for development and provide job opportunities.

The course introduces planning and funding, as well as background in the relevant technologies. Emphasis is on community development and national objectives.

SPEAKERS

Guest speaker is Prof Margaret Petersen of the University of Arizona. Prof Petersen also worked for the Bureau of Reclamation and is responsible for their Hydraulics Department, and the author of two books in water resources. She has worked as consultant to many developing countries including Africa and has many examples of bad as well as well planned projects.

Other speakers from the Development Bank, Government Departments, and Consultants will present specialized aspects. Prof David Stephenson is convenor. His research group is engaged in a number of water resource projects in Transkei and other neighbouring countries.

COURSE CONTENT

- (1) Water resource assessment, multi-purpose development.
- (2) Hydrological networks in developing areas.
- (3) Planning models.
- (4) Benefit cost studies.
- (5) National policies.
- (6) Role of women.
- (7) Job creation, training.
- (8) Hydro power.
- (9) Irrigation.
- (10) Soil conservation.
- (11) Funding.
- (12) International case studies.
- (13) Rural water supplies.
- (14) Environmental and social impact assessment.

Workshops on irrigation planning, economic analysis and socio-enviro impact assessment will take place in the afternoons.

LECTURERS

Prof Margaret Petersen — University of Arizona, and US Bureau of Reclamation.

Prof D Stephenson and Staff from Water Systems Research Programme.

Dr Robert Clark, Director, Hydrology, US Weather Service.

Officials from banking and government departments and consultants.

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11 — 13 JANUARY 1988

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The tube array is made up of filter tubes woven from polyester yarn in a curtain connected between an inlet and a reject manifold. The diameter of the tubes can range from 25 to 50 mm and the length from 10 to 20 m, depending on the application.

The feed slurry is pumped under pressure into the tube array against a closed reject recycle valve. As the pressure in the tube array increases the filtrate permeates through the tube walls and the slurry solids are deposited as a cake in the inner walls of the tube (Figure 2). The cake thickness increases with time and is monitored by measuring the filtration rate.

When the desired cake thickness has been achieved the outlet valve is opened and the flush pump started. The cake is dislodged from the inner tube surface by the action of the cleaning head moving along the tubes (Figure 3). The cleaning head houses a pair of rollers which, when engaged, create a restriction in the tubes. The resultant high velocity and turbulence at the constriction dislodges the cake from the tube surface. The cake is then conveyed out of the tanks in the bulk fluid flow and is collected on a perforated conveyor belt. A high-pressure water spray system has also been installed on the cleaning head in order to clean the filter fabric whenever necessary.

The process operation is cyclic, each cycle consisting of a cake formation stage (typically lasting 10 to 60 min depending on the feed sludge concentration), and a cake removal stage (typically 2 to 4 min). Feed slurry is pumped under level control into the feed tank, filtrate is returned under gravity to the inlet of the water works and the cake is deposited in a trailer prior to dumping. The entire process is micro-processor-controlled and requires a minimum of operator attention.

PROTOTYPE UNIT RESULTS AND TREATMENT CAPACITIES

Solids concentrations of the feed, filtrate and cake streams are given in Table 1.

The cake production capacity of the prototype unit at various feed solids concentrations is given in Table 2.

The estimated treatment capacity for various sized filter tube arrays is given in Table 3.

The treatment capacity is directly related to the specific cake resistance of the slurry.

PROCESS CHARACTERISTICS

LOW CAPITAL COST

The filter cake is formed inside the fabric tubes, thus avoiding the need for filter plates as used in standard filter presses. The cake thickness is approximately one fifth of that produced in conventional filter presses which reduces the filtration area. The tubular filter can be housed in a light industrial building.

LOW OPERATING COST

Power requirement is approximately 7 kWh/ton dry solids at a feed concentration of 25 g/l and a pressure of 400 kPa. The process operates without chemical addition, is fully automated and self-cleaning and requires a minimum of operator supervision.

CAKE AND FILTRATE QUALITY

The cake solids concentration is about 35 per cent and is discharged in the form of finely divided flakes which are well-suited to rapid secondary drying. The filtrate is suitable for recycling to the head of water treatment plant.

All enquiries should be addressed to Mr E J A Coopmans, Explochem Water Treatment (Pty) Ltd, P O Box 89567, Lyndhurst 2106, South Africa.

TABLE 1: Prototype unit: Feed, filtrate and cake solids analysis (bentonite/poly-electrolyte sludge)

	Feed susp. solids g/l	Filtrate susp. solids mg/l	Cake solids conc. % mass/ mass
Mean	25	55	31
Range	2 to 50	0 to 200	28 to 35

TABLE 2: The effect of feed solids concentration on prototype unit cake production capacity at feed pressure of 400 kPa (bentonite/polyelectrolyte sludge)

Feed conc. g/l	Process time min	Clean. time min	Total cycle min	Cake per cycle kg dry/ m ²	Prod. rate kg dry/ m ² .d
25	26	4	30	0,8	38
50	13	4	17	0,8	68
75	9	4	13	0,8	89

TABLE 3: Estimated cake production capacity for various filter tube array sizes at feed pressure of 400 kPa (bentonite/polyelectrolyte sludge)

Tube array dimensions				Cake prod. capacity per tube array	
Number of tubes	Tube diameter mm	Tube length m	Filtration area m ²	tons/d dry solids	
				Feed solids g/l	
				25	75
20	25	10	15,7	0,6	1,4
40	40	15	75,4	2,9	6,7
40	50	20	125,7	4,8	11,2



Die moderne tegnologie produseer dikwels afvalprodukte wat nie sommer in swart plastieksakke na die naaste vullishoop vervoer en onder die grond toegestoot kan word nie.
Kernafval is so 'n produk. Dit bevat radioaktiewe isotope wat tot 300 jaar 'n gevaar kan inhou en moet daarom op 'n spesiale manier weggedoen word om te verhoed dat dit die omgewing en die grondwater besoedel.
SA Waterbulletin het onlangs gaan kyk hoe die Atoomenergie korporasie van Suid-Afrika Beperk (AEK) die probleem van kernafvalwegdoening in Suid-Afrika hanteer.

Kernafval in Boesmanland drooggesit

'n Kernkragstasie produseer tydens normale bedryf medium- en laagaktiewe afval (MLAA). Die mediumaktiewe afval bestaan hoofsaaklik uit harse, ventilasiefilters en verdampde konsentraat terwyl die laagaktiewe afval daaglikse besmette gebruiksgoedere soos handskoene, glasware, plastiekhouders en klerasie behels. Die belangrikste radioaktiewe isotope wat in dié afval voorkom, is kobalt-60, strontium-90 en cesium-137 wat na 'n vervalperiode van ongeveer 300 jaar eers onskadelik is.

Na die oprigting van die Koebergkernkragstasie naby Kaapstad, moes Suid-Afrikaanse wetenskaplikes 'n geskikte terrein vind waar die kernafval veilig weggedoen kan word totdat dit onskadelik is. Koeberg sal jaarliks nagenoeg 2 000

dromme MLAA produseer wat weggedoen moet word. Hiervan sal ongeveer 1 500 met laagaktiewe afval gevul wees en die res met mediumaktiewe afval.

'n Deskundige studiegroep oor Alternatiewe vir die Beheer oor Radioaktiewe Afval vir Handelskernkrag in Suid-Afrika is in 1978 gestig en het aanbeveel dat die Staat 'n program aanpak om 'n fasiliteit daar te stel vir die wegdoening van radioaktiewe afval in Suid-Afrika. Die Staat het die verantwoordelikheid aanvaar en die Kernontwikkelingskorporasie (vandag bekend as die Atoomenergiekorporasie) was aangestel om namens die Staat 'n geskikte terrein te vind en die fasiliteit in bedryf te stel.

Die eerste ondersoek was 'n kantoorstudie waar talle gebiede in Suid-Afrika, wat vir die berging van kernafval geskik sou wees, onder meer gemeet is aan kriteria soos bevolkingsdigtheid, landboupotensiaal, minerale rykdom en die jaarlikse reënval.

Aanvanklike ondersoeke het getoon dat die Noordwes-Kaap die waarskynlikste gebied vir die ontwikkeling van 'n wegdoenfasiliteit is. Die ondersoek is uitgebrei en die geskikste terrein is geïdentifiseer by Vaalputs, 'n plek sowat 100 km suidoos van Springbok (600 km noord van Kaapstad). In 1983 is drie plase deur die Staat in dié semi-woestynwêreld gekoop en is die terrein, wat vandag bekend staan as die Vaalputs Nasionale Fasiliteit vir die Wegdoening van Radioaktiewe Afval, daar ontwikkel deur die AEK.

Die terrein, wat uit die gedeeltes Garing en Geelpan van die plaas Vaalputs en die gedeelte Stofkloof van die plaas Bokseputs bestaan, beslaan 'n oppervlakte van nagenoeg 11 000 hektaar. Na indringende studies oor die grondformasies, die grondwater, plantegroei, diere en insekte op Vaalputs, is die Geelpanblok as die geskikste gebied vir die wegdoenterrein aanbeveel. Die terrein is 700 meter by 500 meter groot en 'n bufferstrook van 200 meter is om die terrein gelaat as bykomende veiligheidsmaatregel.

AFVAL

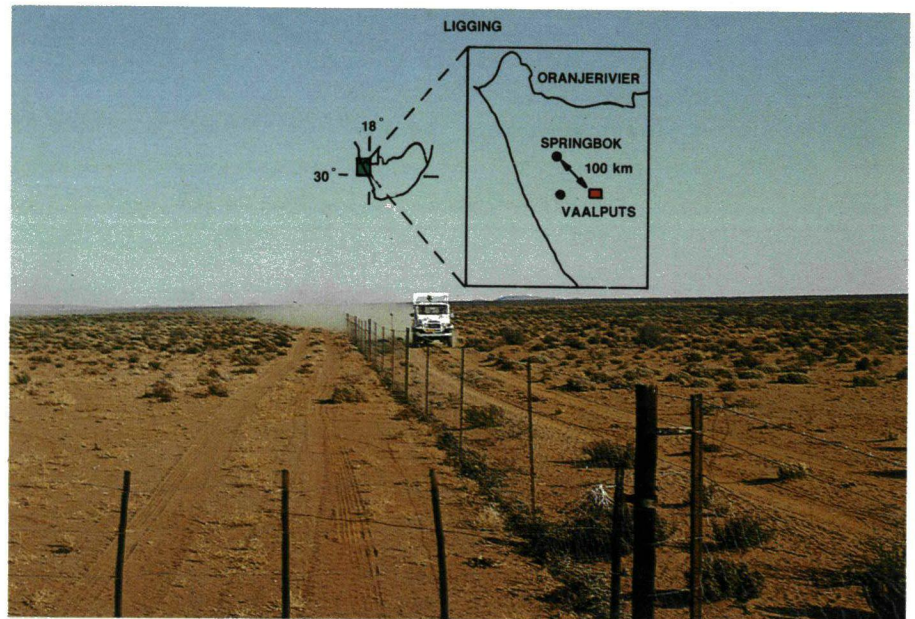
Radioaktiewe afval is skadelik as dit aan die omgewing vrygestel word. Die afval moet dus geïsoleer word sodat geen water daarmee in aanraking kan kom nie. Hierdie

isolasie moet vir 'n tydperk van tot 300 jaar effektief behou word om besmetting van die omgewing te voorkom.

Indien die houters waarin die afval geborg word met water in aanraking sou

se afdeling heeltemal tevrede is dat die grondwaterpatroon op Vaalputs baie geskik is vir die berging van radioaktiewe afval in die gebied.

"Die grondwater beweeg baie stadig en



Die Vaalputsterrein naby Springbok in die Noord-Kaap

kom, kan die radioaktiewe isotope uitloog en in die ondergrondse water beland. Die roetes waarlangs die isotope die omgewing kan besmet, moet deur soveel versperrings as moontlik uitgeskakel word. Die versperrings, in die vorm van spesiaal ontwerpte houters en 'n geskikte geologiese formasie vir bergingslote, is dus baie belangrik.

Die afwesigheid van grondwater by 'n wegdoeningsfasiliteit vir radioaktiewe afval, veral waar die water 'n hulpbron is, is een van die belangrikste oorwegings by die keuse van die regte terrein. Grondwater verskaf die hoofvervoermeganisme vir normale radioaktiewe vrylatings oor die langtermyn. Wanneer die belangrikheid van die grondwater oorweeg word, is kennis van die poreusheid en indringbaarheid van die grond, die ligging van die waterdrasiers, die aard van breuke, hidrouliese gradiënte, dispersiekoëffisiënte en ionenuitruilingsvermoë van die klei sommige van die parameters wat evaluering vereis.

Mnr Manie Levin, Hoof Wetenskaplike, Departement Geotegnologie van die Atoomenergiekorporasie, het aan SA Waterbulletin gesê dat die AEK se geotegniese

daar is min aanvulling tot grondwaterreserwe. Die grondwatervlak is diep genoeg dat indien isotope in die reënwater sou deursypel, dit waarskynlik so lank sou neem om die grondwatervlak te bereik dat die radioaktiewe isotope reeds skadeloos sou wees."

Die volgende eienskappe van die Vaalputsterrein wat deur die ondersoek aan die lig gekom het, maak die terrein besonder geskik vir die wegdoening van medium- en laagaktiewe afval:

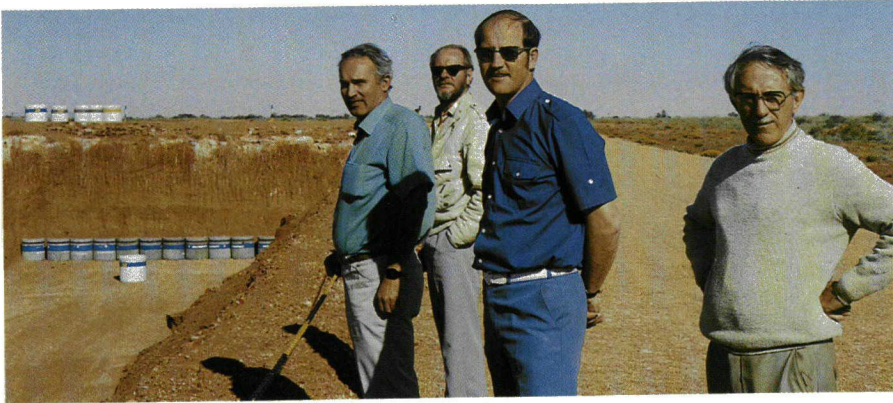
KLIMAAT

Vaalputs lê op die Boesmanlandplato en temperature bereik uiterstes: soms meer as 40 °C bedags en 0 °C snags.

Alhoewel Vaalputs in die oorgangsones tussen somer- en winterreënval geleë is, dui die data op 'n neiging tot somerneerslag. Die gemiddelde jaarlikse reënval is slegs 74 mm. Die reën kom dikwels in die vorm van stortbuie voor en dit kan meebring dat die totale reënval vir 'n seisoen binne 'n uur kan val. Omdat die gebied op

'n waterskeiding geleë is, loop die water weg en geen opdamming kom voor nie. Ook kan water nie genoegsaam versamel om vloedtoestande te veroorsaak nie.

langse aanvulling van die waterdraers was. Met die uitsondering van een voorbeeld wat in die gruipe in 'n dreineringskanaal voorkom, is geen tritium gevind nie.



'n Wegdoensloot met houe vol mediumaktiewe kernaflval daarin. Van links: mnr M Levin (AEK), mnr J Botha (AEK), mnr A du Toit (Onderwyskollege, Wellington) en mnr C P Swart (AEK).

Die verdamping is in die omgewing van 2 100 mm per jaar, dus ongeveer 30 keer soveel as die jaarlikse reënval.

Die hoë temperatuur, reënpatroon en die verdampingstempo, veroorsaak dat daar min, indien enige, noemenswaardige grondwateraanvulling in die gebied is.

GRONDWATER

Die grondwatervlak lê op 'n diepte van 55 meter onder die oppervlakte en water wat vanaf die oppervlakte deursyfer, moet dus baie diep beweeg om deur die deklaag en dan deur die gekraakte graniet by die grondwater uit te kom. Die bergingslote is slegs agt meter diep en dus op 'n veilige afstand vanaf die grondwatervlak.

Grondwatermonsters is in die omgewing van Vaalputs vir die ontleding van stabiele en radioaktiewe isotope geneem. Die koolstof-14-datering van die grondwater toon konvensionele ouderdomme tussen 2 000 en 13 000 jaar vir die grondwater.

In die breë dui die ouderdomme aan dat die tempo van grondwateraanvulling baie stadig is. Dit is egter moeilik om die absolute ouderdomme van die water te bepaal aangesien dit 'n vermenging van twee of meer waterdraers en dus ouderdomme kan verteenwoordig.

Tritiumontledings van die grondwater is uitgevoer om te bepaal of daar enige on-

Dit toon dat daar die afgelope 50 jaar geen tritiumbevattende (vars) water die grondwater vanaf die oppervlak bereik het nie.

Die soutgehalte van die water neem beduidend toe in die rigting van die Koavallei, ongeveer 100 km noordoos van Springbok, wat 'n aanduiding is van die stadige tempo waarmee die water weg-dreineer. Dié stadige vloei patroon kan voorspel word as mens in aanmerking neem dat

- ☐ volgens 'n topografiese kontoerkaart van die watervlak in die gebied, die kontoere baie ver van mekaar is en die gradiënt dus nie baie steil is nie en
- ☐ die enigste uitvloei van grondwater die verdamping is wat in die Bosluispan in die Koavallei plaasvind. Water word teen 'n baie stadige tempo verplaas deur die verdamping uit die pan en geen fontein of spruite kom in die stelsel voor nie.

Oppervlaktebedekking is oral teenwoordig in die grootste deel van die Boesmanlandplato en in die omgewing van Vaalputs vorm dit deel van 'n groot paleo-alluviale waaier van Middeltersiëre ouderdom (plus minus 25 miljoen jaar) wat ooswaarts van die Kamiesberg uitwaaier. Die terrein is dus geleë in 'n gebied wat in oertye 'n dreineringskanaal gevorm het en met verloop van tyd opgevolg is met puin in die vorm van kleie wat uit die berge versamel het.

'n Algemene geologiese deursnee van die gebied (van bo na onder) toon 'n half-meter los rooi sand, gevolg deur 'n dun gekalkretiseerde laag van een of twee meter bo-op 'n laag sanderige klei van

ongeveer 15 meter. Put-, boorgat- en seismiese gegewens het aangetoon dat slote vir die berging van die medium- en laagaktiewe aflval maklik in dié materiaal gegrawe kon word.

Die kleie wat hier aangetref word, is baie ondeurlaatbaar omdat dit uitswel as dit nat word en 'n digte laag vorm. Tritiumisotoop-ondersoeke het getoon dat reënwater slegs tot op 'n diepte van 3,5 meter deur die klei dring voordat dit weer verdamp. In Desember 1985 het dit binne drie dae 128 mm in die streek gereën – dit word geag 'n een-in-200-jaar-gebeurtenis te wees. Vogprofile na hierdie reën het hierdie waarneming bevestig en na ses maande was die grondvog terug na die normale vlakke voor die reën.

Die reënwater het in 'n eksperimentele sloot versamel. Vogprofile is geneem deur buise 0,5 m van die sloot se wand te plaas.

Uit die resultate het dit geblyk dat die water glad nie deur die klei beweeg het nie. Dit het een jaar geneem voordat al die water uit die sloot verdamp het aangesien geen water kon wegsyfer nie.

Die isotoopvashou vermoë (Kd waardes) van die klei asook die spoed waarmee water daardeur kan beweeg, is ingebou in 'n wiskundige model sodat voorspellings gemaak kan word van hoe ver die radioaktiewe isotope sou kon beweeg binne 'n sekere tyd. Volgens dr Van As, Bestuurder: Departement Isotope en Straling van die AEK, se berekenings wat die stadige beweging van die grondwater en die absorpsie-eienskappe van die grond in ag neem, sal cesium 131 (die vernaamste aflval-isotoop) as dit sonder 'n houer in die grond geplaas word, 750 jaar neem om een meter deur die klei te beweeg. Die cesium sal teen daardie tyd onskadelik wees.

Data toon geen groot seismiese aktiwiteit in die gebied nie en die aanduidings is dat die gebied ten minste die laaste 35 miljoen jaar – die ouderdom van die jongste bekende stollingsindringings – seismies onaktief is.

'n Seismiese stasie op die terrein monitor die gebied daagliks en sal enige aard-skudding in die omstreke dadelik aandui.

Met inagneming van al die gunstige faktore wat die ondersoeke aan die lig gebring het, kan daar min twyfel bestaan dat Vaalputs, en veral die bergingsterrein, een van die geskikste plekke ter wêreld is vir die wegdoen van radioaktiewe aflval.

Die Atoomenergiekorporasie het hom verbind om alles moontlik te doen om die veiligheid van die publiek te verseker. Behalwe om seker te maak dat die terrein keuse so noukeurig moontlik gemaak word, word ook in die bedryf van die stortingsterrein aan alle moontlike probleme aandag geskenk.

Die eerste besending radioaktiewe afval vanaf Koeberg Kernkragstasie het in November 1986 op Vaalputs aangekom. Alle radioaktiewe afval wat hier weggedoen moet word, moet in 'n vastestof vorm verwerk wees voordat dit na Vaalputs vervoer word.

HOUERS

Laagaktiewe afval word in metaaldromme

skadelik raak. Die vervasting en verpakking van die afval vind plaas by Koeberg, in 'n fasiliteit met dik betonmure en 'n afstandbeheermeganisme om die veiligheid van die operateur te verseker.

Eskom vervoer die houters na Vaalputs met vragmotors waarvan die laaibakke spesiaal vir die doel ontwerp is. Vanweë die seëlproses en afskermingsvermoë hou die houters geen gevaar vir die publiek in nie.

Om egter die veiligheid van die personeel op Vaalputs te verseker, word die vragmotors in 'n gebou wat vir die doel gebou is, ondersoek en die houters vir besmetting met radioaktiwiteit en stralingspeile getoets.

Die lug en water in die gebou word beheer en gemoniteer en is afgeskei van die res van die gebou wat administratiewe kantore, laboratoria, werksinkels ens. in-



Die gebouekompleks op Vaalputs waar die houters vanaf Koebergkragstasie in ontvangs geneem en deeglik ondersoek word vir besmetting met radioaktiwiteit.

geberg. Die mediumaktiewe afval word in beton vervas en met versterkingsdrade, 'n laag metaal en betonwande omring wat wissel van 15 tot 40 cm afhangende van die aktiwiteit. 'n Betondeksel word dan oorgegiet om die houer te verseël. Die betonhouters is 1,4 m in deursnee en 1,3 m hoog en weeg ongeveer 5,5 ton.

Albei soorte houters is ontwerp om bestand te wees teen korrosie en verwerking totdat die inhoud daarvan mettertyd on-

sluit. Die toegang van personeel word ook streng beheer.

Indien enige houer beskadig is of om een of ander rede 'n radioaktiewe besmetting toon, word dit deur 'n oorhoofse hyskraan in 'n "rooi gebied" geplaas waar die besmetting hanteer kan word en die houer veilig gestel kan word.

Hierdie voorsorgmaatreëls word getref om te verseker dat die houters veilig hanteer kan word.

SLOTE

Die bergingslote is ongeveer 7,7 m diep en die vloer val effens na eenkant en is met 'n gruislaag bedek. Indien enige water dus op die bodem sou beland, sal dit na een kant toe dreineer. Inspeksietype is in die slote geplaas, drie per sloot, wat die aanwesigheid van enige water op die bodem van die sloot sal aantoon. Hierdie pype steek bokant die oppervlakte uit nadat die sloot toegegooi is en kan gereeld gemoniteer word.

Die slote is 20 m wyd en 100 m lank en die dromme word in 'n spesifieke patroon, 5 m diep in die sloot opgestapel. Daar word noukeurig rekord gehou van die posisie van elke drom asook van sy inhoud – hoeveel en watter soort isotope daarin vervas is.

Die wande van die slote is skuins, teen 'n helling van 85° om te voorkom dat dit intuiem.

Nadat die sloot gevul is, word dit bedek met 'n gekompakteerde kleideksel en 'n sandlaag. By 'n eksperimentele sloot is gevind dat reënwater slegs vir een meter deur hierdie gekompakteerde deksel dring voordat dit verdamp.

Mnr Hendrik van der Westhuizen, Bestuurder: Kernafvaltegnologie by die AEK, vertel dat die terrein voorsiening maak vir drie kernkragstasies se afval en kan uitgebrei word om nog veel meer kernkragstasies se afval te huisves.

Die Vaalputsfasiliteit word bedryf as 'n natuurbewaringsgebied en proewe is gedoen om vas te stel hoe natuurlike plantegroei van die versteurde omgewing ná slootterugvulling weer herstel kan word. Sade en plante uit die omgewing is versamel en die grond vir ses weke met die brakwater deur drupbesproeiing natgehou. Daar is gevind dat die natuurlik veld volledig gerehabiliteer kan word.

Elke sloot sal, nadat dit gevul en bedek is, van 'n duursame "kopstuk" voorsien word wat die inhoud van die sloot aandui. Die fasiliteit sal vir minstens vyf-en-sewentig jaar bedryf word en daar word voorsiening gemaak dat daarna gereelde kwartaallikse inspeksies uitgevoer word vir ongeveer tweehonderd-en-vyftig jaar. Omdat hierdie afval vir ongeveer 300 jaar veilig bewaar moet word, sal die kopstuk verseker dat komende geslagte presies weet wat onder die sand begrawe lê.

MEASUREMENT OF PLANT AND SOIL WATER STATUS

An international conference on the measurement of soil and plant water status was held in July 1987 at Utah State University in Logan, Utah, USA. Dr Derrick Oosterhuis, Professor of Crop Physiology at the University of Arkansas reports for *SA Waterbulletin* on the proceedings.

The conference centered on reviewing the state of knowledge on the theory and instrumentation for measurement of soil and plant water status, as well as introducing some new concepts and methodology. Leading scientists from more than 35 countries were present, and approximately 125 paper and poster presentations were given. A highlight of the conference was the chance for interaction between leading authorities and young scientists from all over the world. It is not practical to summarize all the papers that were presented during the conference, but a brief summary of some of the highlights will be of interest.

SOIL WATER

During the first two days the current status of soil water measurement was reviewed and some exciting new concepts introduced. Historical perspectives were presented by Dr W H Gardner, Washington State University.

The neutron moisture meter was the subject of a number of papers dealing with calibration, plastic standards for transferring neutron probe calibrations, a collimated neutron probe, and application in large diameter boreholes. Presentations also covered the use of the neutron meter in irrigation scheduling in corn and a comparison of the neutron probe in computer model for irrigation scheduling in wheat.

Time domain reflectometry (TDR) is an exciting new concept, and was the subject of five papers. TDR involves measurement of the propagation of electromagnetic waves or signals in the soil, the velocity and attenuation of which depends on the soil properties, especially its water content. Description of the technique and the equipment was detailed, as was use of TDR in hydrological studies.

There was also an interesting paper on the determination of soil water content by X-ray computer tomography and nuclear magnetic resonance (NMR) imaging. Two other papers also dealt with the sophisticated technique of NMR, which together with X-ray tomography scanning and nuclear magnetic scanning, allows repeated measurements *in situ* of soil moisture content and root presence. Prospects of fiber optic sensing in soils, as well as a simple microwave method for the measurement of soil moisture, were also covered.

An overview of soil water potential measurement was given by Dr G S Campbell. This was followed by presentations in the use of soil hygrometers, and evaluation of *in situ* water potential measurement, and a discussion of the accuracy, reliability and durability of soil psychrometers. Use of tensiometers was reviewed and discussed in five papers, which included details on the calibration and testing of a tensiometer-transducer system, and the field evaluation of a tensiometer data acquisition system for hydrological studies on waste

disposal sites. A paper was presented about an electrotensiometer in automated drip irrigation of cotton, and another speaker described irrigation scheduling using gypsum blocks to prevent ground water pollution. Among the many other topics covered in this section were the use of gypsum blocks, the use of date pods to record soil moisture in rangelands, and the application and accuracy of a dielectric soil water content meter.

PLANT WATER

The second two days concentrated on plant water measurements. Dr P J Kramer, one of the leaders and pioneers in the field, gave some historical perspectives and current concerns about plant relative water content and other methods of water measurement. Overviews and updates were supplied by Dr John S Boyer on thermocouple psychrometry, by Dr Niel C Turner on the use of the pressure chamber, and by Dr S B Idso on some of the perils of porometry.

Thermocouple psychrometry was the subject of a number of papers which included temperature-corrected *in situ* psychrometers, calibration of *in situ* hygrometers, measurement of internal plant water potential gradients with *in situ* psychrometers, the use of leaf discs in end-window psychrometers, and the effect of stomatal conductance on vapour pressure determinations of water potential. A technique to measure the water potential of plant stems using a modified *in situ* psychrometer was presented.

A unique and novel technique of non-destructively monitoring changes in water content and water binding in living plant tissue using MMR imaging was described by Dr Kramer. It uses a strong, graduated magnetic field, carefully timed pulses of radio frequency radiation, and computer processing of signals to produce images of intact, living tissues without injuring them. Advances in instrumentation for gas exchange measurements of CO₂ and water vapour were covered by Dr Bingham who maintained that many of these techniques and measurements would probably become common diagnostic tools in the near future.

Remote sensing of canopy temperatures and the crop water stress index were reviewed by Dr R D Jackson. Use of the

techniques for assessing water use in wheat was discussed, as was the link with the physical environment. Also discussed in other papers was the use of an imaging radiometer to measure cotton leaf temperatures, and a thermal infrared multi-spectral scanner to estimate surface thermal responses of forests. Measurement of acoustic emission as a measure of plant water status was covered by a group from Davis, California. The use of rain-out shelters in plant water stress research and minirhizotrons for quantifying root distribution were also discussed.

The measurement of hydraulic conductance, an important aspect of water movement in plants as well as an integral component in modelling studies of water flow, was covered in a number of papers. An update on the heat-pulse method was presented, and a method of sealing xylem resin ducts and using stains to determine

the path of water flow was described. An interesting freezing-cuff technique was described which uses evaporative cooling of liquid CO₂ to freeze small sections at the base of a branch without disturbing its position in the canopy, and thereby allowing the study of foliage under increasing water stress (using the pressure chamber and porometry) compared to unstressed adjacent branches.

In conclusion, the sentiments of one of the distinguished participants at the conference is worth stating, and that is that we live in an exciting time, when many things that have been the life time work of dedicated scientists are beginning to come together for the benefit of science and mankind in general. Developments in many fields are combining to make available techniques and measurements that have only been theoretically discussed in the past.

EQUIPMENT DEMONSTRATIONS

Many of the companies manufacturing instrumentation for measuring soil and plant water status as well as for micro-climate measurements were present with exhibits and demonstrations of their products.

PROCEEDINGS

The proceedings for the conference were printed in three volumes, the first covering soil water measurement and the second covering plant water measurement. The proceedings are available for \$US 35.00 from the Agricultural Experiment Station, UMC 4810, Utah State University, Logan Utah, 84322.

In order to enable the WRC to properly and timeously plan its budget for 1989, it would be appreciated if any water research proposal which your organisation may be planning for submission to the WRC for funding during 1989, could reach the Executive Director before 31 May 1988.

These proposals will be seen as preliminary proposals and consequently only the following information is required:

- ☐ Title of the proposed research project.
- ☐ A short resumé of the motivation for the research and the intended modus operandi. (Approximately two pages).
- ☐ Proposed duration of the planned research.
- ☐ A budget for each year of the proposed duration in which i.a. the following are indicated:
 - Salaries of research personnel to be remunerated from the project funds.
 - Other running expenses.
 - Costs of capital equipment to be purchased for the project.

Should you require any advice or assistance in the preparation of this preliminary proposal, you are invited to consult with the WRC's advisers in this regard.

The merits and priority of all submissions received by the WRC will be considered jointly. You will be informed as soon as possible whether your submission(s) have been accepted for development into detailed research proposals. Thereafter negotiations will be initiated regarding the agreement eventually to be entered into with the WRC. During this development phase close co-operation between the WRC's adviser and the proposer of the research is essential. Finally the proposal will be considered at a meeting of the Commission with a view to a recommendation to the Minister of Water Affairs regarding the funding of the project.

Baberborey



Mnr Wynand Uys se plaas, Moria, naby
Hoedspruit in die Oos-Transvaal. Mnr Uys is
hier besig om met 'n gooi-net babers te vang.



wetenskaplik bedryf

Na baie jare se proefnemings en intensiewe navorsingswerk word babers nou grootskaals vir kommersiële gebruik geteel.

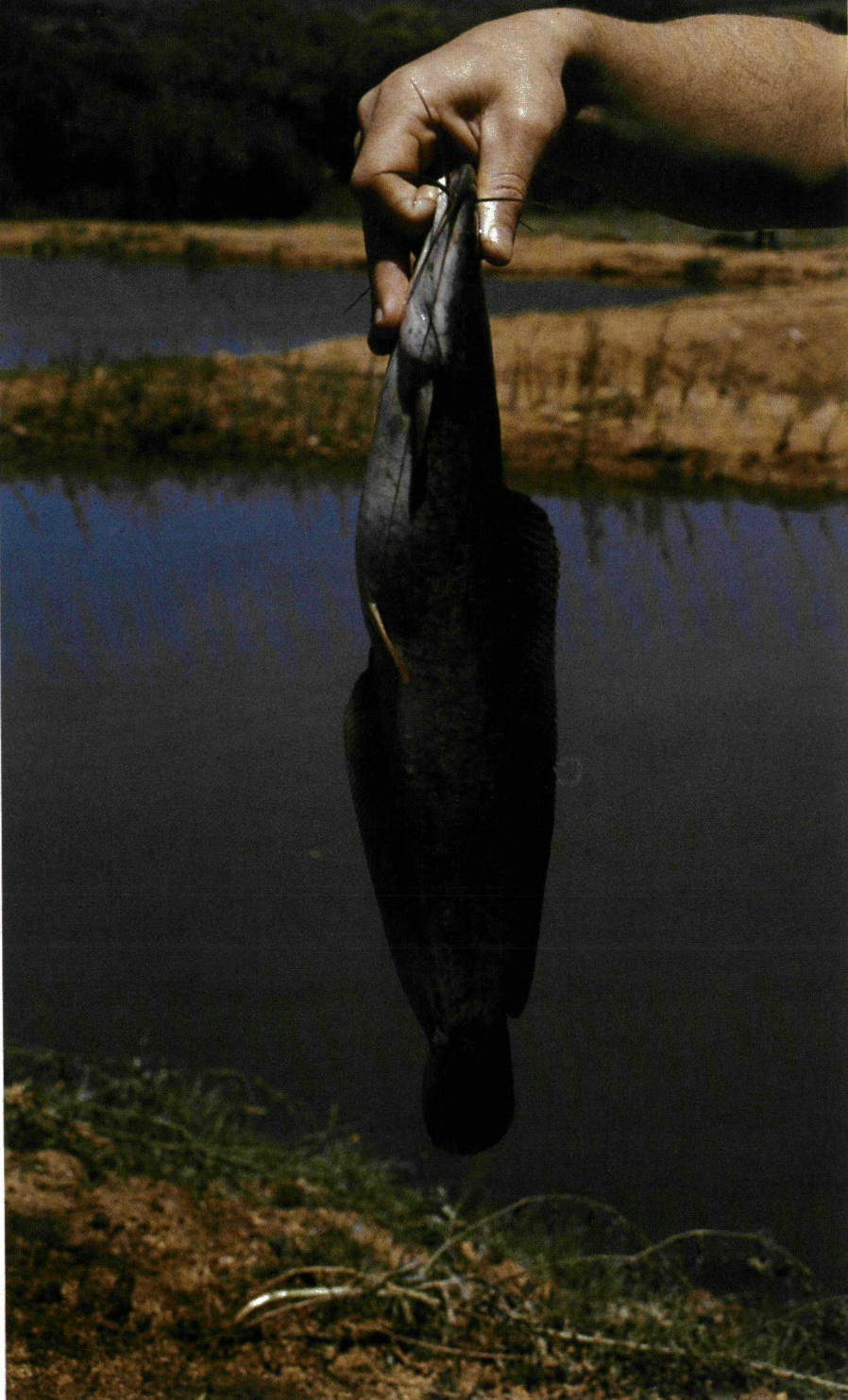
'n Oos-Transvaalse boer, mnr Wynand Uys, is sedert Februarie vanjaar op sy plaas naby Hoedspruit besig met die ontwikkeling van 'n visboerdery wat spesialiseer in die produksie van babers vir die plaaslik mark.

Mnr Uys se plaas, aan die voet van die Drakensberge, beslaan 26 hektaar bewerkbare grond en lê aan 'n kanaal van die Blyderivierbesproeiingskema. Op grond van die plaas se grootte, kan 0,5 kusek water vir boerderydoeleindes gebruik word en spesiale toestemming is van die Departement van Waterwese verkry om die besproeiingskwota vir akwakultuur aan te wend, omdat dit nie normaalweg as 'n boerdery beskou word nie. Mnr Uys sê as hierdie watertoekenning later vanweë uitbreidings in die boerdery ontoereikend raak, sal aansoek gedoen word om water uit die rivier te gebruik. Die uitvloeisels uit die damme moet aan nywerheidstandaarde voldoen voordat dit kan terugvloei na die rivier.

Die produksiedamme op die plaas, hoofsaaklik gronddamme, beslaan elk ongeveer $\frac{1}{10}$ hektaar en wissel van 50 by 20 meter tot 30 by 30 meter, met 'n diepte van gemiddeld een meter.

Water vloei uit die Blyderivierkanaal in 'n leidam wat dien as 'n reservoir. Vandaar word die water deur gravitasievloei met pype en kanale na die 20 gronddamme gevoer. Wanneer die volggroeide babers geoes word, word die dam leeggemaak en die water deur gruiskanale omgelei om die ammoniak af te breek en die water weer bruikbaar te maak. 'n Herkondisionerings-reservoir waarin plante groei wat die nitrates en fosfates in die water kan opneem, sorg vir 'n mate van watersuiwering. Hieruit word die water na verdere produksiedamme gelei.

Geselekteerde babers word vir teelddoeleindes gebruik. Die eiers neem tussen 18 en 36 uur om uit te broei, afhangende van die water se temperatuur. Hierdie proses vind in September, aan die begin van die somerseisoen, plaas. Die vingerlinge word



'n Baber wat gereed is om bemark te word.

Uys het gevind dat die visse baie baat by die gronddamme omdat daar, buiten die voeding wat aan hulle voorsien word, ook natuurlike nutriënte in die damme voorkom. Die visse gaan dan terug na die broeihuis waar gradering plaasvind. Hierdie proses voorkom dat kannibalisme onder die visse voorkom terwyl die groter visse vir broeimateriaal geselekteer word.

Die babers wat voldoende gegroei het tydens die eerste ses weke van hul leeftyd word dan in die produksiedamme geplaas. Tussen die ouderdom van ses maande tot een jaar bereik die visse 'n bemarkbare

babers teen 'n baie hoë besettingsdigtheid in damme geteel. Onder hierdie omstandighede is die produksiesyfer tussen 20 en 100 ton lewende massa per hektaar per jaar.

Mnr Uys se besettingsdigthede vir vingerlinge is ongeveer 100 000 per hektaar. Teoreties sou mens dus 100 ton vis per hektaar kon aanhou maar dit word nie so toegepas nie omdat die nadele van 'n té hoë besettingsdigtheid nog nie bekend is nie.

Mnr Uys glo dat ongeveer 40 ton lewende vis per hektaar in 'n volle somerseisoen geproduseer kan word. Tot dusver het hy



Twee navorsers by Rhodes Universiteit: mnr Peter Britz, 'n nagraadse student en mnr Martin Davies, senior tegniese beampte. Beide is reeds geruime tyd betrokke by die navorsing oor kommersiële visboerdery.

wat aan restaurante in Johannesburg en selfs aan die oorsese mark verskaf kan word, word in die vooruitsig gestel. Hierdie proses sal egter groot uitgawes meebring aangesien 'n slagpale en verpakkings-gewerwe gebou sal moet word.

NAVORSING

Die tegnologie wat mnr Uys in sy boerdery toepas, is gegrond op navorsing wat hoofsaaklik aan Rhodes Universiteit en die Universiteit van die Noorde gedoen is.

Prof Tom Hecht van die Departement Igtologie en Visseriewetenskap by Rhodes, het jare gelede reeds die kommersiële potensiaal van die *Clarias Gariepinus*, algemeen bekend as die baber, herken en intensiewe navorsing oor babers by die Universiteit gedoen. Al die ondersoek was daarop gemik om genoeg basiese kennis oor die teel en grootmaak van die baber in te win sodat dit in die praktyk beoefen kan word. Faktore soos die gewenste waterkwaliteit en -temperatuur, die teel en grootmaak van die larwes en die voeding van die visse het deel uitgemaak van die studie.

Mnr Peter Britz, 'n MSc-student aan die Universiteit van Rhodes, was verantwoordelik vir die navorsing oor die grootmaak van larwes. Hy moes die hoë sterftesyfer, tot 90 persent, probeer teëwerk. Die visies het veral gevrek as gevolg van kannibalisme. Hy het intensiewe ondersoek gedoen in 'n broeihuis waar die besettingsdigtheid, watertemperatuur en -kwaliteit asook die ammoniakkonsentrasie in die water beheer kon word. Uitstekende resultate is behaal en met behulp van sy program, kan larwes nou grootskaals geteel word sodat genoeg beskikbaar sal wees vir produksiedoeleindes.

Mnr Wynand Uys het self vroeër aan die Universiteit van die Noorde navorsing gedoen oor die voedingsbehoefes van die larwes. Sy bevindinge is vervat in sy MSc-verhandeling.

Tans is mnr Uys verbonde aan Rhodes Universiteit en ondersoek hy die voeding van die volgroeide babers in 'n kommersiële omgewing. Die biologiese voedingsbehoefes van dié visse is bekend maar moet in die praktyk aangepas word om die boerdery ekonomies uitvoerbaar te maak. Die program word gefinansier deur die Stigting vir Navorsing en Ontwikkeling van die WNNR.

AFVALPRODUKTE

Mnr Uys skenk veral aandag aan die moontlikheid van afvalprodukte wat met konvensionele voere soos mielies, sonneblomsaad, vismeel en lusern vermeng kan word. In die omgewing van sy plaas is byvoorbeeld verskeie fabrieke waar veselperskes, tamaties en ander vrugte verwerk word. Deur afvalprodukte van hierdie fabrieke te gebruik as bymiddel, kan die hoë koste van visvoere bekamp word. Die wet op veevoere en -middels verbied egter die gebruik van afval, soos hoenderafval en bederfde graan in die vervaardiging van kommersiële voere.

Mnr Uys vervaardig op die oomblik sy eie visvoer volgens formules wat gerekenariseer is. Die voer word op die plaas vermeng, verwerk en verkorrel. Omdat barberboerdery nog in 'n ontwikkelingstadium is, was die aanvraag vir voer tot nou toe nog te klein om 'n veevoermaatskappy vir dié doel te kontrakteer. Daar is egter nou belangstelling by privaatmaatskappye om baberantsoene te produseer.

Baberboerdery hou baie voordele in as dit met die meeste ander boerderysoorte vergelyk word. Dit is nie 'n arbeidsintensiewe operasie nie en mnr Uys meen dat hy, nadat die ontwikkeling op sy plaas voltooi is, slegs omtrent 12 werknemers sal benodig om die visboerdery in stand te hou. Wat dié boerdery ook van ander projekte waar lewendehawe ter sprake is, onderskei, is die feit dat daar tot dusver op mnr Uys se plaas geen siektes by die babers voorgekom het nie. Visvretende voëls wat as tussengasheer dien vir byvoorbeeld rondewurm, word nogtans sover moontlik van die produksiedamme verwilder.

Verskeie opvolgekspperimente sal nog gedoen moet word om die bestaande kennis van barberboerdery aan te vul. Dit sluit onder andere in:

- ☐ Die berekening van die optimale besettingsdigtheid in die produksiedamme sodat die hoogste moontlike massa vis per hektaar geproduseer kan word.
- ☐ Ondersoek na die temperatuurafhanklikheid van die visse sodat met sekerheid gesê kan word hoe temperatuur produksie beïnvloed, asook
- ☐ genetiese navorsingswerk waarin sekere verlangde eienskappe van die vis ontwikkel word.

I·R·R·I·G·A·T·I·O·N

IDES

Irrigation design at your finger tips

IDES is a computer program developed by a firm of consulting engineers, Murray, Biesenbach and Badenhorst in co-operation with Professor D Karmeli of Israel.

WRC



The development of this computer program formed part of a research project conducted on behalf of the Water Research Commission. The main objective of the project entitled: "The Development of procedures for the Design and Evaluation of Irrigation Systems" was to develop a comprehensive procedure for designing irrigation systems.

Mr David van der Merwe, Chief Adviser at the Water Research Commission, says it was clear that this objective could only be achieved by developing a computer program. The computer program could be structured in such a way that it could provide the designer with a series of parameters which would enable him to evaluate the designed system.

The design of an irrigation system includes the following steps:

- ☐ Determining the operational requirements of the irrigation system e.g. the irrigation cycle, application per cycle and the application rate.
- ☐ Choosing an emitter e.g. a dripper, microspray or sprinkler and determining the actual operating programme.
- ☐ Deciding on the size and shape of the land to be cultivated.
- ☐ The design of the main line and
- ☐ The choice of the pump and control systems.

If the designer uses these steps to reach a well-designed goal, for example maximum profits, repeated calculations will have to be made. The designer is however, limited by the tools currently available to him. To formulate an objective at such high level, he must of necessity use certain empirical and simplified yardsticks in order to cut down on the number of calculations needed.

Computers have already penetrated the world of engineers and designers and have brought about a large-scale revolution in the process. However, the influence of the computer has not hitherto been quite so dramatic in the field of irrigation design, mainly as a result of the shortage of suitable software. The development of IDES is an attempt to bridge this gap.

In the development of the IDES irrigation design software, the irrigation design process was systematically analysed, the components that had to be analysed were identified and classified, and thereafter a structure was developed for the entire design process as shown in Figure 1. The

design phase was divided into three modules, namely:

- ☐ Preliminary design
- ☐ Block design
- ☐ Main line design

Figure 1 shows the design phases within each of these modules, and the required input and output of each of the phases. IDES relates only to the design phase, namely the Block and Main line design modules.

BLOCK DESIGN

The block design module was divided into six functions:

- ☐ The compilation of data whereby all information concerning the compilation of IDES was introduced as input and stored.
- ☐ The data concerning the block lay-out is introduced into the computer.
- ☐ The design function in which the pipe diameters are calculated.
- ☐ The evaluation function in which the entire block design is evaluated.
- ☐ The reporting function, from which a report can be obtained on the design and evaluation done. The print-outs obtained at this stage also give lists of pipe diameters and lengths for each part of the block.
- ☐ The maintenance function with which the emitter and pipe data bases can be updated.

The lay-out, design and evaluation functions are the main functions whereby data is introduced, processed and evaluated. In the lay-out function the position of the laterals and branch lines in respect of the slope of the block are introduced.

In the design function the diameter of the pipes, as well as the length of every diameter of pipe are designed, firstly from the laterals and secondly from the branch lines. The graphic polyplot process which forms the basis of the computer model was translated into computer algorithms, and point-to-point hydraulics were used in the computations.

In the evaluation function the newly designed system is evaluated according to parameters that are introduced as input. There are two main types of evaluations that are done, namely a water distribution analysis and an economic cost/benefit analysis.

In the water distribution analysis the

general performance of the system is evaluated, using, for example, the coefficient of uniformity, the average, minimum and maximum emitter output, the ratio of average to nominal emitter output and laterals with emitter output beyond specified limits. The above-mentioned performances are also evaluated at other working pressures.

The economic cost/benefit analysis uses the ratio between water applied and yield, as well as the output from each emitter and other input relating to cost, to compute the yields, efficiency and equivalent annual value of different annual applications. The optimal operating policy is also calculated.

Once the block has been designed and evaluated, the influence of any design consideration can be tested by changing any of the data introduced as input or even by changing the results of computations. The evaluation function is a very strong feature of the program and enables the designer to evaluate the input data and norms very rapidly and effectively.

MAIN LINE DESIGN

The main line design module was divided into four main functions:

- ☐ The lay-out function
- ☐ The valve schedule computation function
- ☐ The design function in which the pipe diameters are computed
- ☐ The optimization function in which the diameters of the pipes and the working pressure of the pumps are optimized.

In the lay-out function a preliminary pipe design is made using input diameters. This preliminary pipe design is used later on as the point of departure for the optimization function. The data consisting of the length of the pipe section and the height at the beginning and end of each section, are also introduced as input values. The pressure class of the pipes in each section is estimated, using an average friction loss for the network, chosen beforehand by the designer. A first estimate of the pipe diameter in each section is done on the basis of flow speed.

This function also includes an evaluation model in which the cost is analysed. The purpose of this is to give the designer an opportunity of choosing the better lay-out on the basis of the information available to

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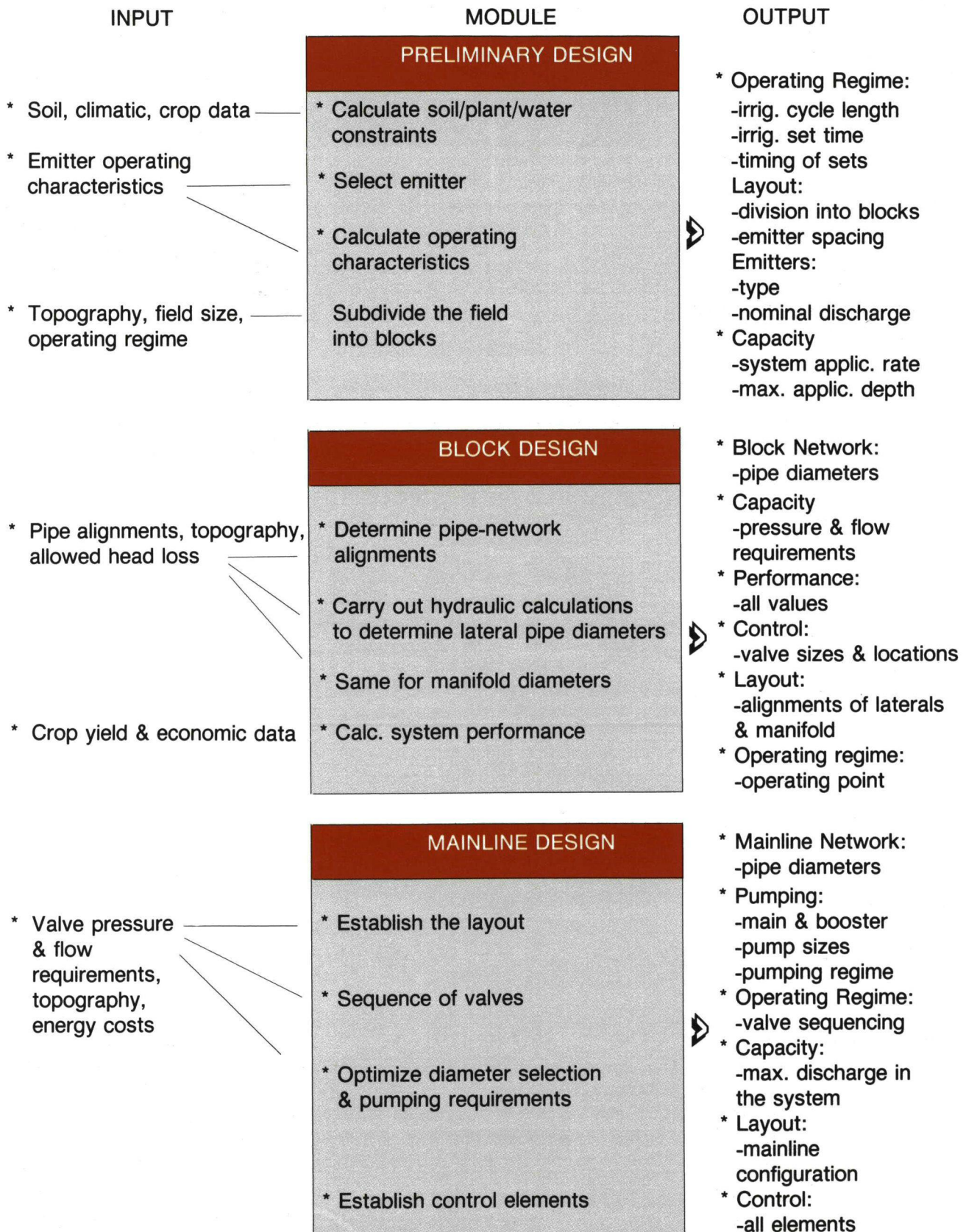


FIGURE 1: The design modules.

him at that stage, before the rigorous optimization process commences.

The purpose of the valve schedule computation function is two-fold:

- ☐ To minimize the pump energy needed for each application.
- ☐ To spread the flow as widely as possible throughout the network during each application. This reduces the pipe size needed.

In the optimization function the pump and pipe sizes are played off against each other. The current value of the pumping costs for the anticipated lifetime of the system are computed and added to the capital costs. After this the cheapest pipe diameters are determined with the aid of linear programming. The facility exists to incorporate booster pumps into the pipe network as additional decision variables.

From this module one also obtains print-outs of all related data.

STRUCTURE OF THE PROGRAM

The design and structuring of the computer program was regarded as being an important aspect of the research project, because the acceptability and usability of a computer program as a design tool is determined by the degree to which the program is user-friendly. IDES contains three important elements that makes it very user-friendly, namely:

- ☐ Menus or option lists which the user can employ at any time in order to go to any part of the program without disturbing data that has been recorded.
- ☐ Data-input help facilities which assist the user to input data quickly and accurately. Amongst other things,

these help facilities contain the following elements:

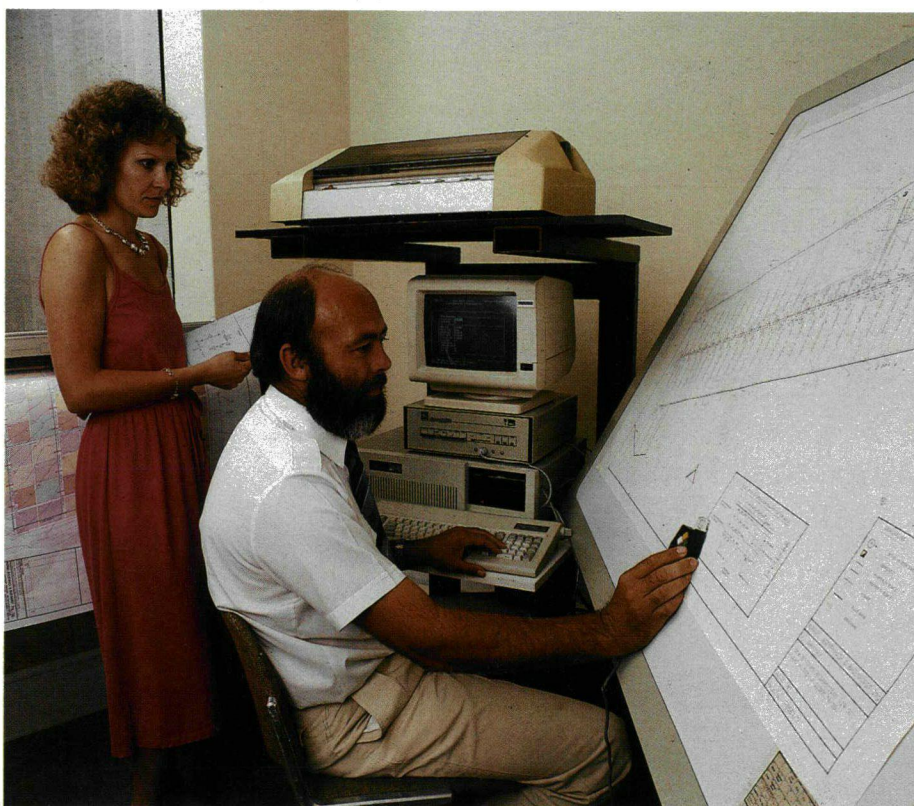
- A pipe data base reference table
- An emitter data base reference table
- A program help facility setting out the steps that have to be followed, and
- A maximum-length computer with which the maximum length of an irrigation lateral can be computed.

Transfer facilities with which any information in any of the abovementioned windows can be transferred to the workfield.

This transfer is very simple and takes place merely by pressing a button.

- Extra and interpolation facilities with which the data that is fed into the computer can be extrapolated or interpolated. This can lead to a considerable reduction in the volume of data that has to be fed into the computer.

Data-amending facilities based on complete data display and easy access to the data. In addition there is always the option of deciding whether or not changes that have been made should be accepted.



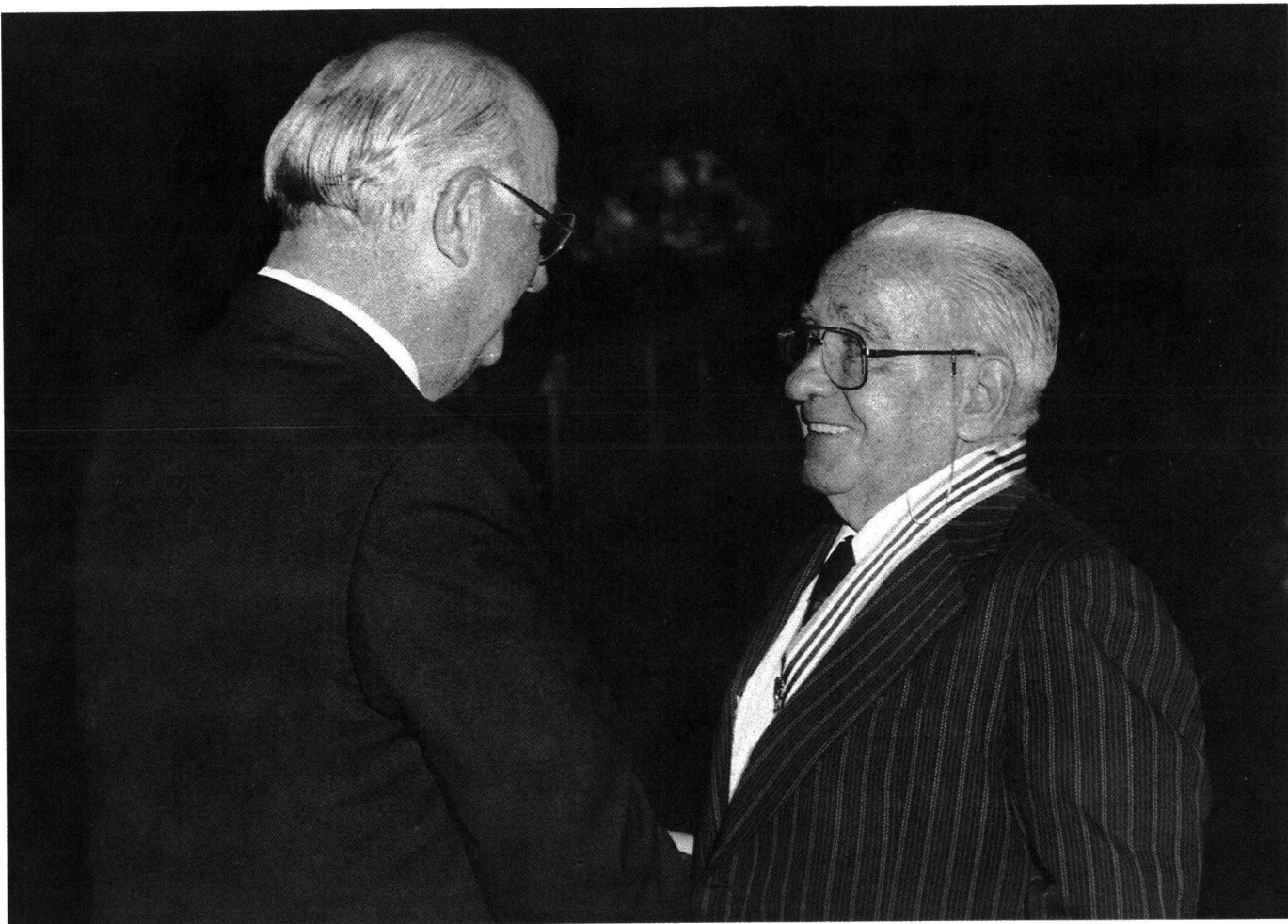
Mrs E van Wyk and Mr B C Robinson of the firm Murray, Biesenbach and Badenhorst working on the design of an irrigation system.

IDES has been fully tested over the last few months and will be introduced at courses held at universities during 1988. The eventual aim is to make IDES available to every irrigation designer so as to assist the end user to acquire the most economical irrigation system. It is hoped that this step will lead not only to water-saving, but also to more economical crop production.

Negotiations between the Water Research Commission and the firm Murray, Biesenbach and Badenhorst Incorporated are underway for the drawing up of a manual which, together with the software, should be available commercially towards the end of 1988. Two reports entitled: "The Development of Procedures for Design and Evaluation of Irrigation Systems" are presently available free of charge from the Water Research Commission, P O Box 824, Pretoria, 0001.

STANDER AS BAANBREKER VEREER

Bernard Clark



Dr Stander wat in 1957 die Nasionale Instituut vir Waternavorsing aan die WNNR tot stand gebring het asook die eerste hoof uitvoerende beampte van die Waternavorsingskommissie was, het die toekenning ontvang vir sy buitengewone vermoë tot wetenskaplike leierskap asook vir sy briljante prestasies op die gebied van waternavorsing wat aan hom internasionale erkenning besorg het.

Dr Stander is die outeur van meer as 90 wetenskaplike en navorsingspublikasies en word internasionaal erken as 'n wêreldoutoriteit op die gebied van waterherwinning.

Een van die baanbrekers op die gebied van waternavorsing in Suid-Afrika dr G J (Gerrie) Stander, is op 30 Oktober vanjaar vereer toe die Staatspresident, mnr P W Botha, tydens 'n oorhandigingsfunksie in Pretoria die Orde vir Voortreflike Diens, Klas 1: Goud aan hom toegeken het.

In 'n onderhoud met SA Waterbulletin het dr Stander die ekonomiese belangrikheid van water beklemtoon en sy bekommernis uitgespreek oor die toenemende versouting van Suid-Afrika se waterbronne.

Stander:

Water is lewe! Dit is die absolute waarde van water. En die gemeenskap wat daarvan afhanklik is, sal nie maklik die koste om hulle waterbronne te beskerm en te optimaliseer beperk nie.

Wat die PWV-kompleks in die besonder betref, is ekonomiese ontwikkeling na my mening die mees voor-die-hand-liggende

faktor om 'n definieerbare waarde aan die gebied se waterhulpbronne te gee.

Dit word allerweë erken dat die PWV-gebied die ekonomiese kragssentrale van die Republiek is. Dit is dan ook die belangrikste rede hoekom varswatervoorraade van elders ingevoer word om die hidrologiese krag van die Vaalrivier te versterk.

Die stedelike, nywerheids-, mynbou- en landbouaktiwiteite in die opvanggebied van die PWV-kompleks het egter 'n nadelige invloed op varswaterbronne van die Randwaterraad. Die toenemende versouting van water wat deur die Randwaterraad behandel en binne die PWV-gebied gelewer word, veroorsaak probleme met verreikende implikasies, veral omdat die soute die distribusiestelsel en huishoude-

Sonder twyfel stuur ons egter op 'n konfrontasie af en die inbloeï van varswater as 'n strategie om die soutwater te verdun, het 'n beperkte leeftyd. Om te voorkom dat hierdie soutbesoedeling deur vele ondernemings (wesentlike besoedelaars) die breekpunt van sê 800 mg/l opgeloste soute in die watertoevoer bereik, moet ontsouting 'n roetine uitvloeiselbehandelingsproses word. Hierdie tegnologie lê alreeds voor die deur en soos in die geval van tegnologiese ontwikkeling op talle ander gebiede om aan gesofistikeerde sosio-ekonomiese behoeftes van die gemeenskap te voldoen, bied ontsoutingstegnologie die uiteindelijke roete waarlangs enersyds beter waterbenutting verkry kan word en, andersyds, versouting

relatief hoog is in vergelyking met die neergelegde tariewe wat deur die gemeenskap en sy onderneming betaal word.

Volgens Verslag nr 09-14-05 van die Sentrale Statistiekdiens, getiteld Bruto geografiese produk teen faktorinkome volgens landdrostdistrik, 1978, het ek 'n tabel saamgestel om die bruto geografiese produk te bepaal vir die onderskeie gebiede wat binne die PWV-kompleks val en wat deur die Randwaterraad bedien word.

Die ondernemings en ander instansies wat hier ter sake is volgens die verslag is: Landbou, Bosbou en Visserye, Mynwese en Steengroefwerk, Fabriekswese, Elektrisiteit, Gas en Water, Konstruksie, Handels-, Verversings en Akkommodasiedienste, Vervoer, Opberging en Kommunikasie, Finansiering, Vaste Eiendom en Besigheidsdienste, Gemeenskaps- en Maatskaplike Dienste, minus die toegerekende Finansiële Dienste, plus die algemene owerheid en ander produsente.

Al hierdie instansies is onlosmaaklik afhanklik van die beskikbaarheid van water alhoewel sommige nie waterverbruikers is ten opsigte van hulle ondernemings nie.

Gedurende 1983 het die Randwaterraad $854 \times 10^6 \text{ m}^3$ water aan die PWV-kompleks voorsien. Om die bruto geografiese produk (BGP) van 1978 aan te pas vir 1983 word 'n 10 persent groei oor vyf jaar aangeneem – dit wil sê die (BGP) vir 1983 sal $R15\,608,9 \times 10^6$ wees. Dit gee 'n bruto geografiese produk van $R18/\text{m}^3$ water.

Die nywerheid binne die PWV-gebied het in 1979 'n bruto nasionale produk (BNP) van $R4\,404 \times 10^6$ gegenereer met 'n watergebruik van $300 \times 10^6 \text{ m}^3$. Dit gee 'n bruto nasionale produk van ongeveer $R15/\text{m}^3$ water.

Hierdie verslag van die Sentrale Statistiekdiens rapporteer ook die bruto geografiese produk volgens provinsies, statistiekstreke en die landdrostdistrikte van die Republiek insluitende Walvisbaai, die Republieke van Transkei, Bophuthatswana, Venda, Ciskei en die Nasionale State van Suidwes-Afrika (SWA). Gevolglik kan die waarde van water wat gelewer word uit ontwikkelde waterskemas in hierdie gebiede bereken word soos vir geval van die PWV-kompleks.

SA Waterbulletin:

Ontslaughting is 'n duur proses. Hoe sien u die toepassing en die finansiering daarvan?

Stander:

In hierdie verband moet kennis geneem word van twee belangrike feite naamlik:

- Die leeftyd van die verdunningsopsie (met inagneming van die Lesotho

“Dr Stander het deur 'n leeftyd van werk bewys gelewer van sy spesiale vermoë tot leierskap ten opsigte van die saak vir skoon water en die verbetering van die omgewing van die mens. Deur sy briljante pogings het hy gehelp om die peil van watervorsing in sy land te verhoog om aan dringende nasionale behoeftes te kan voldoen en sodoende internasionale erkenning en respek vir sy land se prestasies op die terrein van watervorsing verkry. Een van sy unieke wetenskaplike bydraes was die ontwikkeling van navorsingstudies op die gebied van die herwinning en heraanwending van afvalwater. Dr Stander is sonder twyfel 'n wêrelddeskundige op hierdie terrein en die werk wat hy in Suid-Afrika geïnisieer het, dien as baken vir alle ander lande wat die dringende noodsaak van waterberwinning erken.”

like en nywerheidstoerusting beskadig en dit groot kostes meebring. Hierdie 'stille waterbesoedeling' word wel deur verskeie maatreëls met 'n groot mate van sukses ingekort.

'n Belangrike bydraende faktor tot hierdie versouting van die water is die indirekte hergebruik van uitvloeiels wat in die wateromgewing gestort word en die direkte hergebruik van water en behandelde riooluitvloeiels in die nywerheid. Albei hierdie aktiwiteite is belangrike strategieë om elke kiloliter water beter te benut.

Dit is 'n welbekende feit dat elke siklus watergebruik in die huishouding 'n toename van 300-350 mg/l in soutkonsentrasie meebring. Om dus binne 'n geslote watersisteem soos dié van die PWV-kompleks deurlopend 'n water van gewenste kwaliteit aan gebruikers te lewer, word daar enersyds toenemende druk geplaas op die verdunningskapasiteit van die varswaterbronne en, andersyds, op die inwerkstelling van verskerpte besoedelingsbeheer.

terselfdertyd ingekort kan word. Feit is dat by voorgemelde konfrontasiepunt versouting nie meer prakties en ekonomies bestry kan word nie.

SA Waterbulletin:

Hoe kan volgens u die waarde van water binne die PWB-gebied bereken word?

Stander:

In die talle verslae en referate oor die Republiek se waterhuishouding in die algemeen en oor die Vaalriversisteem in die besonder, word daar geen spesifieke evaluasie gemaak van die waarde van water in terme van bruto geografiese of nasionale produk nie. Ek het egter probeer om 'n spesifieke evaluasie te maak van die waarde van water in terme van bruto geografiese produk per kubieke meter water wat aan die PWV-kompleks gelewer word. Dit is duidelik uit hierdie gegewens dat die waarde van water in die PWV-kompleks

Hoogland-projek en ander varswater-toevoere) om die soutinhoud te handhaaf.

- Ontsouting as sleutelstrategie om veelvuldige hergebruiksiklusse van varswaterbronne in die PWV-gebied te bevorder.

Daar kan geen beswaar wees teen die inbloeï van varswater as 'n oorbruggingstrategie vir die beskerming van die minerale kwaliteit van water gelewer aan die PWV-kompleks nie, mits deeglik kennis geneem word, andersyds, dat dit tot probleme lei en, andersyds, van die sleutelrol van progressiewe toepassing van ontsouting. Dit is dan ook uiters bemoedigend dat verskeie instansies binne die PWV-kompleks alreeds bakens geskep het en nog sal skep in die grootskaalse toepassing van ontsouting. Sodoende sal die druk op die varswaterbronne se verdunningskapasiteit verlig word en meer siklusse van waterhergebruik bevorder word.

Indien daar grondig gekyk word na die ondervinding van die verlede, die huidige feitekennis en probleme wat in die toekoms voorlê, dan is daar net een slotsom, naamlik dat ons voorgeslagte en die huidige samelewing met al sy ondernemings binne die PWV-kompleks, ten volle verantwoordelik is vir die versouting waarmee vandag geworstel word en dat 'n filosofie om kostes vir bekampings laag te hou, neerkom op die opbou van 'n geweldige skuld las vir die nageslag om sy eie ondernemings deur te voer teen hoë kostes.

Weens die toekomstige waarde van hierdie varswaterbronne vir lewenskragtige sosio-ekonomiese groei in die gebiede wat van die Vaalrivier afhanklik is, moet daar besin word oor die langtermynprogrammering en finansiering van ontsouting as 'n sleutelstrategie. Dit sal vir die gemeenskap ongetwyfeld groter koste-implikasie meebring vir die bekampings van versouting as tans. Gevolglik is dit belangrik om die inskakeling van ontsouting op 'n langtermyngrondslag te beplan met inagneming van ekonomiese faktore.

Vir die eerste fase byvoorbeeld, sal die skepping van soutwateromgewings 'n belangrike skakel wees om die spuiwaters van ontsouting te akkommodeer. In die daaropvolgende fases sal die herwinning van soute deur dampdrukdistillasie en kris-

tallisasie belangrike tegnologiese prosesse word. Terloops kan gemeld word dat laasgenoemde prosesse alreeds in die Republiek deur sekere nywerhede bedryf word.

Die probleem van versouting soos tans in die PWV-gebied ondervind word, is besig om sy kop ook in ander rivieropvanggebiede uit te steek. Om hierdie toenemende skuld las wat uit versouting voortspruit te verlig en om die maksimum eksploitasie van die varswaterhulpbronne te bevorder, kan 'n gemotiveerde saak dus gemaak word vir die skepping van 'n kapitaalfonds vir die toekomstige finansiering van 'n ontsoutingsprogram in die langtermyn. Die daarstelling van 'n nasionale kapitaalfonds sal verseker dat skemas betyds aangepak kan word om knelpunte in watervoorsiening, insluitende versouting, te voorkom.

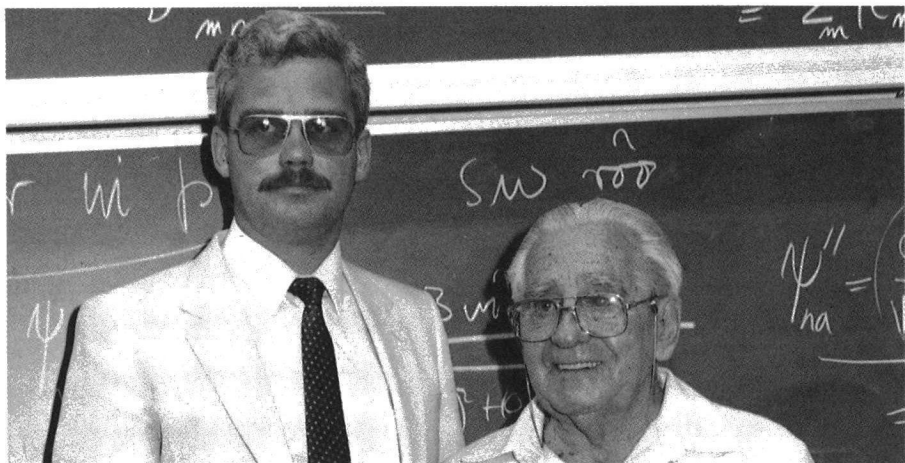
Die is egter wenslik dat die potensiele aanwending van so 'n fonds in 'n breër perspektief gesien moet word as net die oprigting van kapitaalwerke vir watervoorsiening. Vir die optimale beplanning en benutting van ons waterbronne moet die gehalte (onder andere versouting) van water ook deeglik in berekening gebring word en behoort 'n kapitaalfonds eweneens voorsiening te maak vir die oprigting van kapitaalwerke om watergehalte te beskerm.

Ingevolge die Waterwet berus die onus wel op die besoedelaar om self te betaal vir die behandeling van sy uitvloeisels ten

einde aan die neergelegde uitvloeiselstandaarde te voldoen. Dit beteken natuurlik dat hy verantwoordelik is vir die oprigting van sy eie kapitaalwerke vir die doel. In die spesifieke geval van versouting, en veral in die komplekse besoedelingsituasie van die PWV, kan 'n saak egter wel uitgemaak word vir die daarstelling van gesentraliseerde fasiliteite wat uit so 'n kapitaalfonds gefinansier word. Hier word gedink aan byvoorbeeld die skepping van kunsmatige soutwateromgewings soos vroeër genoem en die oprigting van ontsoutingsinstallasies vir munisipale uitvloeisels.

Daar moet in ag geneem word dat die PWV as ekonomiese kragbron die ekonomiese welsyn van die land as geheel bevorder, en dit onregverdig sal wees as die inwoners van die PWV alleen die las moet dra vir die bekampings van 'n besoedelingsprobleem wat juis met die intensiewe ekonomiese bedrywighede van dié gebied verband hou.

Die skepping van 'n kapitaalfonds vir die toekomstige finansiering van die Republiek se verkeersweë is alreeds 'n aanvaarde beginsel. Veel te meer geld dit uit die oogpunt van nasionale ekonomie vir die Vaalrivier en ander strategiese rivieropvanggebiede. Dit sal beslis sosio-ekonomiese vooruitgang bring vir geografiese gebiede wat weens gebrek aan standhoudende waterbronne nie ten volle ontwikkel kan word nie.



Dr Standen is onlangs ook deur die Suid-Afrikaanse Chemiese Instituut met lewenslidmaatskap vereer. Dr Standen was 44 jaar lid van die Instituut. Hier ontvang hy die toekenning van dr Hein Strauss (links), voorsitter van die Pretoria-tak van die Instituut.

STREEK	Bruto Geografiese Produk (1978) R1000-eenhede
Streek 47: Johannesburg en Randburg	5 077 995
Streek 48: Germiston, Alberton, Boksburg, Kempton Park, Benoni	2 686 087
Streek 49: Brakpan, Springs, Nigel	677 770
Streek 50: Krugersdorp, Roodepoort, Westonaria, Randfontein, Oberholzer	2 059 629
Streek 51: Pretoria, Brits	2 404 309
Streek 52: Vereeniging, Vanderbijlpark	926 620
Streek 53: Sasolburg	357 502
TOTAAL VIR BOGEMELDE GEBIEDE	14 189 912



Osoon in Switserland onder soeklig

Die Agtste Wêreldkongres van die Internasionale Osoonassosiasie (IOA) is vanaf 15 tot 18 September vanjaar in die Kongressentrum te Zürich, gehou. Die kongres is bygewoon deur ongeveer 450 afgevaardigdes uit 30 lande, waaronder vyf uit Suid-Afrika, naamlik dr Ben van Vliet van die Afdeling Watertegnologie, WNNR, mnr Tertius van der Spuy en mej Annaline Toerien van die Wes-Transvaalstreek se watermaatskappy, mnr Günter Rencken van die Umgeniwaterraad en mnr Hans van Leeuwen van die Universiteit van Pretoria.

Referate oor die volgende onderwerpe is gelewer:

- drinkwatersuiwering
- osoon- en geaktiveerde koolstofinteraksies in watersuiwering
- osoon-chemie en reaksieprodukte in water
- die kombinasie van osoon- en ultravioletbestraling
- die behandeling van water wat gebruik word vir swembaddens, akwariums, verkoelingsstelsels ensovoorts
- osoonopwekking waar onder andere die nuutste ontwikkelings op die gebied van ontladingsbuis-tegnologie bespreek is
- afvalgassuiwering en
- die mediese toepassing van osoon by bloedsirkulasieverbetering, kankerbehandeling en VIGS-bestryding.

Osoon is nog steeds besig om 'n wyer veld te wen in waterbehandeling. Daar is verskeie referate aangebied wat nuwe wa-

tersuiweringsinstallasies beskryf soos die Los Angeleswaterwerke (2 270 MI/d), die Boedapestinstallasie (130 MI/d), dié in Andover, Massachusetts (48 MI/d) en die Bedokaanleg in Singapoer (144 MI/d). Verder is daar installasies in aanbou soos die waterwerke in Worcester, Massachusetts (200 MI/d). Osonering word ook beplan vir die Central Arizona Project (400 MI/d), die Des Moines, Iowa-aanleg (32 MI/d) en word oorweeg vir die waterwerke van Osaka, Japan (2 430 MI/d).

'n Hele aantal referate is gewy aan navorsing en ontwikkelingswerk op die gebied van die toepassing van osonering in water- en afvalwaterbehandeling. Navorsing is veral toegespits op die gebruik van osoon om organiese stowwe af te breek en om die afgebreekte produkte te bestudeer en te verwyder, byvoorbeeld deur biologiese oksidasie of adsorpsie op geaktiveerde koolstof. Verder is daar ook werk gedoen oor die gebruik van osoon om flokkulasie te verbeter en die verwydering van metale soos yster en mangaan. Daar is nog steeds teenstrydighede oor die vermoë van osoon om organohalogeno-voorlopers te verwyder. Sommige outeurs vind osoon doeltreffend terwyl een studie, onder streng gekontroleerde toestande, geen statistiese beduidende effek kon vasstel nie.

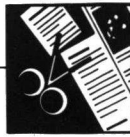
Geen rewolusionêre nuwe ontwikkelings is by die kongres bekendgestel nie. Daar was wel referate wat gehandel het oor interessante proseskombinasies wat nie algemeen gebruik word nie soos byvoorbeeld flottasie en osonering, osonering en biologiese behandeling van afvalwater en osonering tesame met waterstofperoksied of ultravioletbehandeling wat almal in sekere toepassings belangrike voordele kan inhou.

Aansluitend by die referate is 'n interessante uitstalling van osoon- en verwante toerusting gehou en daar is ook tegniese toere na verskeie watersuiweringsinstallasies en navorsingsinstansies onderneem.

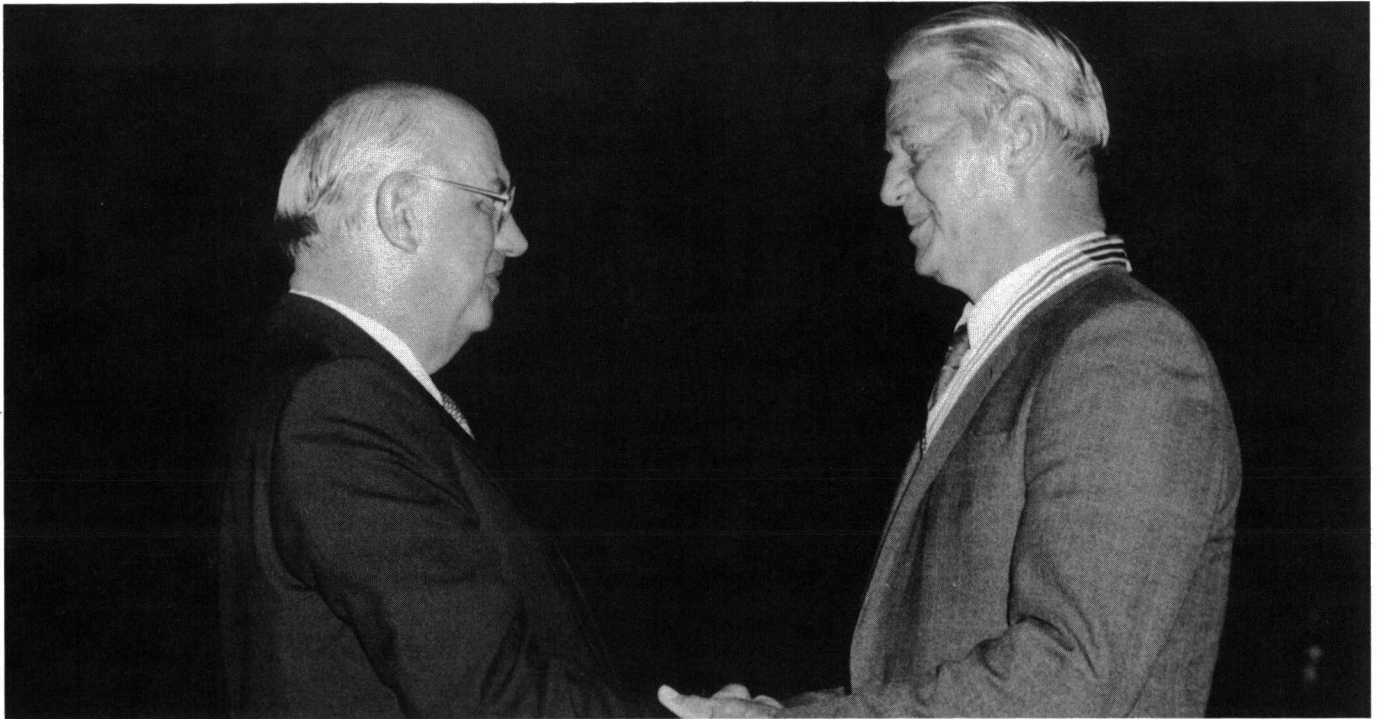
Dr van Vliet en mnr Van Leeuwen is beide herkies as direkteure vir 'n nuwe ampstermyn van twee jaar by 'n algemene vergadering van die Internasionale Osoonassosiasie wat die kongres voorafgegaan het. Gelukkig is die IOA 'n organisasie wat hom nie deur politiek laat beïnvloed nie. Onder sy lede is mense uit al die verskillende magsblokke in die wêreld wat op vriendelike voet sosiaal verkeer en bymekaarkom om die wetenskap te dien.

In die geheel was die kongres baie suksesvol. Insigte is verbreed en verdiep en verder verhelder deur lewendige besprekings.

—Hans van Leeuwen, UP.



Stutterheim vereer met goue toekenning



'n Lid van die Waternavorsingskommissie, dr Niko Stutterheim, is ook met die Orde vir Voortreflike Diens, klas 1: Goud vereer. Dr Stutterheim het die toekenning van die Staatspresident mnr P W Botha (links) ontvang vir die belangrike bydraes wat hy oor baie jare op talle gebiede gelewer het tot die bevordering en toepassing van die ingenieurswese in Suid-Afrika.

Die spanwydte van sy bedryfsaktiwiteite dek die chemiese, farmaseutiese en petrochemiese terreine, die elektrotegniese en meganiese ingenieursgebiede en ook die bankwese en in elk van hierdie vele fasette was dr Stutterheim 'n uitblinker.

HYDROLOGY EXPERT VISITS SOUTH AFRICA

Right: Dr F I (Fred) Morton (left) from Quebec, Canada, recently visited South Africa as a consultant in the field of hydrological research and in particular evapotranspiration studies. Mr F J Kruger (right) is Director of the South African Forestry Research Institute (SAFRI). Dr Morton delivered the keynote address at a symposium on mountain catchments of South Africa organised by SAFRI.





A liquid consumption survey of individuals in greater Cape Town

By L T Bourne, D E Bourne, G S Watermeyer and J M C Kloppe

There is no published data for the per capita consumption of water of individuals in South Africa. A daily rounded volume of two litres per person is usually taken as a working estimate from world-wide data. As part of ongoing epidemiological studies into potential health effects of changes in the water supply to greater Cape Town, water consumption patterns were ascertained.

As health effects are often spatially ascribed to the place of residence of a person, it was necessary to ascertain how much water was drunk at home as well as away from home. Water consumed was divided into three classes:

- ☐ water consumed from the tap,
- ☐ commercial beverages and
- ☐ water bound in food.

A review of methods of conducting dietary surveys indicated that a 24-hour recall would be the most appropriate method.

Two surveys on total dietary intake utilizing a 24-hour recall were carried out (n=2 000 persons for each survey), one in winter and the other in summer. The design of the survey involved a cluster sample of households that were representative of the socio-economic and demographic structure of greater Cape Town.

Three pretested types of questionnaires were administered by trained interviewers:

- ☐ a placement questionnaire to describe the household composition,
- ☐ a recall questionnaire for

individual adults and children and

- ☐ a recall questionnaire for babies.

Particular attention was paid to the accurate ascertainment of the volumes of food and drink consumed as well as their preparation, to facilitate accurate analysis. The water content of each food item was calculated by a computer programme that utilized computerized food composition tables.

The water consumption data was analysed by sex, age, population group, income and the season of the year. Detailed graphs and tables are provided. Results were also standardized to the population of greater Cape Town.

It was found that the difference in consumption between the White and 'Coloured' population groups was greater than the difference between those people of high and low income groups.

The mean total water intake for Whites was 2,19 litres per day, while for 'Coloureds' it was 1,26 litres per day. There is no obvious bias to account for this difference. The figures for protein consumed by two groups, which was used as a control, are consistent with values reported in the literature.

Summer consumption was higher than that during winter.

The ratio of tap water consumed at home to total liquid consumed was approximately 0,5.

Price: Free of charge

WRC Report No: 74/2/87

ISBN 0 908356 57 9

Obtainable from: Water Research Commission, P O Box 824, Pretoria, 0001, Republic of South Africa. Please complete and return the Book Order Card in this Bulletin.

Epidemiological studies pertaining to the possible reclamation and reuse of purified sewage effluent in the Cape Peninsula

By D E Bourne, A R Sayed, G S Watermeyer and J M C Kloppe

The South African Department of National Health and Population Development has established proposed directives for the reclamation of treated effluents for direct recycling and reuse as domestic water. These state, *inter alia*, that epidemiological (health effects) surveys must where possible be conducted in the area concerned before and after the use of reclaimed water.

Having reviewed the experiences of direct recycling for potable reuse in Windhoek, indirect reuse by groundwater recharge in Los Angeles, and reclaimed reuse in London as well as surveying the recommendations of the World Health Organisation, the Water Pollution Control Federation and the US Environmental Protection Agency it was decided that the baseline for an epidemiological survey for the possible reuse of water in the Cape Town area would comprise information on mortality (deaths), morbidity (disease) from general practice and birth defects.

In addition a liquid consumption survey was carried out to indicate the total volume of liquid drunk by individuals as well as its source. It was found that only a half of the water was consumed from the tap supply at home.

Health data was collected at a spatial resolution of census tracts (approximately 1 500 in greater Cape Town) to allow this information to be related to the population at risk.

The mortality data (10 000

records per annum), data from the morbidity survey (50 000 records per annum) and the birth defects surveillance with its associated (20 000 births per annum) have been placed in a computerized data base.

If reclaimed water were to be introduced this computerized baseline data could easily be manipulated to relate to those areas which would or would not receive reclaimed water.

The sensitivity of these epidemiological studies to detect a change in health patterns is however limited. It is expected that only gross changes could be detected. Thus it is essential that a comprehensive catchment quality control programme, coupled with thorough chemical, microbiological and virological monitoring also be instituted in addition to epidemiological studies to ensure that safety of the water supplied.

This research project has shown that an appropriate baseline for epidemiological surveillance can be established. The methodology and procedures developed could easily be utilized in other centres in South Africa. The continued long term surveillance of the health indicators measured in this project is, however, more properly the responsibility of the public health authorities such as the Department of National Health and Population Development.

Price: Free of charge

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WASTEWATERS

An international specialised conference on the microbiology of waters and wastewaters 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.

ANAEROBIC DIGESTION

The fifth international symposium of anaerobic digestion will be held in Bologna, Italy, from 22 to 26 May 1988. Interested authors are invited to submit abstracts for consideration.

Enquiries: Dr E R Hall, Environment Canada, Wastewater Technology Centre, 867 Lakeshore Road, P O Box 5050, Burlington, Ontario, Canada, L7R4A6.

WASTE TREATMENT

An international conference on alternative waste treatment systems will be held at Massey University, Palmerston North, New Zealand from 26 to 27 May 1988.

Enquiries: Dr Rao Bhamidimarri, Coordinator, Pollution and Waste Treatment Programmes, Department of Biotechnology, Massey University, Palmerston North, New Zealand.

WATER RESOURCES

The sixth IWRA Congress on water resources will be held in Ottawa, Canada, from 29 May to 3 June 1988. The theme is Water for World Development.

Enquiries: The Secretariat, Sixth IWRA World Congress on Water Resources, University of Ottawa, 613 King Edward Avenue, Ottawa, Ontario, CANADA K1N 6n5.

DRINKING WATER

The third national conference on drinking water with the theme "small system alternatives" will be held on St John's, Newfoundland, Canada, from 12 to 14 June 1988. Authors are invited to submit abstracts for consideration.

Enquiries: Chairman, Third National Conference on Drinking Water, P O Box 205, St John's, Newfoundland, Canada A1C 5J2.

REVERSE OSMOSIS

A symposium on the advances in reverse osmosis and ultrafiltration will be held in Toronto, Canada, from 5 to 11 June 1988. Enquiries: Dr S Sourirajan/Dr T Matsuura, Division of Chemistry, National Research Council of Canada, Ottawa, Ontario, Canada K1A0R9.

POLLUTION

The 8th International Symposium on environmental pollution will be held from 9 to 10 June 1988 in Toronto, Canada.

Enquiries: Dr V M Bhatnager, Alena enterprises of Canada, Cornwall, Ontario, K6H5V7, Canada.

LARGE DAMS

The 16th International Congress on large dams organised by ICOLD will be held from 13 to 17 June 1988 in San Francisco, USA. Topics include reservoirs and environment, embankment dams, new developments in concrete dams and design floods and operational flood control.

Enquiries: H L Blohm, Secretary, ICOLD, 88 Steering Committee, Bechtel Civil Inc, P O Box 3965, San Francisco, CA 94119, USA.

LIMNOLOGY

The 25th anniversary congress of the limnological society of Southern Africa will be held in Pietermaritzburg from 27 June to 1 July 1988. Post congress excursions will include trips to Maputaland (St Lucia, Lake Sibaya, Kosi Bay and Ndumu Game Reserve), the Drakensberg pump/storage scheme and the Mgeni system.

Enquiries: Mr J Akhurst, Department of Botany, University of Natal, P O Box 375, Pietermaritzburg, 3200.

POINT SOURCE POLLUTION

A workshop on the statistical methods for the assessment of point source pollution will be held at the Canada Centre for Inland Waters, Burlington, Ontario from 19 to 21 September 1988. Papers invited.

Enquiries: Dave Chapman, Wastewater Technology Centre, P O Box 5050, Burlington, Ontario, L7R 4A6, Canada.

WATER SUPPLY AND SANITATION

A seminar on water supply and sanitation in KwaZulu will be held at the Elangeni Hotel in Durban from 28 to 30 June 1988. Enquiries: Symposium Secretariat S.433, CSIR, P O Box 395, Pretoria, 0001, Telephone: (012) 841-2063.

WATER QUALITY

The International Water Supply Association will arrange a workshop on water treatment and drinking water regulations in Vienna on June 30 to July 1 1988.

Enquiries: Prof D R Oehler (Chairman of the Standing Committee on Water Quality and Treatment) Bebelstrasse BO, D 7 000 Stuttgart-1 Federal Republic of Germany.

IAWPRC

The IAWPRC's 14th biennial conference and exhibition will be held during July 1988 in Brighton, England. South African companies are invited to participate in the exhibition.

Enquiries: IAWPRC, 1 Queen Anne's Gate, London SW1H9BT, England. Telephone 01-2223848, Telex 918518 WAS-SOC. Attention IAWPRC.

WATER QUALITY

A conference on water quality and management for recreation and tourism will be held in Brisbane, Australia, from 10 to 15 July 1988.

Enquiries: R Sadler, Working Group Secretary, P O Box 388, North Quay, Brisbane, Queensland, Australia, 4000.

POLMET 88

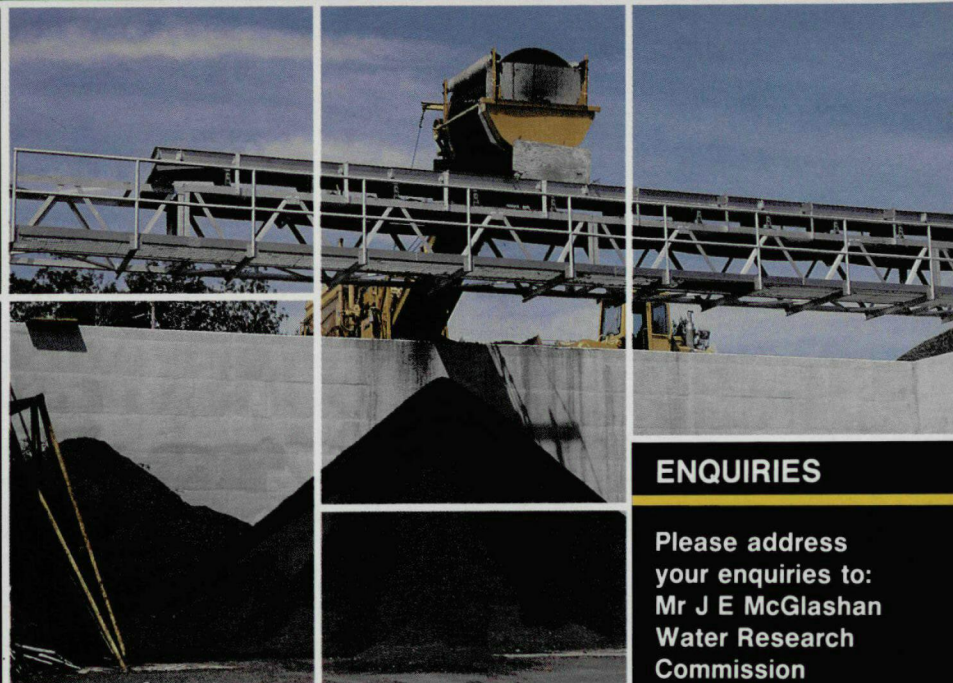
An International conference on pollution in the metropolitan and urban environment will be held in Hong Kong from 28 November to 2 December 1988. Papers are invited for the technical sessions which will include: Environmental management practice, Industry and environment, Air Quality management.

Enquiries: Polmet 88 Secretariat, c/o Hong Kong Institution of Engineers, 9/F Island Centre, No 1 Great George Street, Causeway Bay, Hong Kong.

26 FEB 1988

TECHNOLOGY TRANSFER

Seminar and Demonstration



FORCED AERATION STABILISATION (COMPOSTING) AND DISINFECTION OF SEWAGE SLUDGE

ENQUIRIES

Please address
your enquiries to:
Mr J E McGlashan
Water Research
Commission
P O Box 824
PRETORIA
0001
Tel: (012) 28-5461

or

Mr W R Ross
National Institute
for Water Research
P O Box 109
SANLAMHOF
7532
Tel: (021) 97-6181

PROGRAMME

08h30	REGISTRATION
08h40	Welcome
09h00	Fundamentals of the Composting Process. J E McGLASHAN
09h30	Design and Cost of Forced Aeration Stabilisation Unit Operations. W R ROSS
10h00	Kompostering van Rioolslyk dmv Suigbelugting: Beheer, Monitoring en Werkverrigting. J H NELL
10h30	TEA/COFFEE
11h00	Benutting van Rioolslyk in die Landbou. A M KITSHOFF
11h15	Transport to Northern Works, Johannesburg.
12h45	Demonstration of Forced Aeration Composting of Sewage Sludge at Northern Works, Johannesburg.
13h00	Transport to Indaba Hotel. LUNCH. (Indaba Hotel and Conference Centre).

VENUE

SEMINAR:
Indaba Hotel and
conference centre,
Hartebeespoort
Dam road,
Witkoppen (north
of Johannesburg).

DEMONSTRATION
Northern works
Johannesburg

TRANSPORT

Transport from
the seminar to the
demonstration
will be provided.

REGISTRATION FEE

R45, payable to
the Water Research
Commission
before 31 January
1988. Attendance
limited to 200

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g-base



THE COMPLETE GROUND-WATER DATA BASE

G-Base is a comprehensive ground-water data base, consisting of four modules, namely the data base, a statistical package, a graphics presentation package and a CAD based mapping facility. G-Base has been implemented on an IBM-compatible micro computer and is available on 5 $\frac{1}{4}$ and 3 $\frac{1}{2}$ floppy disks.

G-Base makes provision for a large number of variables to be entered under the following main headings: geology, construction, installation, discharge, water levels, chemistry and water pollution, pumping test analysis, meteorology, borehole geophysics and surface hydrology. Data which have been entered into the data base can be extracted by programmes provided, to be analysed statistically, graphically and to be plotted on maps. Two- and three-dimensional contours are also supported. The package can be used in various fields of water research such as in water supply, mine dewatering and water pollution studies. Mining companies, industries, local authorities and individuals dealing with ground-water aspects will benefit from this package.

For further information contact: The Director, Institute of Ground-water Studies, University of the OFS, Bloemfontein 9300, South Africa. Tel 051-4012394. Fax 051-473541.