SA waterbulletin

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WATER MANAGEMENT
Water losses quantified in the lower Orange River

WATERSUIWERING
Standaarde vir Suid-Afrikaanse filterbedmedia opgestel

WASTE WATER
Membrane technology could recover valuable water and metals in the electroplating industry

Announcement:

Legionella

Seminar and workshop

Occurrence of Legionella bacteria in cooling water and the protection of public health

20 September 1995

Topics and discussions will include:

- Water associated diseases
- Occurrence and distribution of Legionella bacteria
- Outbreaks and risk factors
- Detection and renumeration methods
- Treatment and prevention procedures
- Guidelines and standardisation of methods

Venue: CSIR Conference Centre, Pretoria

Cost: R250 per delegate (includes refreshments and lunch)

Registration: Closing date Friday 18 August 1995

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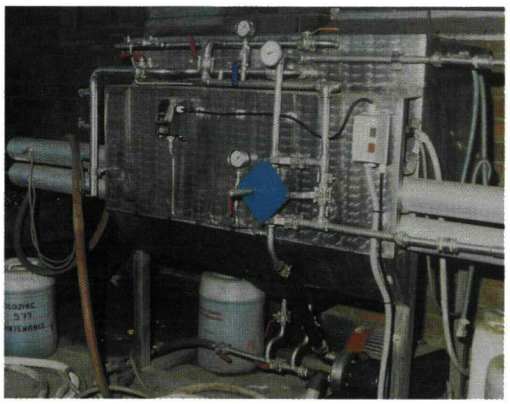

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Cover: Boegoeberg Dam near Groblershoop in the Northern Cape Province (Photo: Anton Prinsloo)

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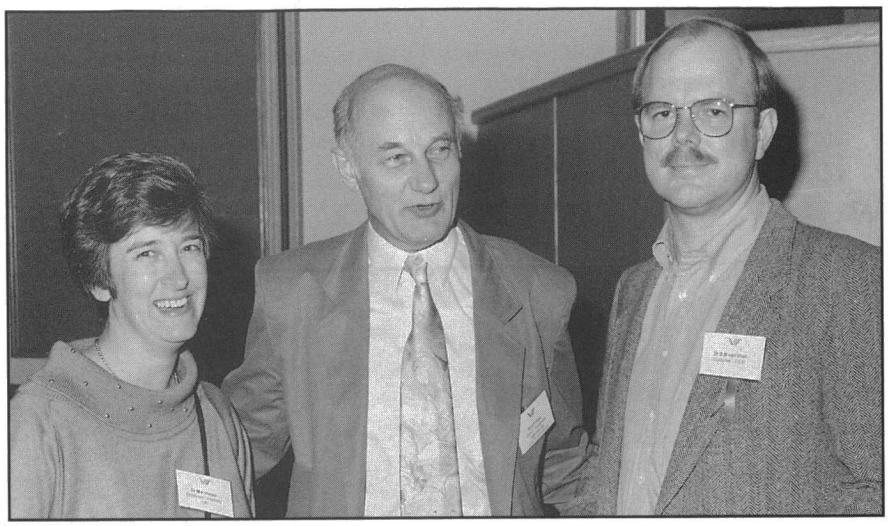
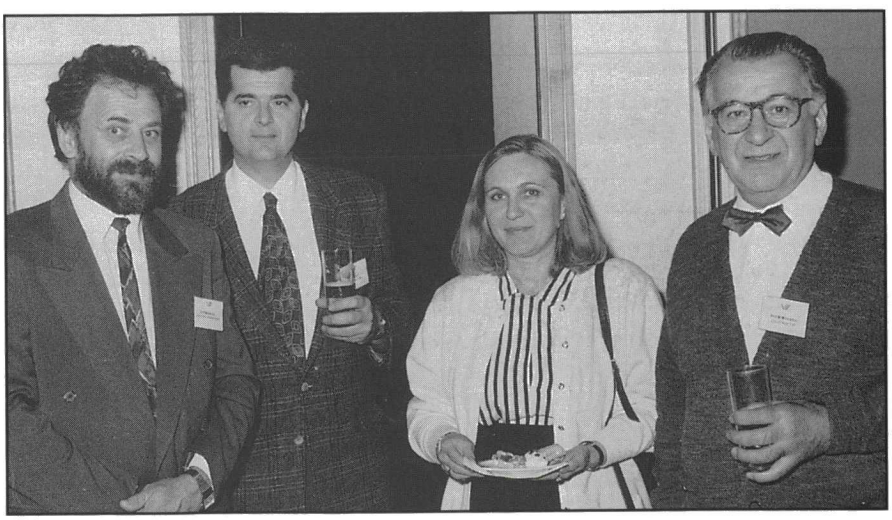
INTERNATIONAL RIVER BASIN BASH ...





A truly international specialised conference on River Basin Management for Sustainable Development was recently hosted by the Water Institute of South Africa (WISA) and the National Parks Board under the auspices of the Specialist Group on River Basin Management of the International Association of Water Quality (IAWQ). Delegates came from Argentina, USA, Canada, the UK, Belgium, The Netherlands, Germany, Austria, Finland, Poland, Hungary, Czech Republic, Yugoslavia, Italy, Russia, Sri Lanka, Taiwan, Korea, Australia as well as from Kenya, Zambia, Namibia and Swaziland. Many good contacts were made amongst the delegates.

The conference papers addressed broad topics of river basin management. Dr Ben van Vliet said that the initial response to the call for papers for the conference was overwhelming, but the conference programme allowed for only 46 oral paper presentations. A further twenty papers were presented as posters. Judging by reports received the delegates enjoyed the presentations.

The conference was held in the Kruger National Park which afforded all the delegates the opportunity of visiting this renowned Park and to glimpse something of the African wildlife, unfortunately the game didn't quite oblige!

Top: Dr Margaret House (Middlesex University, UK) a guest speaker, with the inimitable Dr Peter Grau (Czechoslovakia) past president of IAWQ, and Dr Ben van Vliet (Watertek, CSIR) chairman of the conference organising committee .

Middle: Dr PR Thomas (La Trobe University, Australia), Mrs Alida van Zyl and Mr Fred van Zyl (Department of Water Affairs and Forestry, SA) with Mrs Alina Lewandowska-Suschka and Dr Jan Suschka (Poland) at the meet-and-greet reception.

Bottom: Dr P Marjanovic (University of the Witwatersrand) left, and Mrs Vida Marjanovic (centre, right) were hosts to Dr Z Cukic (centre, left) and Prof M Miloradov (right) both from the University of Novi Sad, Yugoslavia.

ERWAT wastes no water

The East Rand Water Care Company (ERWAT) provides a highly technical and efficient wastewater treatment service to some three million people and industries in the Greater Johannesburg Metropolis in Gauteng. Water treated and purified to the highest possible level at 18 ERWAT wastewater treatment plants is returned to the Vaal River catchment in the southern part of the region and the Crocodile River catchment in the North.

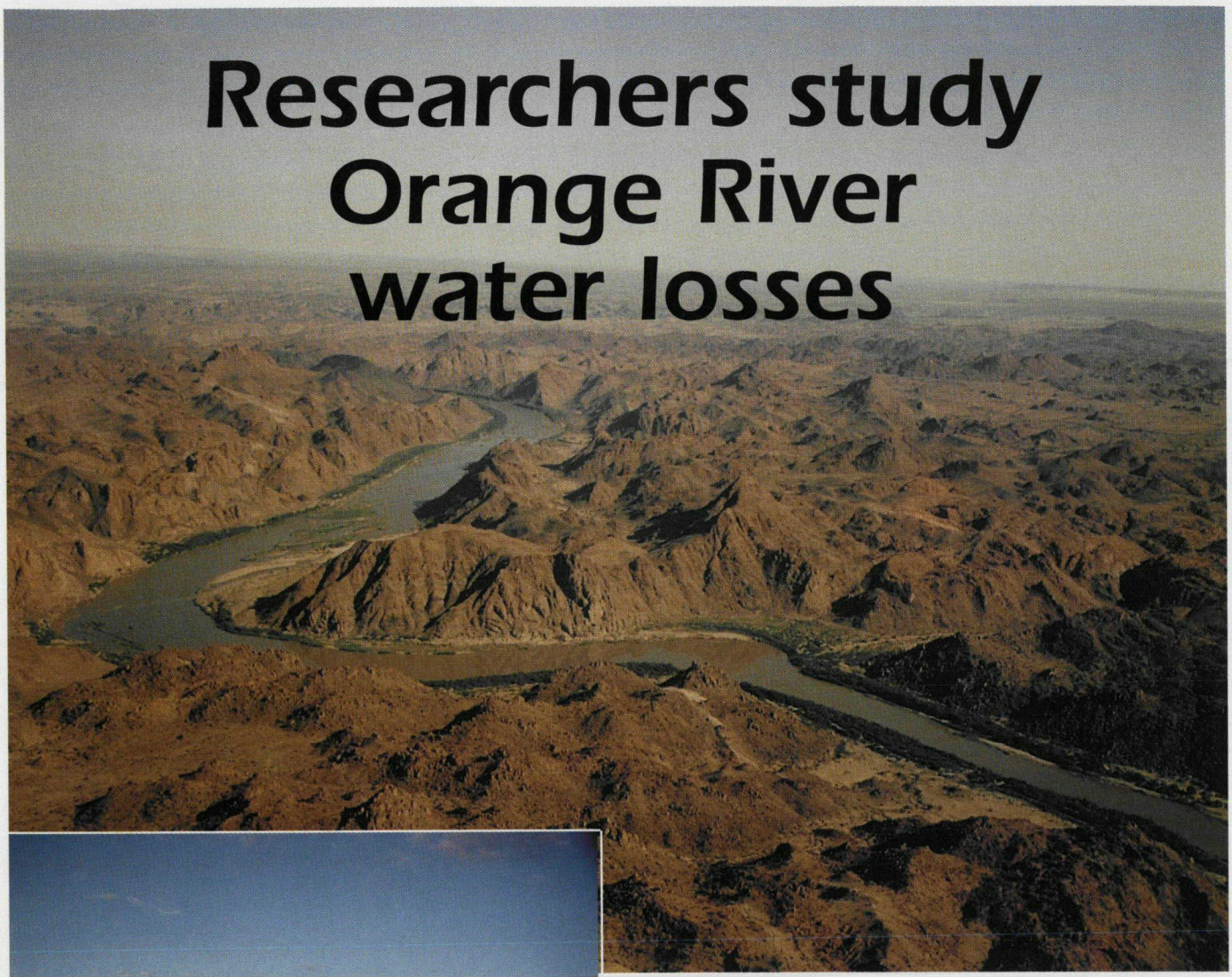
Recently ERWAT opened the Olifantsfontein Water Care Works which will ultimately be the largest of their plants, with a capacity to handle some 156 Ml of wastewater per day. This works serves the communities of Olifantsfontein, Thembisa, Ivory Park, Kempton Park and Midrand.

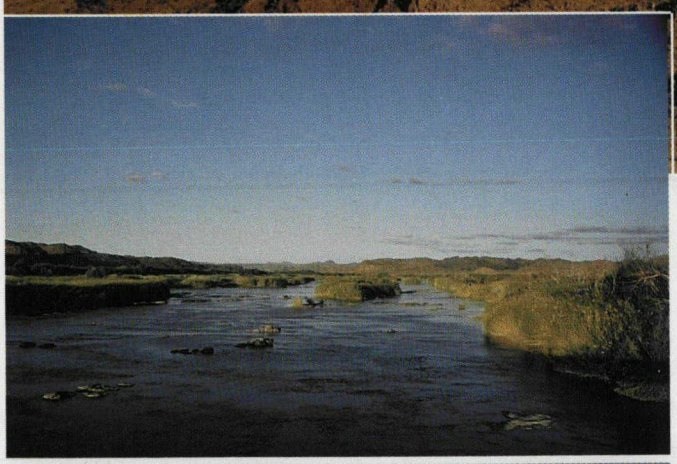
Along with the opening of the Olifantsfontein plant, ERWAT hosted a conference on Wastewater Management on Developing Metropolitan Areas. The theme throughout centred around the structures, systems and strategies to manage wastewater in metropolitan areas. A number of invited foreign speakers gave this conference a decidedly international flavour. Delegates got a glimps of the situations elsewhere in Africa and the vast needs in the huge metropolises of South America, as well as hearing how things are done in the metropolitan area of Seattle, USA

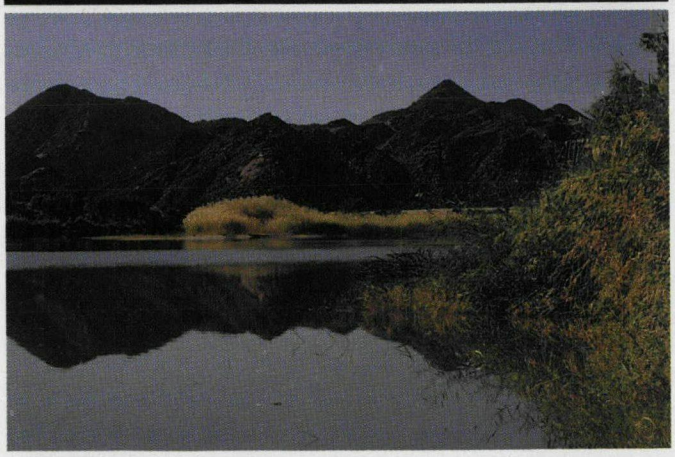
Some of the speakers at ERWAT's Wastewater Management conference (from left): Dr W Stottman (Principal Sanitary Engineer, World Bank), Ms Lyn Faas (King County METRO, Seattle, USA), Dr Lorraine Lotter (Greater Johannesburg Metropolis), Mr Arie Korf (Managing Director of ERWAT), Mr C Chaumin (Aguas Argentinas, Buenos Aires).

Right: Jenny Osten (left) and Mrs Jennifer Simpson from the Sunshine Coast Environment Coucil, Australia, and Mr JAHC Lodder (DHV Consul-tants) (centre) with Mrs Lodder from the Nether-lands, in the company of Mr Meiring du Plessis (far-right) of the Water Research Commission, SA, at the meet-and-greet reception of the River Basin Management conference.

Researchers study Orange River water losses







Until recently the quantity of water in the Orange River had never been a problem. However, studies in 1988/89 have shown that the available water resources in the Orange River are significantly less than originally indicated in a water balance estimate and that resources may soon be insufficient to meet projected demands.

A water shortage was already experienced in the Orange River system during 1992/93, demonstrating some of the potential problems. During this period the river system operators tried to release just enough water from the PK le Roux Dam (now the Vanderkloof Dam) to meet downstream requirements without allowing any excess spillage into the Atlantic Ocean. This release was complicated by the variability of the downstream irrigation demands and river losses, as well as an the eight week transmission time. In order to release the correct volume of water it is essential that the various components significant to the water balance are known with some accuracy.

In the original water balance estimate, however, environmental water demands (which include natural water losses from the river) were unfortunately not considered as a consumptive demand.

If the environmental demands of the lower Orange River, and at the river mouth in particular, are given a priority similar to other water demands the estimated water balance deficit will increase to 1 086 million m^3 per annum, say researchers RS McKenzie and C Roth (BKS Inc) a recent report to the Water Research Commission on the river losses in the lower Orange River.

The river losses from the Orange River, occurring downstream of the Vanderkloof Dam, are relatively large and these river losses need to be quantified accurately and ought to be included in any water resources assessment of the Orange River in order to operate the river system in such a manner as to minimise wastage, or shortfalls at the river mouth.

In view of the large uncertainty concerning river losses, it was identified as an area requiring urgent attention. For this reason a study to evaluate the water losses in the lower Orange River was given high priority by the Department of Water Affairs (DWAF) who agreed to provide the logistics and manpower support, as well as the Water Research Commission who agreed to provide the necessary funding for this research project.

Copies of the report **The evaluation of river losses from the Orange River downstream of the PK le Roux Dam** (WRC Report no. 510/1/94) emanating from this research project are available from the Water Research Commission, PO Box 824, Pretoria 0001, free of charge. Foreign orders will be charged a list price of US$ 20 per copy.

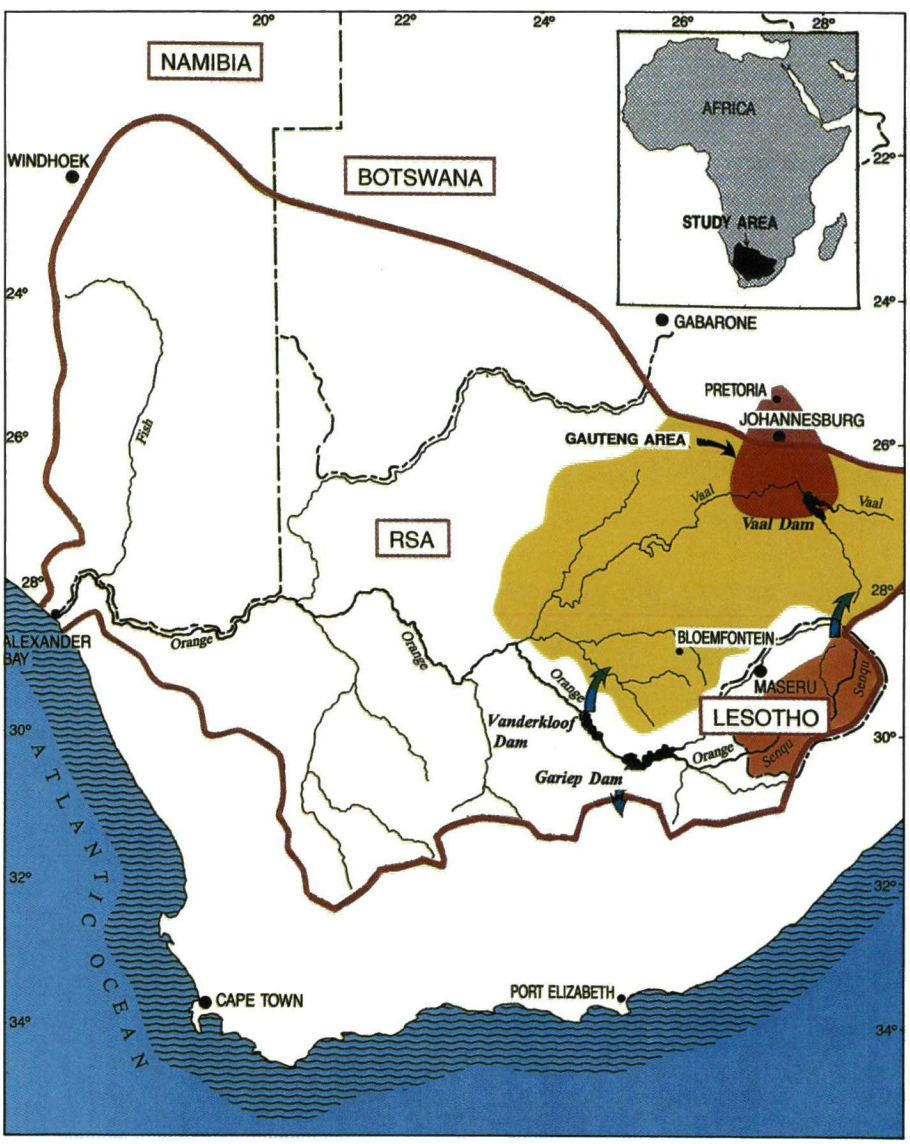
The Orange River is the largest river in Southern Africa, south of the Zambesi, with a total catchment area in excess of 1 million km^2. More than half of the catchment is inside South Africa, with the remainder in Lesotho, Botswana and Namibia.

By South African standards the natural water resources of the Orange River are large; an estimated 11 500 million m^3 per annum before any development took place within the catchment.

However, due to major developments that have already taken place in the basin, the current water resources of the Orange River are now estimated to be in the order of 6 500 million m^3 per annum. In other words, the water remaining available for use after the current demands have been met, is now only 6 500 million m^3 per annum.

DEMAND

Most of the development in the Orange River basin has taken place in the Pretoria/Witwatersrand/Vereeniging (PWV) area now commonly refered to as Gautengwhich forms the industrial heartland of South Africa, producing over 50 per cent of the gross national product (GNP). The rapidly increasing water demand in this area is not merely because of growing industrial demand, but greatly due to the rapidly rising urban population as a result of the movement of people from the rural areas to the major centres, in search of employment and higher living standards.



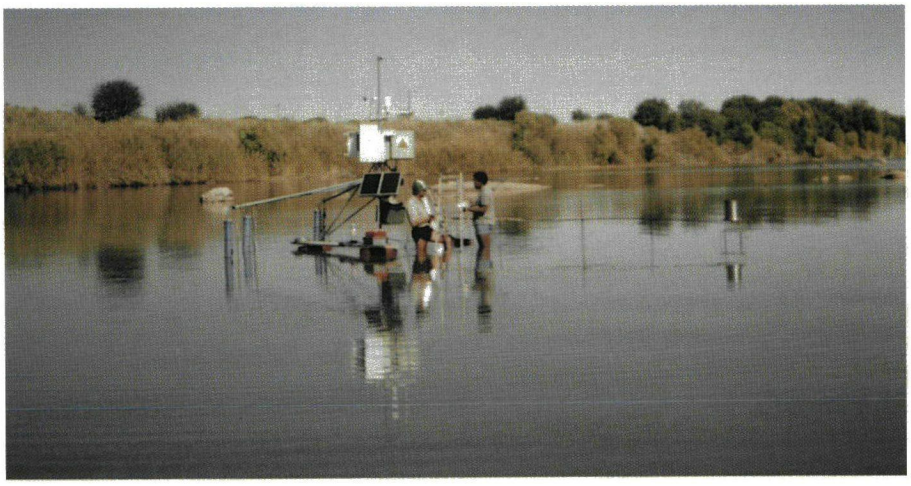
Location Plan: Orange River Catchment

RESOURCES

Several major interbasin transfers already exist to supplement the limited water resources available to the PWV area. As the demand continues to increase, however, the need for additional resources grows. The Lesotho Highlands Water Project (LHWP) is at present the largest and most ambitious water transfer project to be undertaken in Africa, and one of the largest water projects currently being undertaken in the world. When completed an estimated 2210 million m^3 water per annum will be transferred from the upper reaches of the Lesotho highlands to the PWV area in the Vaal River basin, which is the major tributary basin of the Orange River.

In view of the limited water resources of the Orange River and the implementation of Phase 1 of the Lesotho Highlands Water Project (LHWP) to supplement water resources in the PWV area, the Department of Water Affairs and Forestry (DWAF) commissioned a study to assess the water resources of the Orange River and to evaluate the likely impacts of the LHWP on these resources. The results of the study indicated that the water resources of the Orange River are significantly less than originally estimated, causing great concern.

It was decided to re-assess certain key elements which were considered in the water resources assessment, as doubts had been expressed about the reliability of the initial estimates of these components. The river loss downstream of the Vanderkloof Dam was identified as a key component requiring detailed analysis, leading to the current study of Orange River losses, of which the first phase is presented in this report by the researchers.



Bowen Ratio equipment used to measure evaporation from the Orange River surface

Aerial view showing riparian vegetation along the lower Orange River

AIMS

The primary objective of this research project was to improve the reliability of the loss estimate made in the course of the Orange River system analysis. This objective can only be achieved by identifying the main processes influencing the losses and incorporating it in a conceptual model.
The main components in the water losses estimate, to be investigated, as envisaged by the researchers were:

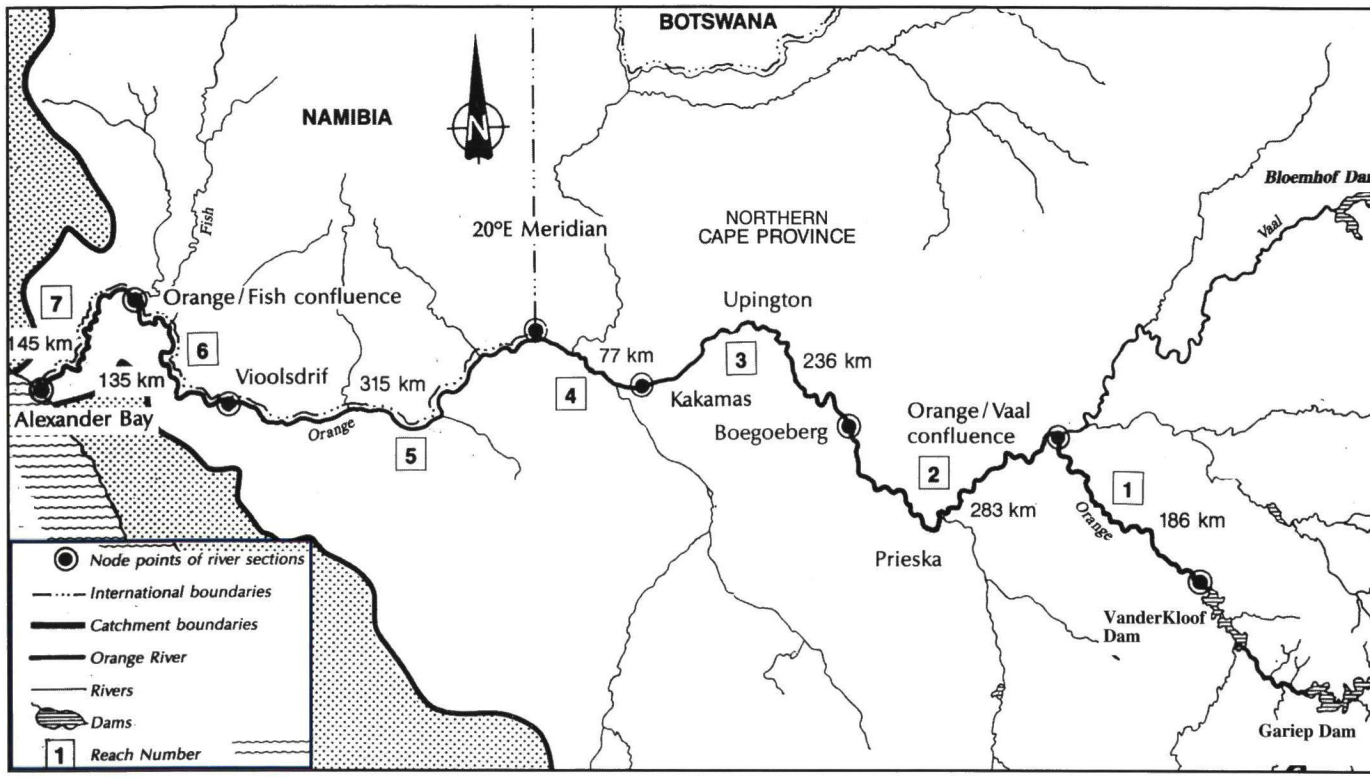
- water surface area,
- area of riparian vegetation,
- variability of water surface area with flow,
- river bed and bank seepage,
- evaporation from the water surface,
- evaporation from the riparian vegetation.

The ultimate aim of the study was to provide a reliable methodology for estimating river losses through evaporation which can be used in an operational model of the Lower Orange River. It was suggested that the techniques should also be suitable for application in other rivers in Southern Africa and provide a simple and systematic approach for such work.

The researchers' conclusions from the results they obtained during the course of the Orange River Losses study, are as follows:

EVAPORATION

The net evaporation losses occurring from the Orange River are likely to be higher than the 800 million m^3 per annum initially estimated, using the Symons Pan evaporation values and pan to lake correction factors. According to the report the evaporation calculated using the Bowen Ratio technique suggests that the evaporation from the river is actually higher than pan evaporation. However, this conclusion is based on a very short period during which the pan evaporation measured at four different pans showed considerable scatter. At the writing of the report it was not yet possible



River reaches selected for the Orange River losses study

Table 1: Summary of net evaporation losses from the Orange River

Reach	From	To	Length (km)	Evaporation areas (km^2)			Precipa-tation (mm/a)	Gross evapo-ration (mm/a)	Net evapo-ration (mm/a)	River losses	
				Water surface	Vegeta-tion	Total				10^6 m^3/a	m^3/s
1	Vanderkloof	Orange/Vaal	186	24,9	8,7	33,6	300	2 200	1 900	63,8	2,02
2	Orange/Vaal	Boegoeberg	283	59,9	19,4	79,3	230	2 340	2 110	167,3	5,30
3	Boegoeberg	Kakamas	236	74,3	24,4	98,7	150	2 590	2 440	240,8	7,63
4	Kakamas	20° E Meridian	77	12,6	5,4	18,0	100	2 700	2 600	46,8	1,48
5	20° E Meridian	Vioolsdrif	315	78,9	13,6	92,5	100	2 600	2 500	231,2	7,33
6	Vioolsdrif	Orange/Fish	135	32,9	3,8	36,7	50	2 400	2 350	86,2	2,73
7	Orange/Fish	Orange Mouth	145	52,8	7,7	60,5	50	2 100	2 050	124,0	3,93
Total			1377	336,6	83,0	419,3	-	-	-	960,1	30,40

for the researchers to confirm that the river evaporation is higher than pan evaporation throughout the year although the initial indications suggest that this is the case.

Using the Symons Pan evaporation figures directly, without any reduction factors, along the Orange River, the estimated total net evaporation loss occurring along the full length of the river is in the order of 690 million m^3 annually. The basis for this estimate is given in Table 1.

It should be noted that the values given in Table 1 are based on the available Symons Pan evaporation values estimated from various gauges in the vicinity of the Orange River. According to the report these gauges are not situated directly adjacent to the river and are usually several kilometres from the water surface. The recent work carried out by Forestek indicates that there can be a significant difference between the tank evaporation at the waters edge, and that only a few kilometres away. This aspect will have to be considered in the subsequent phases of the study.

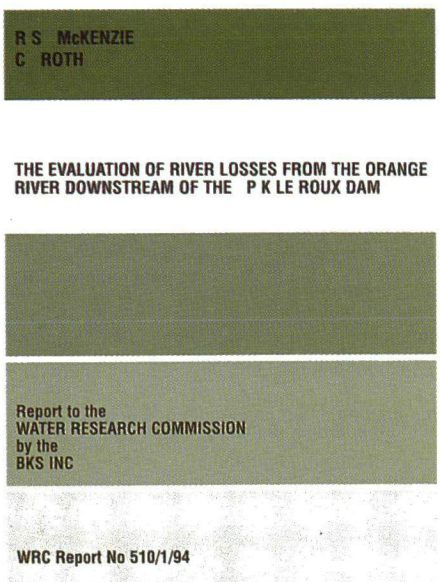
The confluence of the Orange River (left) and the Vaal River (right), note the water from the Orange River pushing up the Vaal River.

IRRIGATION RETURN FLOWS

Furthermore it should be noted that the influence of irrigation flows was disregarded and not taken into account in table 1 or in the original loss estimate of 800 million m^3 per annum. However, from the water balance analysis carried out using the gauged flows, it is clear that the irrigation return flows are significant and must be included in any river loss evaluation. Such return flows are more than likely to offset the higher evaporation estimates used in Table 1.

The return flows will depend, to a large degree, on the application method and scale of irrigation. It is estimated that return flows are in the order of 10 to 40 per cent of the water applied.

With the information currently available it is not possible to quantify the return flows with greater accuracy, since the abstractions are not known accurately and the lag time associated with the return flows is also an unknown factor at this stage. Should the return flows found to be in the order of 30 per cent for example, the estimated net river losses will drop from 960 million m^3 per annum mentioned in Table 1, to 720 million m^3 per annum.



VEGETATION AND TRANSPIRATION

The analyses indicate that aerial photographs can be used to provide realistic estimates of both the water surfaces areas and the areas of sand banks as well as riparian vegetation. By analysing photographs of the same river reach at different flow rates it is possible to evaluate the influence of flow rate on surface area. In the case of the Orange River the surface areas vary little as long as the flow rate remains within the normal release limits (80-200 m^3 /sec).

Satellite images can also be used to estimate various areas and once processed, the images can be incorporated into a GIS which allows considerable information to be obtained very quickly.

However, problems often occur when processing the satellite images, resulting in vegetation areas which may be unrealistic due to misinterpretation of certain types of vegetation. For example, it is often difficult to distinguish between riparian vegetation and nearby irrigation. In such cases it is essential to verify the results, which usually involves making use of aerial photographs, and undertaking site visits to selected areas. It is often more economical to base the areas on aerial photographs, and to use satellite images in cases where additional information is required.

Water losses as a result of transpiration from riparian vegetation are significant. According to the report the total area of riparian vegetation is estimated to be more than 80 km^2 (equalling 25 per cent of the total water surface as indicated in Table 1). It is estimated that the water loss via the riparian vegetation is similar in magnitude to that lost directly from a free water surface. Such losses will naturally depend upon the type of vegetation (i.e. reeds or trees) and the availability of water.

Removing colour from Cape waters

The results of an investigation into the removal of natural colour from Cape water using ozonation and membrane separation processes, are available in the form of a final report from the Water Research Commission in Pretoria. The investigation was carried out by GJG Juby and GR Botha from the consulting engineering firm Stewart Scott Inc.

According to the researchers a desk study had shown that it would be possible to utilise ozonation and membrane separation processes at approximately the same cost as the conventional treatment systems, but without the sludge disposal problem. Other benefits of the ozonation and membrane separation processes include a possible greater reduction in trihalomethane formation potential (THMFP) and a reduction in land area requirements. The latter could be of importance when waterworks have to be extended in areas where space is limited.

The final report released by the Water Research Commission presents findings of both laboratory scale investigations and pilot plant studies.

Copies of the report entitled Removal of colour from Cape waters using ozonation and membrane filtration (WRC report 445/1/94) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US$ 20.)

Many of the natural river waters of the southern and western Cape and also some of the waters of the eastern Transvaal contain humic and fulvic substances which impart a brownish colour to the water. These organic substances are introduced to the water as a result of extraction from vegetation and plant residuals.

There are several reasons why natural water is treated to remove colour. Some of these are:

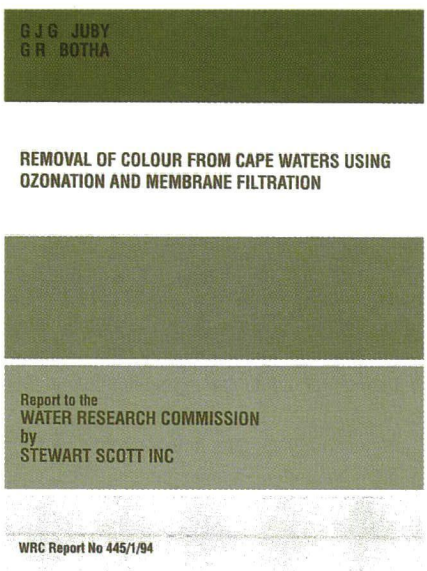
❑ Aesthetic. The World Health Organisation reports that most people are able to detect levels of colour above 15 true colour units (TCU) or Hazen units in filtered water. This is in line with the SABS recommended limit of 20 Hazen for potable water.

❑ Taste and odour. The presence of humic substances is often associated with other taste and odour compounds particularly when the water is chlorinated.

❑ The formation of disinfection by-products such as trihalomethanes (THMs). These substances have been shown to be potential carcinogens and could pose health risks.

The usual methods for colour removal from Cape waters are the well proven techniques of coagulation with aluminium sulphate (alum) or an iron salt, followed by flocculation, sedimentation and filtration. These processes rely on the precipitation of humates or fulvates and the adsorption of the colour compounds on the metal hydroxide floc particles.

The researchers say that although the process works well and reduces colour to acceptable levels it relies on relatively large dosages of coagulant to remove colour and to produce floc with good settling characteristics. Lime dosing is usually required to adjust the pH to the desired range for efficient colour removal and polyelectrolite flocculants are also often used for aggregation of floc particles and to improve settlement.



The area requirements for plants of this type are extensive due to the often poor settling characteristics of the flocs. Furthermore, the process produces fairly large volumes of sludge which generally has poor dewatering characteristics, creating disposal problems.

RESULTS

Two alternative treatment methods, namely ozonation followed by biologically enhanced filtration and membrane separation using nanofiltration membranes were investigated. Colour removal efficiencies with ozone followed by biologically enhanced sand filtration were better than with ozone followed by biologically enhanced granular activated carbon (GAC), with up to 95 per cent colour removal being achieved, the researchers report. However, the product quality varied and was only below the recommended limit of 20 Hazen in the last 700 hours of operation, when the average colour was 14 Hazen.

Nanofiltration membranes demonstrated excellent colour removal (to less than 5 Hazen). However, problems were experienced with membrane fouling which necessitated frequent detergent washes of the membranes. The relatively high natural turbidity of the water was identified as the cause of the fouling. Attempts to remove the turbidity in a simple pretreatment step were unsuccessful on the pilot plant.

Compared with conventional treatment methods for colour removal (such as alum coagulation), both the ozonation-biological filtration process and membrane separation were able to reduce the trihalomethane formation potential of the product water to lower values.

COSTS

A nett present value cost analysis at different nett discount rates over a 20 year plant life showed that the options of ozonation followed by biologically enhanced filtration in GAC and sand filters, would be between 15 and 14 per cent cheaper than the conventional alum coagulation method. The product reference unit cost for the two ozone and biologically enhanced filtration systems varied between 60 and 85 c/m^3, depending upon the nett discount rate. On the other hand, ozonation only and membrane nanofiltration could be about 55 per cent more costly than the alum method, with product reference unit costs of between 108 and 142 c/m^3.

Researchers evaluate membrane technology for the treatment of electroplating effluents

"Very little experience is available in South Africa regarding the use of membrane and other technologies for the treatment of electroplating effluents. In particular, the fouling potential of electroplating effluents for membranes and ways and means to clean fouled membranes, are unknown." This is said in a report published by the Water Research Commission on the evaluation of membrane technology for electroplating effluent treatment.

The research summarised in the report was carried out by JJ Schoeman and A Steyn from the Division of Water Technology at the CSIR in Pretoria.

The researchers say the annual water consumption by the electroplating industry in South Africa is approximately 9 million m^3 of which 80 per cent is discharged as effluent. The effluent is produced as a result of the plating of common and precious metals, metal finishing and electroless plating, and the manufacture of printed circuit boards.

The major sources of waste that result from normal plating and metal finishing operations are alkaline cleanings, acid cleanings, spent plating-bath solutions and rinse waters. The largest portion (approximately 90 per cent) of the water required in the plating process is for rinsing, where it is used to remove the process solution film (drag-out) from the surface of the work pieces. The water thus becomes contaminated with the constituents of the process solutions and is not directly reusable.

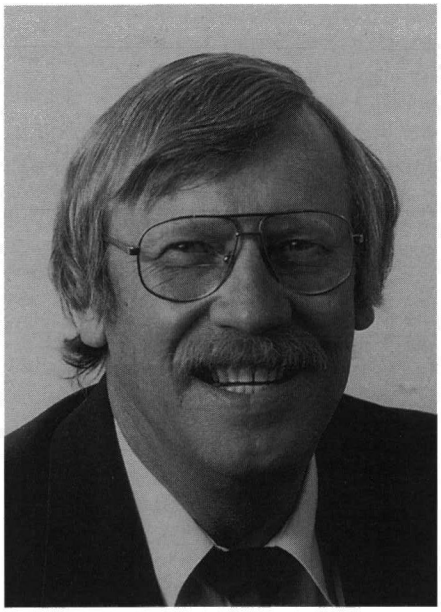
Common plating metals include nickel, chromium, copper, zinc, cadmium, lead, iron and tin. The metals originate from two types of waste streams in the electroplating process, namely, an acid stream and an alkaline stream. These two streams are usually mixed before lime addition in a thickener/clarifier for removal of the toxic metals in the form of their metal hydroxide sludges. These toxic sludges are usually filter pressed and removed by truck from plating shops, for safe disposal. The clarified effluent is discharged into the sewer system and has to comply with the effluent discharge standards laid down by the authorities. In this way, large volumes of water are lost in the process. Ideally, this water should be recycled to decrease water intake by the industry, while the recycling of recovered metals to the plating process will reduce water pollution and sludge volumes dramatically.

EFFLUENT TREATMENT

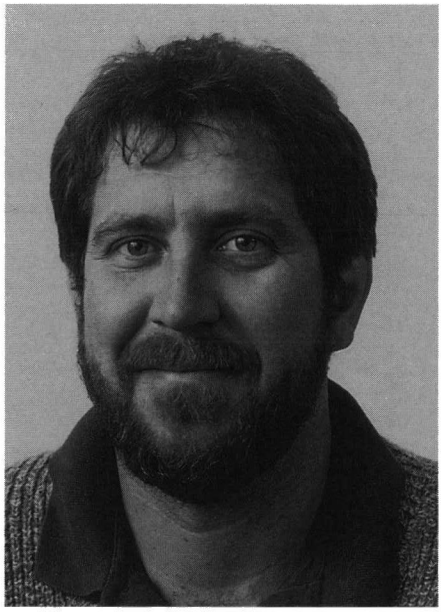
Reverse osmosis, electrodialysis, the coupled transport process, diffusion dialysis, electrolytic metal recovery, evaporation and ion-exchange are all processes that can be used for the treatment of electroplating effluent. The researchers say both reverse osmosis and electrodialysis have been demonstrated to be effective for nickel and water recovery from nickel rinse waters. The coupled transport process has the potential to recover chromium from chromium waste-waters, while acids can be successfully recovered from spent acid effluents with diffusion dialysis. Metals like nickel and silver can be cost effectively recovered from electroplating rinse waters with electrolytic metal recovery technology. From the same wastewaters, evaporation technology can recover nickel and chromium and ion-exchange technology nickel, chromium and copper.

To evaluate these technologies for the treatment of electroplating effluents under South African conditions, the Water Research Commission financed the Division of Water Technology at the CSIR to undertake a research study with the following objectives:

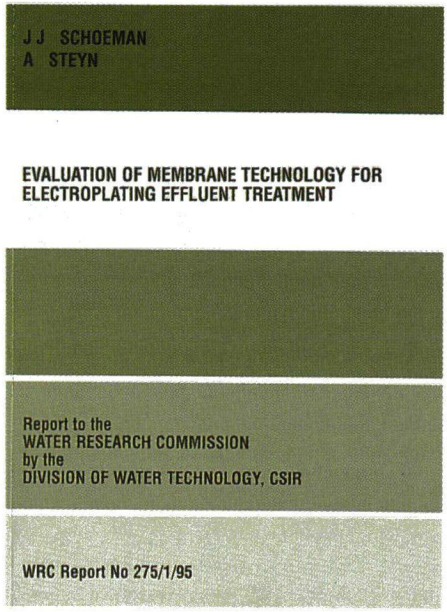
- ❑ To evaluate reverse osmosis and electrodialysis for metal and water recovery from electroplating rinse waters;
- ❑ To evaluate reverse osmosis and electrodialysis for treatment of mixed (before metal removal by precipitation) and final (after metal removal) electroplating effluents;
- ❑ To determine the fouling potential of electroplating effluents for reverse osmosis and electrodialysis membranes and to develop membrane cleaning methods;
- ❑ To evaluate an electrolytic metal recovery process for metal recovery from electroplating rinse waters;
- ❑ To evaluate diffusion dialysis for acid recovery from spent acid;



Dr Japie Schoeman



Mnr André Steyn



❑ To evaluate ion-exchange for metal recovery from electroplating rinse water;

❑ To develop process design criteria for electroplating effluent treatment, and

❑ To determine the economics of the processes.

The researchers say the investigation was carried out on specific selected effluents (nickel, chromium, cadmium and other related metals) that were identified by an industry survey to have major environmental impact and containing high value recoverable materials.

CONCLUSIONS

Reverse Osmosis

❑ Nickel rinse water

Nickel drag-out (rinse water) can be cost effectively treated with a tubular cellulose acetate reverse osmosis membrane system for nickel and water recovery for reuse in the electroplating process. Payback periods for 5 m^3/h, 5 m^3/d and 15 m^3/d nickel/water recovery reverse osmosis plants were determined at 1,3; 2,1 and 1,7 years respectively. Nickel could be concentrated from 1 300 mg/*l* in the inlet drag-out (13 500 mg/*l* nickel revers osmosis feed tank) to 14 400 mg/*l* in the reverse osmosis brine at a water recovery of 93 per cent (feed and bleed system, concentration factor 11,1). The nickel concentration in the reverse osmosis permeate was only 37,4 mg/*l*. Therefore, a nickel removal of 99,7 per cent was obtained from the reverse osmosis feed. Nickel could also be concentrated in a batch system from 1 760 mg/*l* in the feed to 7 400 mg/*l* in the brine at a water recovery of 93 per cent (concentration factor 4,2). The reverse osmosis permeate had a nickel concentration of only 38,9 mg/*l* Therefore nickel removal was 97,8 per cent. Higher water recovery (approximately 95 per cent) and therefore higher brine (nickel) concentration is possible. Very little membrane fouling took place when the fouling potential of nickel-drag out was determined for cellulose acetate reverse osmosis membranes and it was demonstrated that it should be possible to control membrane fouling with regular chemical cleaning.

❑ Chromium rinse water

The researchers recovered chromium and water successfully with the tubular cellulose acetate reverse osmosis membranes. Chromium in the inlet drag-out was concentrated from 740 mg/*l* (2 950 mg/*l* in the reverse osmosis feed tank) to 3 100 mg/*l* in the reverse osmosis brine (concentration factor 4,2) at a water recovery of 80 per cent (feed and bleed system). The chromium concentration in the reverse osmosis permeate was 189 mg/*l* Therefore chromium removal was 93,6 per cent. Chromium could also be concentrated from 469 mg/*l* in a batch system to 2 320 mg/*l* (concentration factor 4,9) in the reverse osmosis brine at a water recovery of 92 per cent. Chromium removal was 87 per cent. The researchers say the concentration level of the recovered chromium is too low for direct use in the plating bath. However, it will be possible to increase its concentration level to the required strength (approximately 240 g/*l* CrO_3) with an evaporator. Membrane fouling took place during reverse osmosis treatment of chromium rinse water, but it appears that it should be possible to control membrane fouling with regular chemical cleaning.

❑ Zinc rinse water

Zinc could be concentrated from 1 740 mg/*l* in the acidic zinc inlet drag-out (reverse osmosis feed tank 5 090 mg/*l*) to 5 280 mg/*l* in the reverse osmosis brine (concentration factor of 3) at a water recovery of 80 per cent. The zinc concentration in the reverse osmosis permeate was 323 mg/*l*. Therefore, zinc removal was 93,7 per cent. Zinc could also be concentrated from 630 mg/*l* in the reverse osmosis feed to 2 790 mg/*l* in the reverse osmosis brine (batch systems; 91

per cent water recovery) while the zinc concentration in the reverse osmosis permeate was only 36 mg/*l*. This means that zinc removal was 94,3 per cent. Membrane fouling was experienced, but regular chemical cleaning could solve the problem. The researchers say zinc has a low value compared to nickel and therefore a zinc recovery reverse osmosis plant will not be very economic.

❑ Cadmium rinse water

It appears that it will be possible to treat alkaline cadmium rinse water successfully with spiral wrap Filmtec reverse osmosis membranes. Cadmium was concentrated from 95 mg/*l* in the reverse osmosis brine (concentration factor of 9,5) at a water recovery of approximately 90 per cent (batch system). The reverse osmosis permeate only contained 0,16 mg/*l* cadmium 99,8 per cent Cd removal). Membrane fouling, however, was experienced during treatment of the cadmium rinse water, but it should be possible to control it with chemical cleaning.

❑ Mixed electroplating effluent

Water recovery of more than 80 per cent is possible (feed and bleed system). This means that the mixed plating effluent that must be treated for metal removal, is reduced significantly by reverse osmosis treatment. The electrical conductivity of mixed effluent (181 mS/m) was reduced from 831 mS/m in the reverse osmosis feed (feed and bleed system) to 76 mS/m in the reverse osmosis permeate (90,9 per cent removal). Therefore an excellent quality reverse osmosis permeate can be produced that can be used as rinse water in the electroplating process. Excellent removals of heavy metals were also obtained. Nickel was reduced from 77 to 3,3 mg/*l* (95,7 per cent removal); chromium from 51 to 3,1 mg/*l* (93,9 per cent removal); zinc from 290 to 13,1 mg/*l* (95,5 per cent removal); cadmium from 34 to 1,71 mg/*l* (95,0 per cent removal). Membrane fouling took place, but it should be possible to control it with regular chemical cleaning.

The researchers say batch reverse osmosis tests showed that the electrical conductivity of the reverse osmosis feed could be reduced from 174 mS/m to 36,1 mS/m in the reverse osmosis permeate (79,7 per cent removal) at a water recovery of approximately 90 per cent. Chromium was reduced from 8 to 0,92 mg/*l* (88,5 per cent removal); zinc from 54 to 4,75 mg/*l* (91,2 per cent removal); nickel from 15,4 to 1,35 mg/*l* (91,2 per cent removal); and copper from 1,08 to 0,19 mg/*l* (82,4 per cent removal).

❑ Final effluent

Electrical conductivity of the final effluent (130 mS/m) could be reduced from 529 mS/m in the reverse osmosis feed to 29,1 mS/m in the reverse osmosis permeate (94,5 per cent removal) at a water recovery of 80 per cent (feed and bleed system). Therefore an excellent quality reverse osmosis permeate was produced that could be used as rinse water in the electroplating process. Cadmium was reduced from 5,2 to 0,08 mg/*l* (98,5 per cent removal); chromium from 7,1 to 0,2 mg/*l* (97,2 per cent removal); copper from 3,8 to 0,7 mg/*l* (81,6 per cent removal); nickel from 36,7 to 0,91 mg/*l* (97,5 per cent removal) and zinc from 5,8 to 0,09 mg/*l* (98,4 per cent removal).

Electrodialysis

The research project has shown that it is possible to treat nickel, copper, silver and chromium cost-effectively with electrodialysis for metal and water recovery. A nickel recovery plant payback period of approximately 1,5 year is possible (113 m^2 electrodialysis plant). Nickel in the electrodialysis fee was maintained between 0,5 and 1 g/*l* while nickel was concentrated to approximately 50 g/*l* in the electrodialysis brine. Nickel recovery of 97 per cent was obtained. For alkaline copper (1,2 kg Cu/h; 113 m^2 membrane area) and silver (113 m^2 electrodialysis plant) metal recoveries of 92 and 95 per cent were obtained respectively.

Pilot plant results showed that nickel rinse-water could be concentrated from approximately 3,5 g/*l* in the electrodialysis feed to 23 g/*l* in the electrodialysis brine (concentration factor of 6,5) at a water recovery of approximately 85 per cent. The nickel concentration in the desalinated feed varied between approximately 700 and 1 000 mg/*l*. Nickel removal varied between 68 and 78 per cent. Nickel loading rate was determined at 0,048 g nickel per hour per square metre membrane area at a nickel removal of 78,7 per cent. Electrical energy consumption was determined at 2,35 kwh/kg nickel.

Selemion AMV anionic membranes were rapidly fouled with spent nickel plating bath solution in fouling tests while Ionics A-204-UZL and Ionac MA-3475 anionic membranes showed little signs of membrane fouling. Therefore, care should be taken in the selection of ion-exchange membranes for treatment of nickel rinse water. Alternatively, feedwater should be pretreated with activated carbon prior to electrodialysis treatment to prevent process failure. Regular membrane cleanings with acid and caustic rinses should also be practised to clean fouled membranes.

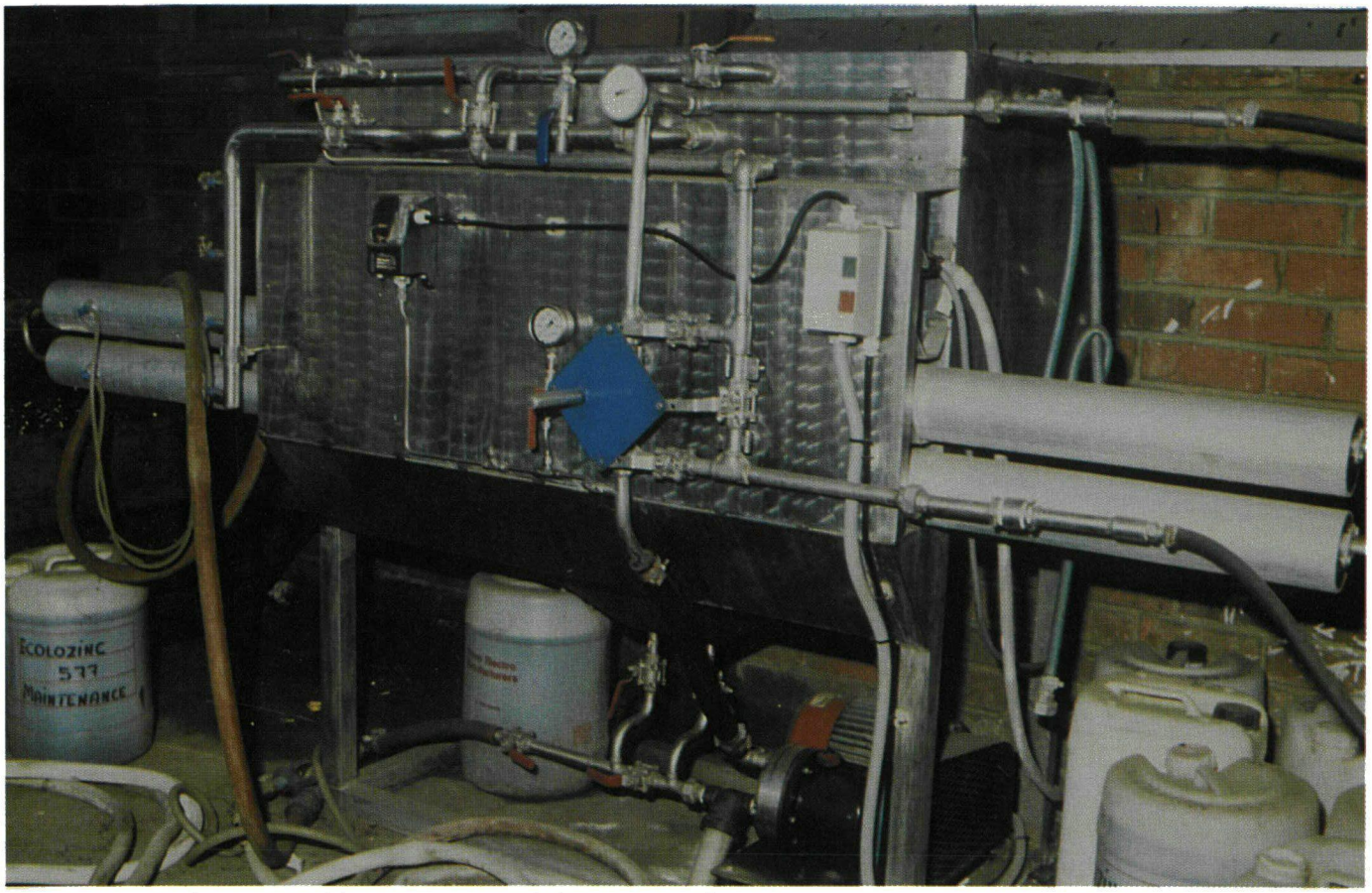
ELECTROLYTIC CELL

The researchers say it would be possible to apply a Chemelec electrolytic cell effectively for cadmium and cyanide removal from cadmium rinse water. Cadmium could be reduced in one case from 190 mg/*l* in the feed to only 4,2 mg/*l* in the product and cyanide from 862 mg/*l* to 429 mg/*l*. However, the researchers say better cyanide removals will be possible if higher electric current is applied.

A Chemelec electrolytic cell can be cost effectively applied for nickel recovery from nickel rinse water. A plant payback period of less than 1,5 year is possible. Nickel, for example, was reduced in one case from 766 mg/*l* in the rinse water to approximately 6 mg/*l* (99,3 per cent removal) in the treated water. Highest nickel removal took place when the pH of the feedwater was controlled between pH 4 and pH 4,8. It was demonstrated in pilot tests that nickel in a rinse water tank could easily be reduced from approximately 1 000 to 400 mg/*l* with a Chemelec cell. Nickel recovery rate was determined at 2,1 g nickel per hour (electrode area 0,045 m^2).

ACID RECOVERY

The investigation showed that diffusion dialysis could effectively be used for acid recovery from spent acid produced during cleaning of metals prior to plating. Acid recovery from sulphuric/hydrochloric acid mixture was determined at 58 per cent. Hydrochloric acid recovery varied between 74 and 76 per cent. Sulphuric



The membrane pilot plant used for the treatment of electroplating effluent

acid recovery was approximately 75 per cent. Approximately 95 per cent of the metals (iron, nickel, copper) could be removed from the recovered acid. Zinc was not as effectively removed (14,4 per cent removal) as the other metals. However, the researchers say it may also be possible in this case to recover acid effectively with diffusion dialysis for reuse in the plating process.

ION-EXCHANGE

According to the report it will be possible to use ion-exchange effectively for nickel recovery from dilute nickel rinse waters (150; 400 and 1 000 mg/l nickel). Most of the nickel could be removed from the exhausted resin with 2,5 to 3 bedvolumes dilute sulphuric acid regenerant. The recovered nickel solution can be used in the plating bath or the nickel can be electrolytically recovered for sale to scrap metal dealers. It might also be possible to use the treated rinse water again as rinse water in the process. Chrome and copper electroplating rinse waters can also be effectively treated with ion-exchange.

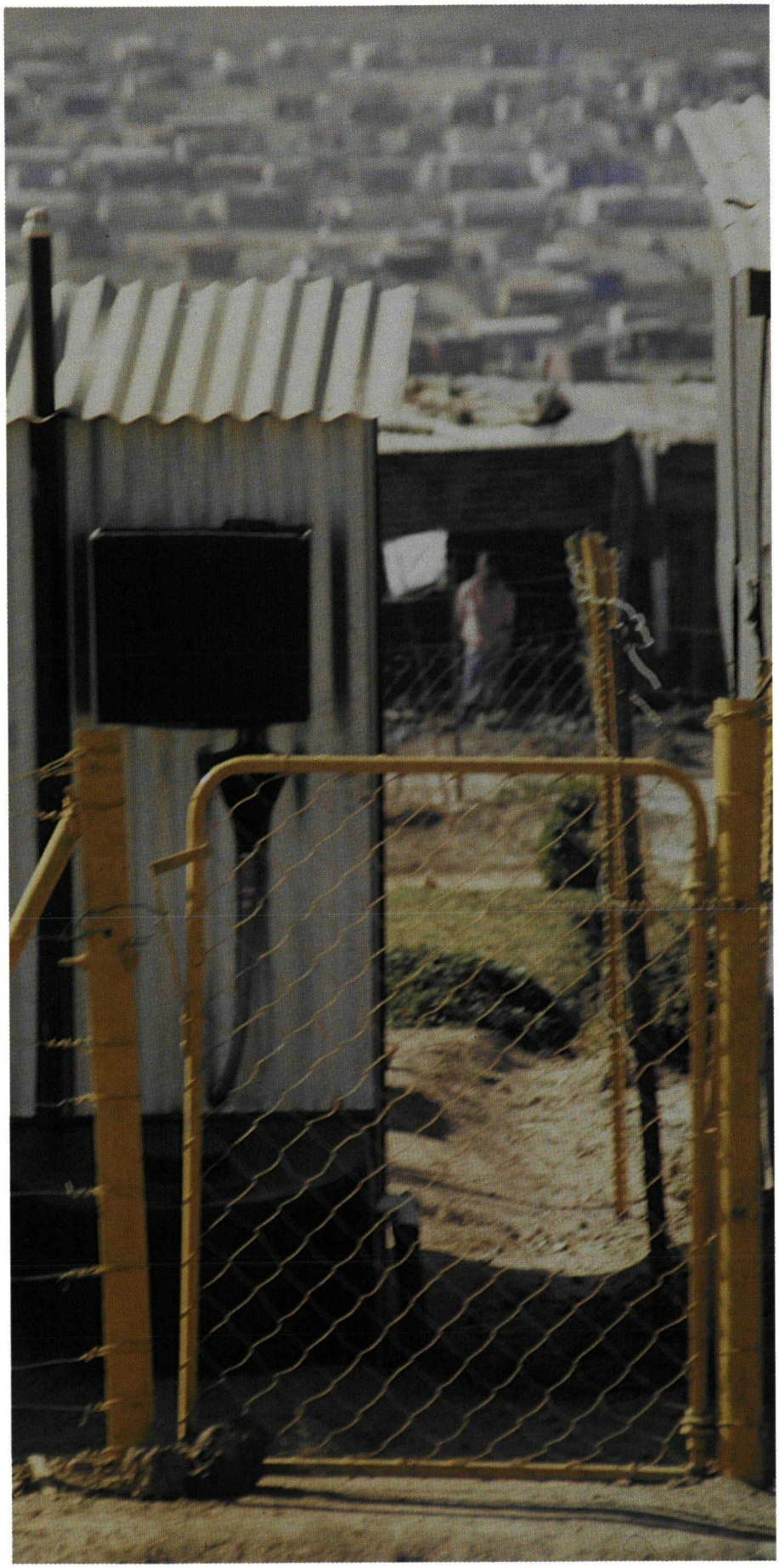
TECHNOLOGY TRANSFER

Process design criteria for electroplating effluent treatment with membrane, electrolytic and ion-exchange technology can be derived from the experimental results. The researchers say demonstration plants should now be installed at selected plating shops to transfer metal, water, effluent volume reduction and pollution control technology to the electroplaters. Electrolytic nickel and zinc recovery plants as well as an evaporator for chromium recovery from chromium drag-out was recently installed at plating shops in South Africa.

CENTRALISED EFFLUENT TREATMENT

Centralised treatment of electroplating effluents is successfully applied in the USA and elsewhere. A centralised facility for treatment of electroplating effluents should also function effectively in South Africa, the researchers say. They say this will take the effluent treatment responsibility away from the electroplater by effluent treatment experts with an effluent treatment infrastructure. The electroplater will benefit from such an approach because it will not be necessary for them to have their own advanced effluent treatment system. However, the economics of such an approach should first be determined or, alternatively, effluent treatment can be conducted for electroplaters by effluent treatment experts on site.

Copies of this report called **The evaluation of membrane technology for electroplating effluent treatment** (WRC report 275/1/95) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US$ 25).



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The Water Supply and Sanitation Collaborative Council Working Group on the Promotion of Sanitation held its first meeting in Thun, Switserland, in March 1994, where, for three days, sanitation experts from around the globe discussed the "Problem of Sanitation" in the developing world. They tried to find an answer to the question why, despite years of rhetoric, good intentions and hard work, is there so little progress in "sanitation provision" in many of third world countries?

The deliberations resulted in a document representing the views and consensus of the Working Group on the Problem of Sanitation. It is in the form of a state-of-the-art paper on why sanitation has not moved forward and is presented here for comment.

Every year millions of people die from diarrhoea that could have been prevented by good sanitation, while millions more suffer the nutritional, educational and economic loss through diarrhoeal disease which sanitation can prevent. Poor sanitation has led to the infestation of nearly a billion people, largely children, with a variety of worm infections, with corresponding costs in health and energy. Human excreta are also responsible for the transmission of schistosomiasis, cholera, typhoid and many other infectious diseases affecting hundreds of millions. Heavy investments have been made in water supply since 1980, but the resulting health benefits have been severely limited by the poor progress in sanitation. Besides this toll of sickness and disease, lack of sanitation is a major environmental threat to

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water resource systems and a fundamental denial of human dignity.

CHARACTERISTICS OF THE PROBLEM

Like all complex problems, poor sanitation can be analysed on many inter-related levels. At its first meeting, the Collaborative Council Working Group on Sanitation Promotion started a process of identifying problems, barriers and themes that appeared to operate on three levels.

Level 1: The basic problem - sanitation isn't happening.

Despite years of rhetoric, good intentions and hard work, most countries are in fact making little or no progress. At current rates of "sanitation provision", the number of people without sanitation will not change in the next forty years: a staggering two billion people. This is astonishing, given the human capacity to solve problems, the fundamental nature of this basic need and the enormous suffering caused by the world's failure to meet it. Yet, those working in the field of sanitation are agreed that, with some notable exceptions, they are either losing ground or barely holding the line.

Level 2: barriers to progress - why sanitation doesn't happen.

Given the magnitude and importance of the problem, why is there so little progress? The barriers to progress found by the working group were varied and complex, but could generally be grouped into nine linked and overlapping categories.

❑ **Lack of political will.** There is little political incentive for government to deal with a difficult subject. Politicians rarely lose their jobs because of poor sanitation, particularly as the people most in need have the least power. Political commitment is needed to create an environment in which demand for sanitation can grow, which in turn can strengthen political will. The issue of political will is thus both a cause and effect of other problems, and a key to successful sanitation promotion.

❑ **Low prestige and recognition.** Low cost sanitation facilities and hygiene promotion campaigns have never been prestigious. Politicians and movie stars don't demonstrate latrines. Among the professionals the best and the brightest avoid low cost sanitation as a low status and low pay career, particularly as it is more difficult and demanding than high status high tech engineering or medical approaches. Among consumers, low cost sanitation has no prestige in comparison with "conventional" water-borne sanitation as used by the industrialised world and by the economic elite of developing countries.

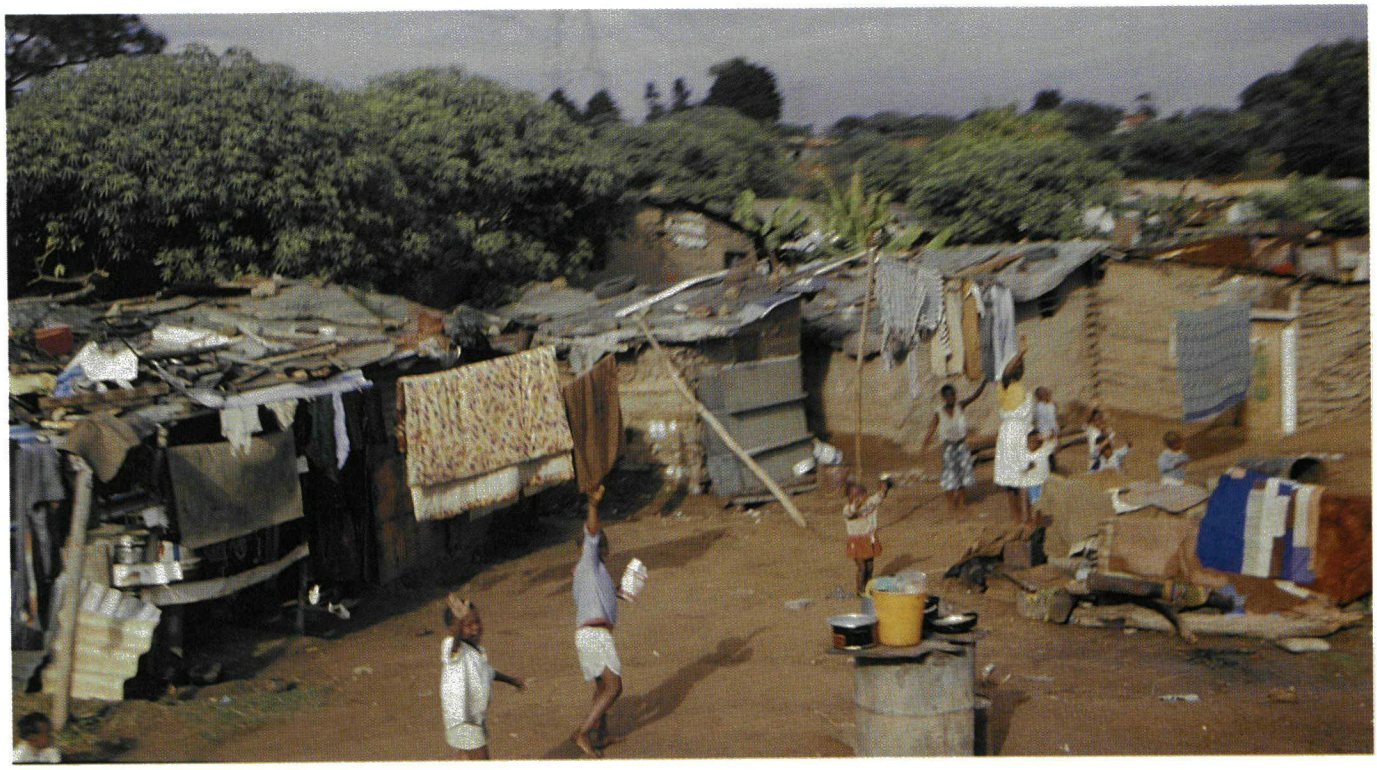
❑ **Poor policy at all levels.** Agencies responsible for creating a supportive environment for sanitation generally have ineffective and counterproductive policies at all levels. These include too much attention to water supply at the expense of sanitation, a focus on short run outputs (hardware) rather than long term behaviour change, and subsidies that favour middle and high income communities. More fundamentally, there is often no philosophical approach to the problem upon which sound policy can be based.

❑ **Poor institutional framework.** Many players are affected by sanitation and many more could be involved in its promotion. The institutional frameworks which are in place fragment responsibilities between government departments, neglect the needs of the most vulnerable and ignore the powerful role that non-governmental organisations and the private sector can play. It is clear that governments by themselves have failed to promote sanitation and that existing institutional frameworks need to change.

❑ **Inadequate and poorly used resources.** Sanitation does not attract a fraction of the resources needed to do the job. It is at least as important for health as water supply and is a far more demanding problem, yet sanitation receives far fewer resources. Increasing resources are required just to maintain the *status quo*, as urbanisation and population growth make the hazards of poor sanitation more acute. Where resources are available, far too much goes into hardware and not enough into mobilisation and hygiene promotion.

❑ **Inappropriate approaches.** Even where sanitation promotion is attempted, the approach taken, is often wrong. Attempts are made to find simple universal solutions which fail by ignoring the diversity of needs and contexts. Urban needs often differ from rural needs, the technological options offered are limited and inappropriate and critical issues of behaviour are ignored or badly handled. The short-term is generally favoured over the long-term and workers in the sanitation field fail to learn from collective experience.

Sanitation also fails by being defined and applied too broadly or too narrowly within a specific environment. In some case, for example, the scope of environmental protection and pollution control becomes so broad that the focus on basic household excreta management lost. In other cases, a narrow focus on pit latrine installation which ignores local drainage needs could exacerbate disease transmission during floods. Short-term disaster relief fails to develop long-term sustainable sanitation because the approach doesn't include the transition as a goal. Current approaches also stifle innovation and undermine confidence: sanitation



workers are so afraid of even more failure in this difficult field that they don't take the risks required for success.

❑ **Neglect of consumer preferences.** Too often, we try to sell what people don't want or can't afford. Low-cost technologies are often seen by consumers as low status technologies, while many "appropriate" technologies are far beyond the economic reach of those most in need. Promoters try to sell sanitation facilities on health benefits, where people really want the privacy, comfort and status which sanitation can offer. Much hygiene promotion is based on messages which ignore existing knowledge, belief and experience. Very simply, most of those promoting sanitation simply don't listen to what people want or believe.

❑ **Ineffective promotion and low public awareness.** People don't want to talk or think about faeces, so selling the idea of sanitation is difficult. Yet the engineers and doctors frequently responsible for selling sanitation are often unaware of effective promotional techniques and continue with top down approaches that alienate "target populations" by denying their voice, desires and involvement in the process. Those in charge are not trained for this job of promotion. Adoption of social marketing and participatory approaches to sanitation is promising but this is still in its infancy: the world have much to learn.

❑ **Women and children last.** Women are potential agents of change in hygiene education and children are the most vulnerable victims, but men usually make the decisions about whether to tackle the problem, and how. Many sanitation programmes ignore the disposal of children's faeces, even though these are a major reservoir of disease pathogens. Women often need privacy and security in sanitation more than men, yet are unable to express these needs in many societies. Those with the most at stake thus have the weakest voice.

Level 3: Cross-cutting themes - demand and taboo

❑ **Little effective demand.** If enough people wanted the available sanitation improvements badly enough, many of the above problems would resolve themselves. These problems are frequently expressed as constraints upon supply. Sanitation planners also need to think about factors which limit economic or political demand. Some people may want sanitation very badly but are powerless to express that want in financial or political terms. Some may want sanitation facilities, but not at the available price, while others may not want the available "improvements" at any price. Where sanitation is poor we need to understand why the effective demand is low to determine whether it is most amenable to political, financial, technical or informational change.

❑ **Cultural taboos and beliefs.** In most cultures excreta are taboo and viewed as a disgusting and dangerous nuisance not to be discussed openly or seriously. Nobody wants to be associated with excreta, even those who actually reduce its offensive characteristics for others are stigmatised by association. Problems can't be solved if people don't want to talk about them and don't want to be associated with their solution. In many contexts, ancient or more modern technical taboos can block the safe reuse of human waste as a resource. The excreta taboo lies behind many of the barriers to progress.

For more information, or if you would like to comment on this paper, please write to: The Working Group on Sanitation Promotion, c/o Mayling Simpson-Hebert, Rural Environ-mental Health, World Health Orga-nisation, 20 Avenue Appia, CH-1211 Geneva 27, Switzerland.

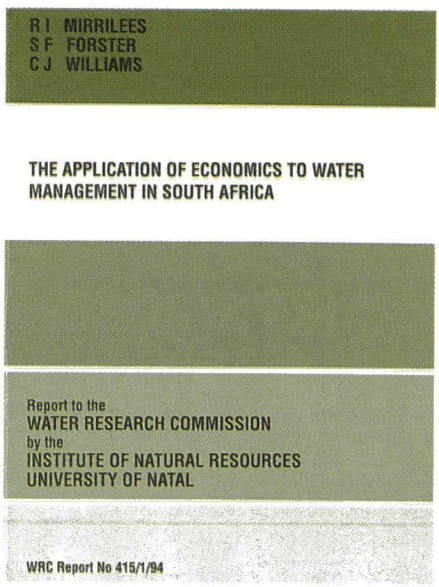
Your views on the issue of sanitation promotion are eagerly sought by the Group.

Economics applied to water management in South Africa

Despite several policy statements from government during the last 20 years which indicated the importance of considering the economic aspects of water resource development, there has been little attention paid, prior to this study, to analysing water management issues from a broad economic perspective. This is the view of researchers from the Institute of Natural Resources at the University of Natal expressed in a report to the Water Research Commission (WRC) on economics and water management in South Africa.

The researchers, RI Mirrilees, SF Forster and CJ Williams, say that after extensive research, it was concluded that the most promising contribution of economics to South African water management lay in the following areas:

- An alternative (to the traditional supply-fix) macro management approach to deal with water quantity (allocation) problems;
- An alternative (to the traditional command-and-control) macro management approach to deal with water quality (pollution) problems; and
- Methods to assist in the piecemeal implementation of macro economic approaches, such as cost-benefit analysis and resource valuation.



As such, the researchers say, the content and structure of the report and its appendices reflects these potential applications. Furthermore, the report has a deliberate bias towards the economic aspects of meeting the vast backlog in the water supply and sanitation services to South Africa's many disadvantaged communities.

The report is not aimed specifically at economists. The methodologies it contains will likely prove somewhat conventional to practitioners of this discipline. It is primarily intended for water managers and decision-makers, particularly those who have had limited exposure to economic concepts. Moreover, the report is not comprehensive manual on the economics of water resource development or its use in water project planning. Although these may be worthwhile products for future consideration, the researchers say, the purpose of this project was to introduce, in broad terms, the potential application of economics to water management in South Africa.

REPORT STRUCTURE

The report comprises two parts. **Part 1: Water management issues** is devoted exclusively to describing a number of broad problems which are frequently encountered in water management undertakings in South Africa. **Part 2: Appendices** consists of four chapters. Appendix A focuses on water quantity issues such as water pricing and allocation. Appendix B describes the use of economic instruments for managing water quality, and Appendix C comprises a collection of economic instruments used for general evaluation purposes, but which in this instance are presented from the perspective of water management. The instruments described, are grouped into two categories: cost-benefit analysis techniques and those used in valuing the natural environment. Appendix D comprises a detailed bibliography serving both the references contained in the report and appendices and the further information needs of the reader.

Copies of the report entitled "The application of economics to water management in South Africa" (WRC report 415/1/94) are available free of charge from the librarian at the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US$ 25.)

Navorsers evalueer Suid-Afrikaanse filterbedmedia

Die Waternavorsingskommissie het onlangs die resultate bekend gemaak van 'n ondersoek na die daarstelling van 'n eenduidige, algemeen aanvaarde plaaslike standaard in Suid-Afrika vir filterbedmedia.

"Daar bestaan op die oomblik geen algemeen aanvaarde Suid-Afrikaanse spesifikasie vir korrelrige media wat in diepbedfiltrasie gebruik word nie," sê die navorsers, AD Ceronio en J Haarhoff van die Waternavorsingsgroep aan die Randse Afrikaanse Universiteit, wat die ondersoek uitgevoer het. "Die gevolg is dat grepe van verskillende internasionale spesifikasies in Suid-Afrika gebruik word sonder dat daar eenduidigheid oor die toetsparameters, die toetsmetodes of die aanbevole standaard is.

Ten einde 'n groter mate van eenvormigheid ten opsigte van die mediaspesifikasies in die praktyk te bevorder, het die Waternavorsingskommissie hierdie studie gefinansier, waarvan die doelwitte as volg was:

- Identifiseer en beskryf watter toetsparameters in bestaande spesifikasies ingesluit is.
- Ontleed alle beskikbare internasionale en plaaslike spesifikasies, en probeer hieruit die toetsparameters identifiseer waaroor daar wel breë konsensus bestaan, asook daardie parameters waaroor daar nog betekenisvolle verskille is.
- Ontleed alle beskikbare toetsprosedures met hulle voordele en nadele.
- Ontleed verskillende wiskundige modelle waarmee die media se hidrouliese gedrag vanaf die primêr gemete media-eienskappe voorspel kan word en toets die akkuraatheid van die voorspellings deur praktiese metings.
- Maak voorstelle vir 'n toekomstige Suid-Afrikaanse mediaspesifikasie in die lig van die gemete media-eienskappe, insluitende aanbevole toetsparameters, toetsprosedures en standaarde.

INTERNASIONALE SPESIFIKASIES

Verskeie lande en organisasies het al die kwessie van mediaspesifikasies aan die hand van eenduidig aanvaarde standaarde ondersoek en verskeie standaarde is reeds internasionaal gepubliseer. Verder het verskeie plaaslike instellings, veral groter waterrade en munisipaliteite ook al aandag aan die onderwerp geskenk en standaarde vir eie gebruik ontwikkel. Die navorsers sê lande wat reeds standaarde het, is Amerika, Duitsland, Nederland en Indië, terwyl Brittanje en Frankryk tans besig is met die opstel van soortgelyke standaarde. Standaarde is ook opgestel deur professor KJ Ives van die University College in London, die Franse firma Degrémont, Rand Water en die Munisipaliteit van Kaapstad. Verder beskik die Suid-Afrikaanse Buro vir Standaarde ook oor standaard toetsmetodes wat plek-plek toepassing vind in die evaluasie en spesifikasie van filtermedia vir diepbedfiltrasie.

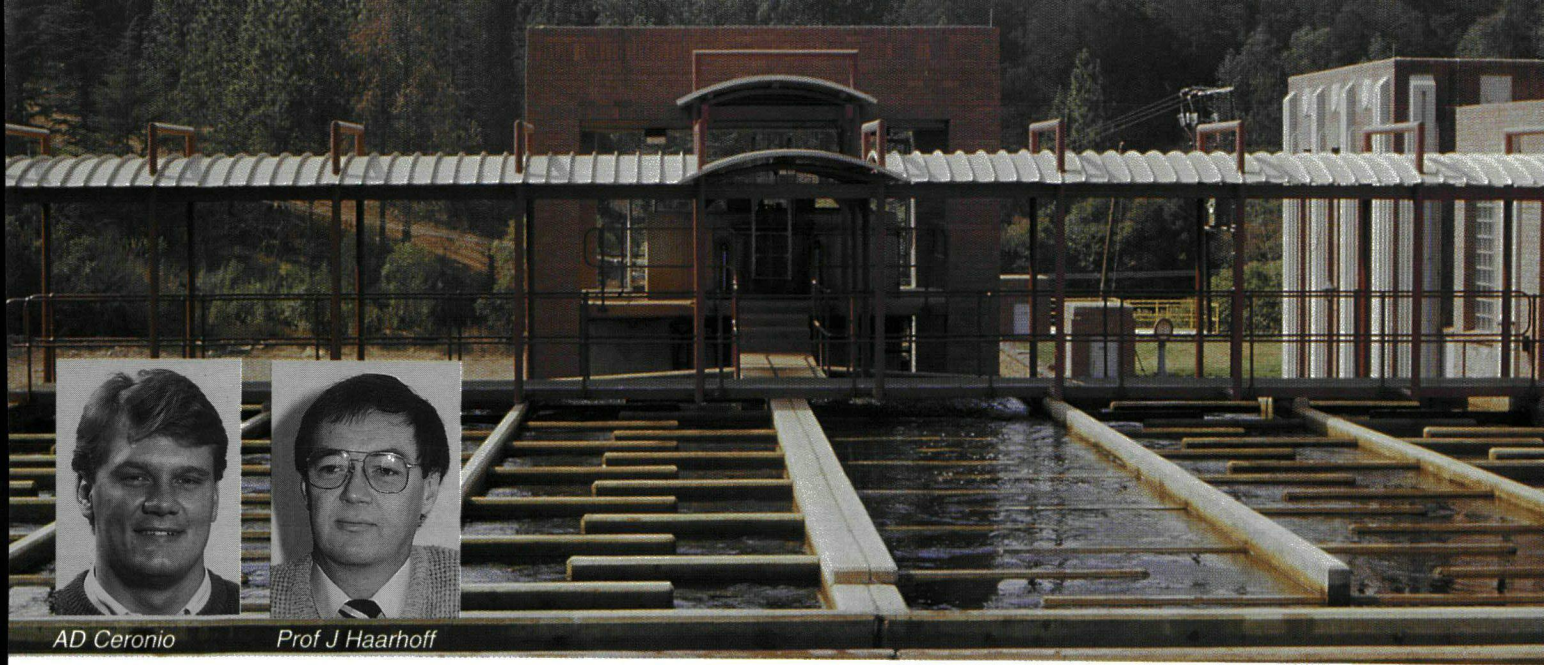
Die navorsers sê elkeen van die bogenoemde spesifikasies, behalwe die Franse en Britse standaarde, is noukeurig ondersoek. Die spesifikasies is almal, met uitsondering van die Indiese standaard, in isolasie opgestel, dit wil sê, die opstellers van die spesifikasies het nooit probeer om 'n eenvormige standaard te bepaal wat wêreldwyd toepassing sou vind nie. Die gevolg hiervan is dat daar wesenlike verskille tussen die spesifikasies bestaan. Dié verskille in definisies en toetsmetodes maak dit onmoontlik om die standaarde direk met mekaar te vergelyk.

TOETSPARAMETERS

Ondanks die verskille wat uit die spesifikasies te voorskyn kom, is daar wel 'n onderlinge ooreenkoms in die media-eienskappe wat ondersoek word. Die belangrikste gemeenskaplike eienskappe is die korrelgrootte en korrelgrootteverspreiding, of gradering, die korrelvorm en die fisiese en chemiese stabiliteit van die media.

Die definisie en meet van korrelgrootte en korrelgrootteverspreiding is, volgens die navorsers, die aspek van media-evaluasie wat die grootste ooreenstemming geniet tussen die onderskeie spesifikasies. Die meetproses wat algemeen gebruik word, is 'n sifanalise, maar die spesifikasies verskil onderling in terme van die skudaksie, die duurte van die skudaksie en die siftipes wat gebruik moet word. Hierdie verskille het resultate tot gevolg wat nie met sekerheid onderling met mekaar vergelyk kan word nie.

Die navorsers sê die definisie en die meet van korrelvorm, anders as met korrelgrootte, is seker dié aspek van mediakarakterisering waaroor die minste konsensus bestaan. Navorsers het verskeie definisies deur die jare voorgestaan en elkeen van hierdie definisies het natuurlik 'n eie meetmetode. Die definisie van korrelvorm in terme van oppervlak-area en volume-oorwegings bkyk die mees korrekte definisie te wees. Die meting en korrelvorm met behulp van die Ergun-vergelyking vir die energieverlies deur 'n skoon mediabed laat egter nog vrae oor die akkuraatheid van die toetsmetode omdat die korrelvormveranderlike bloot as 'n kalibrasiekonstante vir hierdie vergelyking optree.



AD Ceronio Prof J Haarhoff

Die volgende media-eienskap wat vir die ontwerpers belangrik is, is die langtermyn stabiliteit van die media. Hierdie stabiliteit kan beskryf word aan die hand van die fisiese en chemiese eienskappe van die media.

Die navorsers sê toetse en eienskappe van media wat gebruik word om fisiese stabiliteit van media te bepaal, is onder andere:

- Die hardheid van die media;
- Die mate waarin die media teen vergruising en teen slyting weerstand bied.

Die resultate wat uit hierdie verskillende toetse verkry word, is nie onderling vergelykbaar nie en verder bestaan daar geen metode om die resultate van sommige van hierdie toetse direk te vertaal in die langtermynprestasie van die media in die bed nie.

Die bepaling van die chemiese stabiliteit van die media geniet egter meer eenstemmigheid wanneer die verskeie spesifikasies met mekaar vergelyj word. Alle toetse is daarop ingestel om die suuroplosbaarheid van die media te bepaal. Daar bestaan egter nog verskille tussen die spesifikasies in terme van die suursterkte wat gebruik moet word, die periode van onderdompeling van die media en, uiteindelik, watter graad van suuroplosbaarheid as aanvaarbaar beskou kan word.

Ander media-eienskappe en toetsprosedures wat deur die navorsers ondersoek is, is die media se porositeit, silika-inhoud en basis-oplosbaarheid.

TOETSPROSEDURES

Vir elke media-eienskap wat algemeen gebruik en gespesifiseer word, bestaan daar gewoonlik meer as een toetsprosedure. Die verskeie toetsmetodes wat deur verskillende outeurs en instansies voorgestaan word, is almal in die literatuur en sommige in die laboratorium ondersoek om die beste metodes vir gebruik in Suid-Afrika te identifiseer. Die maatstawwe waaraan die finale gekose metodes moes voldoen, is:

- Akkuraatheid en herhaalbaarheid;
- Lae moeilikheidsgraad sodat dit algemeen toegepas kan word; en
- Die resultate verkry uit die toetse moes sover moontlik direk gekorreleer kan word met die werklike mediaprestasie in die filter.

Na afloop van hierdie deel van die ondersoek en die identifikasie van geskikte toetsmetodes, het die navorsers verskeie silika-sandmonsters van verskeie produsente verkry. Hierdie mediamonsters is aan die hand van die onderskeie toetsmetodes ondersoek.

RESULTATE

Die navorsers kon uit die ondersoek 'n tipiese profiel van Suid-Afrikaanse silikasand saamstel. Opsommend lyk dié profiel as volg:

- Effektiewe grootte = 0,28 - 1,10 mm afhangende van die gradering.
- Eenvormigheidskoeffisiënt = 1,26 - 1,60 met enkele uitsonderings.
- Digtheid = 2 625 - 2 641 kg/m^3
- Oppervlakverhouding sferisiteit = 0,42 - 0,86
- Porositeit = 0,42 - 0,57
- Silika-inhoud = 98,5 % per massa
- Suuroplosbaarheid = 0,05 - 0,25 %
- Verlies tydens terugwas = 0,022 - 0,374 %

Die navorsers sê die inligting hierbo toon dat die plaaslike silikasand goed vergelyk wanneer dit teen internasionale spesifikasies opgeweeg word. Aspekte van die plaaslike bedryf wat moontlik wel aandag regverdig is die gradering van die media. Die belangrikste en maklikste om te beheer is die eenvormigheidskoeffisiënt wat hoog vertoon teen internasionale spesifikasies wat oor die algemeen waardes laer as 1,40 vereis. Verder is die gevoel dat, alhoewel internasionale spesifikasies nie pertinent riglyne vir die korrelvorm voorstel nie, 'n sferisiteit van 0,42 te laag is. Hierdie silikasand mag egter wel toepassing vind waar verbruikers 'n voorkeur vir skerfagtige media het.

HIDROULIESE GEDRAG

Volgens die navorsers word baie van die eienskappe wat in hierdie studie ondersoek is, gebruik vir die wiskundige voorspelling van mediagedrag in die filterbed. Die belangrikste vrae wat gevra word in terme van hidrouliese gedrag van die media, is:

- Wat is die energieverlies wanneer skoon water deur die bed gefiltreer word?
- By watter terugwassnelheid begin die bed fluodiseer?
- Wat is die verband tussen terugwas-snelheid en beduitsetting?

Talle modelle wat hierdie vrae aanspreek, is reeds deur ander outeurs gepubliseer. In hierdie ondersoek is hierdie modelle deur die navorsers onder oë geneem en is die mees toepaslikes geïdentifiseer. Hierdie modelle is ook aan die hand van praktiese ondersoeke met plaaslike media geverifieer.

Die navorsers sê ten slotte dat hierdie navorsingswerk en die bevindinge vervat in die finale verslag aan die Waternavorsingskommissie, tesame met insette van ontwerpers, operateurs en mediaverskaffers, gebruik kan word om plaaslike algemeen aanvaarde spesifikasies vir die Suid-Afrikaanse mediabedryf saam te stel.

Afskrifte van hierdie navorsingsverslag getiteld Die evaluasie van Suid-Afrikaanse filtermedia vir diepbedfiltrasie (WNK verslag 472/1/94) deur AD Ceronio en J Haarhoff is gratis beskikbaar vanaf die bibliotekaresse, Waternavorsingskommissie, Posbus 824, Pretoria 0001.

International Symposium Report ...

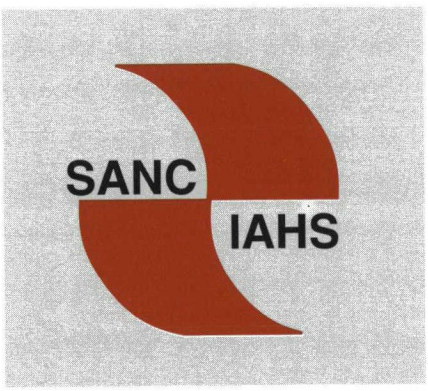
Our Chairman Eberhard Braune attended the UNDP international symposium on water resources management in arid and semi-arid regions held in Israel from 15 to 19 May 1995. The following abstract from his report may be of interest to South African hydrologists.

At the opening of the symposium Simon Peres, Israel's Minister of Foreign Affairs, offered some development principles and pointers, as seen from a political viewpoint:

- The time of big handouts is over. For development the less developed countries will now have to turn to themselves;
- Many southern countries are already taking big leaps forward;
- Science and technology is what makes countries strong in this area. "Education is the oil of our times" (Egyptian Minister of Education). "Ninety six percent of agricultural success in Israel is science." (Simon Peres);
- In arid to semi-area countries water is the key to development;
- Countries should spend less on arms and more on irrigation;
- Shortage of water and the need for cost-sharing in capital-intensive water schemes will hasten the peace process in the Middle East.

The international symposium on water resources management in arid and semi-arid regions was organised as a step towards implementing the water management issues of Agenda 21 of the Rio conference. To continue the process of implementation, participating countries have been asked:

- to participate in the Intergovernmental Negotiating Committee for the Convention to Combat Desertification. (South Africa is represented through the Department of Environment Affairs and Tourism); and
- to establish country and region forums to take the recommendations of the Israel symposium further.



As many competent institutions already exist in most countries, but coordination and integration is lacking, symposium participants made the following recommendations with regard to national capacity building:

- There should be consultations with and within each country to determine the local needs for integrated water resource management, to prioritise the needs and to design plans of action.
- Training is seen as an important aspect, covering training at academic, technical and grassroots level, especially to train trainers to train the people. Training is therefore needed through the whole spectrum of education.
- Assistance should be given at the institutional level to coordinate and streamline existing organisations, to focus on more appropriate activities related to change in objectives and functions, as well as to enhance appropriate information dissemination at all levels from top to bottom.

As a first step the UN Development Programme (UNDP) would like to establish a regional pilot scheme in which policies and strategies for the countries of the region can be developed as a example for many other arid to semi-arid countries. Participating countries will be approached in this regard by UNDP.

South Africa would be a natural country to take the initiative here considering its well developed water sector and its shared catchments with a number of the Southern African Development Community (SADC) countries. This also relates to our initiatives, together with the World Meteorological Organisation, regarding a hydrological data transmission system for the region and the negotiations of representatives of the International Hydrological Programme of UNESCO with our Minister. Such a pilot study could bring major benefits to South and southern Africa, because it would address water matters strategically along with inputs and guidance from international experts.

- Arid and semi-arid countries require special measures and long-term planning to achieve sustainable management of their limited water resources.
- In order to achieve sustainable water resources management, national water policies should have a holistic approach, recognising a comprehensive spectrum of demands and evaluating priorities in the framework of national water master plans.
- The opposite is unfortunately true, with even the basic hydrologic information systems retrogressing in many developing countries. Essential strategies are contained in water master plans, but often lack coordination, resources and implementation.

- Essential components of sustainable water resources management, which are often grossly neglected are, inter alia:

  - water conservation;
  - demand management;
  - alternative water sources;
  - catchment management (institutional) systems;
  - appropriate management and decision-support systems;
  - appropriate legislation that allows for State custodianship of all water resources and its effective and efficient implementation;
  - regional and international co-operation.

- South Africa is very advanced in water resource management, both by developed and developing country standards. Water management facets that are seriously lacking in South Africa, considering its position among the twenty most water-scarce (water availability versus present and projected population) countries in the world, are, inter alia:

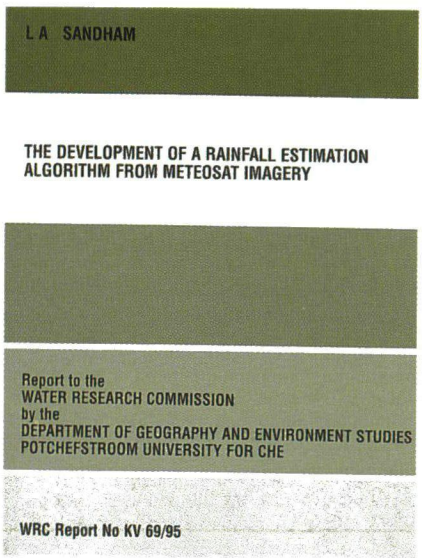
  - attention to strategic planning;
  - integration of land and water resources management;
  - appropriate management (institutional) systems;
  - a modern, appropriate water act.

- The opportunities now offered by a variety of international agencies to assist with both planning and implementation towards more sustainable water resource management in the southern African region should be grabbed with both hands. Separate approaches can be expected shortly from the UNDP and UNESCO.

REPORT AVAILABLE

Rainfall estimation using satellite data

Knowledge of the areal distrubution of rainfall is of vital importance, in particular for agronomists for agricultural planning and management; for hydrologists for flood forecasting, and climatologists for understanding the general atmospheric circulation and global latent heat transfer. However, due to a relatively poor distribution of rain gauges over large parts of the earth, particularly the oceans, as well as the inadequacy of even a realtively dense network to accurately estimate areal rainfall, the need for areal estimates cannot be met satisfactorily by rain gauge data. For this reason the use of satellites for rainfall estimation has been investigated and a number of techniques have been developed in the last two decades. These techniques vary in terms of spatial and temporal scale, aim, and sophistication. However, virtuallly no research on rainfall estimation using satellite data has been undertaken in South Africa.



Recently the WRC published a report on an initial study investigating rainfall estimation by using satellite data, in South Africa.

The aim of this initial study was to investigate the relationship between satellite-derived cloud top temperature and observed rainfall in order to develop a satellite-based rainfall estimation scheme. The scheme follows a discriminant analysis approach to estimate rain/no rain occurence from nominally eight Meteosat images per day, using half-hourly rainfall amounts to train the discriminant rules.

In the first phase a simulation performed show that most of the information on daily rainfall totals (up to 90 per cent of variation) is contained in half-hourly frequency of rainfall occurence.

The second phase consisted of a series of descriptive analyses in order to examine the relationship between Meteosat-derived cloud top temperature parameters (CTTP) and observed half-hourly rainfall.

The third phase dealt with the application of discriminant analysis in order to seperate raining cases from non-raining cases using cloud top temperature parameters.

The report entitled **Development of a rainfall estimation algorithm from Meteosat imagery** (WRC Report no KV 69/95) is available, free of charge, from the Water Research Commission, Box 824, Pretoria 0001. Foreign orders will be charged a list price of US$ 10.

Watergehalte van Olifantsrivier verbeter

Drie projekte wat tans deur die Departement van Waterwese en Bosbou onderneem word om die watergehalte in die Bo-Olifantsrivier-opvanggebied (die Witbank-, Middelburg- en Klipspruit-sub-opvanggebied) te verbeter, werp reeds vrugte af.

Luidens 'n verklaring van die Departement is daar die afgelope ses maande aansienlik gevorder met die projekte. Die gehalte van die water in die Klipspruit-opvanggebied het reeds dramaties verbeter sedert die publikasie van 'n Witskrif oor waterbesoedelingsbeheermaatreëls twee jaar gelede. 'n besoedelingsbeheerwerke word tans opgerig om besoedelde water vanaf uitgewerkte myne te behandel en die watergehalte sal nog verder verbeter wanneer dit eers in werking is.

Myne, nywerhede en munisipaliteite in die opvanggebied het met eie befondsing gehelp en sommige van die langtermyn-doelwitte wat in die Witskrif gestel word, is reeds bereik, soos 'n afname in geleivermoë en verminderings in natrium, chloried en ammoniak.

In die Middelburgdam-opvanggebied het rolspelers, insluitende steenkoolmyne, kragstasies en ander, 'n reëling aanvaar waarvolgens hulle op 'n proporsionele grondslag, maar minder as in die verlede, bepaalde hoeveelhede besoedelstowwe in die wateromgewing mag vrystel. Met dié afname in besoedeling, sal die watergehaltedoelwitte wat vir die Middelburgdam gestel is, bereik kan word, sê die verklaring.

'n Soortgelyke reëling word vir die Witbankdam-opvanggebied in die vooruitsig gestel en die Departement meen dat indien die huidige mate van samewerking en betrokkenheid van die rolspelers voortgaan, sal die watergehalte in die Bo-Olifantsrivierbekken geskik bly vir gebruik.

Improving slimes dam safety legislation

The Minister of Water Affairs and Forestry, Professor Kader Asmal, has announced that he will do all within his powers to assist the Attorney-General and the Department of Mineral and Energy Affairs to address the concerns raised by the Merriespruit inquest. The inquest resulted from a tragedy on 22 February 1994 when a slimes dam failed and 17 lives were lost.

Professor Asmal has referred matters arising from the inquest into the Merriespruit slimes dam disaster to the Attorney-General for his decision and asked that alledged breaches of regulations under the Water Act, 1956 (Act 54 of 1956) should be taken into account in whatever charges the Attorney-General may decide to pursue.

Professor Asmal further announced that regulations in terms of the Water Act that have a bearing on the Mines and Works Act (Act 27 of 1956) which define the safety potential of slimes dams, will enjoy priority in the current water law review. These regulations relate to the handling of water on and around slimes dams. This would help prevent any further loss of life and property due to the mismanagement of water on slimes dams. The Department will review these regulations in co-operation with all other interested and affected parties.

REGULATIONS

The regulations in terms of the Water Act, 1956 relating to slimes dams were published in February 1976 to counter water pollution. The regulations prescribe the requirements for the handling of stormwater on all parts of a slimes dam to prevent polluted water from reaching natural water courses, even during an exceptional rainstorm of one in a hundred years' frequency. The Merriespruit disaster suggests that these measures should be reviewed in conjunction with other safety measures. Issues that will be looked at include:

- Drawing a distinction between the pollution potential of different slimes dams.
- Effective monitoring of compliance with the prescribed freeboard requirements for water storage.
- Fines for non-compliance which are ridiculously low.

Consultations with the Department of Mineral and Energy Affairs are already in progress regarding further regulations to control the structural safety of slimes dams in terms of the Minerals Act, 1991 (Act 50 of 1991) which will supplement the intended regulations for pollution control purposes.

Groundwater: "Scoping Document" released for comment

Almost 300 towns and settlements in South Africa depend partially or entirely on groundwater. With the large number of groundwater users, some for whom groundwater is their only source of water, there is an urgent need for effective management of this resource. The Department of Water Affairs and Forestry has thus released a discussion document, called the "Scoping Document", for comment on aspects that should be covered by a groundwater quality management strategy for South Africa.

The "Scoping Document" covers the components necessary to develop an effective management strategy and also proposes that the following aspects should be included:

- What must be regulated?
- What must be integrated?
- Who must do the regulation?
- What methods should be used?

The "Scoping Document" is available from: Mr Greg Wells (Wates, Meiring and Barnard Inc), Tel: (011) 315 0316. Fax: (011) 315 0317.

Baking soda used as paint remover

Baking soda is a useful way to remove paint from aircraft, allowing water jets to replace chemical strippers, according to a team of US.

Water Newsletter (151194) reports that dichloromethane had been used traditionally for stripping the 4 000 USAF aircraft every five years. The hazardous chemical is on a list of 17 chemicals the US Environmental Protection Agency wants to eliminate during the next few years. Experimentation with possible alternatives has produced the new technique known as the bicarbonate of soda stripping system (BOSS). Pressurised jets of water containing the baking soda are blasted through a nozzle onto the aircraft's surface where it acts as a mild abrasive and loosens the paint.

Training officials to manage Lesotho fish stocks

A workshop to train officials from the Fisheries Section of the Department of Agriculture in Lesotho to monitor the fish stocks in the waters of the Lesotho Highlands Development Scheme, was recently held in the JLB Smith Institute of Ichthyology at Rhodes University.

The delegation from Lesotho included Mr Calvin Mafisa, the Chief Animal Production Officer, Mrs Seipati Mofolo, the Chief Fisheries Production Officer and Mr Pesa Lenka from the Lesotho Highlands Development Authority, Mr Mokitinyane Nthimo, Mr Phakisa Matli and Miss Lefuma Sejane. Mr Nthimo, Mr Matli and Miss Sejane will carry out the monitoring of the fishes in the rivers of Lesotho that are affected by the huge development scheme.

The workshop course was designed specifically for the Lesotho situation and included aspects such as identification of fishes, collecting and preserving methods, the description of study sites, recording of physical and chemical factors in the habitat, analysis of age, growth, reproduction and stocks of fishes and computer techniques. A short field trip to demonstrate netting techniques was also made.

The dams in the Lesotho Highlands Development Project are expected to create substantial aquatic habitat for the development of subsistence and production fisheries involving both indigenous species like the yellowfish and exotics like the rainbow trout. At present fishes are a minor subsistence resource, so considerable effort will have to be put into the development of the fishery if the people most affected by the large lakes being created are to benefit.

SA researchers participate in international study

The Institute for Water Research (IWR) at Rhodes University, Grahamstown, is taking part in an international study involving the testing of rainfall run-off models, the analysis of floods and low flows in rivers and the establishment of a common database.

"We have been awarded a Water Research Commission contract to participate in the "FRIEND" project," said Professor Denis Hughes of the IWR.

The "FRIEND" project is part of an UNESCO International Hydrological programme and stands for Flow Regimes from International Experimental and Network Data. It was first established by the Institute of Hydrology in the United Kingdom. Initially, the main aim of the project was to get centres in Europe to co-operate in setting up a common hydrological database so that standardised analyses could be carried out throughout western and northern Europe.

It was later decided to spread the principle to other regions. Professor Hughes attended a meeting at the end of 1993 in Dar Es Salaam to finalise the start of the southern African project.

A number of analysis methods will be used on the dataset. This will offer guidelines on which analysis methods will be the best for future hydrologists. Testing the applicability of the rainfall run-off model is being researched at Rhodes University.

JLB Smith helping fishery scientists in Malawi

Staff of the JLB Smith Institute of Ichthyology at Rhodes University, Grahamstown, are helping fishery scientists in Malawi keep a watch over the fishery of Lake Malawi.

Fishery scientists working on Lake Malawi have one particular problem; the large number of species of fishes in the lake. It is estimated that over 600 species occur there, many of which are found only in Lake Malawi.

"Without considerable specialist knowledge of these fishes, it is extremely difficult to identify and name the various species," says Dr Humphry Greenwood, Honorary Research Fellow of the Institute. "Once a fish is identified and its scientific name is known, one can discover all that has ever been recorded about it."

Such information can be of vital importance in understanding the roles played by different species in the ecology of the Lake and thus the effect which the loss of a certain species may have in maintaining the well-being of a complex eco-system.

"The disappearance of certain species, or changes in the relative proportion of different species living in a particular area are important indicators that overfishing could be taking place. All these factors are vital if a fishery is to be properly managed and not face ultimate destruction or, at best, a decline in its economic importance," Dr Greenwood said.

Lake Malawi, one of Africa's largest lakes, supports a fishery of great importance to the well-being of the people of Malawi, both as a source of protein and of income. Thus, the health and maintenance of the fishery is vital, and is the concern of local fishery research organisations.

Fishery research in Lake Malawi is now concerned with the fishes living in, and often confined to, the deeper waters of the Lake. To help solve the problem of identifying these species the Malawians have turned to the only organisation that could supply the necessary specialist expertise in this field, namely, the JLB Smith Institute.

At the invitation of Dr Tumi Thomasson, one of the Icelandic International Development Organisation scientists involved with research on this deep water fishery, Dr Greenwood, an acknowledged expert on African lake fishes, recently spent two weeks in a research trawler collecting samples of fishes which form the bulk of the catches made in offshore waters of the Lake.

He returned to the JLB Smith Institute with several hundred specimens which now have to be identified.

As part of this operation, five Malawian fishery workers visited Grahamstown to take part in a two-week course devised by Dr Greenwood to help train them in the far from simple task of identifying the different species.

"For hours each day, the students learned how to use identification keys and in the process are delving into the anatomy of the fishes, discovering the many pitfalls involved in species identification, sharpening their powers of observation and getting a better understanding of the complex fish fauna of Lake Malawi."

Water quality management plan developed for Mgeni catchment

In the Mgeni catchment in KwaZulu/Natal, supplies of water are coming under increasing pressure from the demands of an expanding population, industry and agriculture whose activities can pollute water. The major problems of faecal contamination, erosion and eutrophication represent a very serious threat to the future quality of the water resources in the Mgeni catchment. A well designed strategy is therefore urgently neede to manage these problems to ensure sustainable supplies of clean water for all the recognised users - domestic, industry, agriculture, recreation and the environment.

In response to this situation, a water quality management plan is being developed by Umgeni Water and the Department of Water Affairs and Forestry. The plan will not only control and monitor pollution, but also try and persuade all those involved in the activities which may affect the quality of water to act responsibly and thereby ensure the quality of future supplies. To ensure an integrated approach, this plan focuses not only on the surface water resources of the catchment, but also on the goundwater, estuarine and marine resources.

To ensure the success of the plan, there is a strong drive to fully involve all the interested and affected parties in the catchment, including the local authorities, water managers, civic organisations and other user groups. It is hoped that this will facilitate a co-ordinated approach to the project as well as providing a channel for tapping into their experience and specialist knowledge.

The study is comprised of a number of specific tasks, including a detailed situational analysis which will encompass natural basin characteristics, water supply, water quality and a description of the current status of the catchment as well as demographics, land uses and water users, socio-economic and constitutional issues. The University of Natal's ACRU hydrological model, developed under contract to the Water Research Commission, was used to simulate base flows and runoff for the statistical analysis of the hydrology. Ultimately the plan will provide a wide range of water quality management tools for day-to-day as well as long term water quality management. The final product is a management information system (MIS) which will be operated around a computerised geographical information system (GIS) framework.

Should you require additional information on the Mgeni Catchment Water Quality Management Plan, or be in possession of information which could assist with the development or implementation of the plan, please contact:

- John Howard, Manager Water Quality, Umgeni Water. Tel (0331) 961 233, or
- Mr Lin Gravelet-Blondin, Deputy Director Water Quality Management, Department of Water Affairs and Forestry. Tel (031) 306 136.

Eastern Cape mussel reserves studied

Rhodes University scientists plan to collaborate with scientists from the University of Transkei and the University of Fort Hare on a study of mussel reserves on the Eastern Cape Coast, in an attempt to set up guidelines for the sustainable use of these living resources.

The study, which is being funded through the South African Network for Coastal and Oceanographic Research (SANCOR) by the Department of Environmental Affairs and Tourism and the Foundation for Research Development (FRD), will involve Professor Christopher McQuaid, Professor of Zoology in the Department of Zoology and Entomology at Rhodes, Professor Arthur Dye of the University of Transkei and Dr Rod Bally of Fort Hare. Two research students will come from Rhodes, one from the University of Fort Hare and three from the University of the Transkei.

"This study in which we hope to discover the links between the ecosystems of the shores and the communities who use them, will help to set guidelines for the proper management of the mussel resource, particularly for those people who are living at a subsistence level and rely on the resource," Professor McQuaid said.

The researchers will study the coastline from Algoa Bay to Natal in an attempt to discover more about the way the resources are used.

"Little is known about this at present. How much of the resource do people use? What happens in villages where men are migrant labourers? Is the use of the mussel resource subsistence or cultural? None of these questions have been asked before," Professor McQuaid said.

"We need to discover the extent of the ecological pressures. We know that some areas are massively overexploited, but we do not have the data to allow us to determine how much ecological pressure the resource can sustain. We also need to discover whether overexploited areas can be rehabilitated by re-seeding.

"A non-prescriptive management plan needs to be devised for the resource, in co-operation with the people who use it. In this way scientists would be contributing to co-operation and development through capacity building."

Sea creatures screened for cancer cure

Sea creatures could be a source of natural anti-cancer compounds, say researchers at the US National Cancer Institute. Natural pharmaceuticals have great interest to scientists since no cancer cure has emerged from synthetic compounds.

Water Newsletter (161294) says that sea creatures provide promising sources of anti-cancer compounds as they have developed elaborate chemical arsenals to survive. The powerful toxins they produce could be used to poison tumour cells in cancer patients. Rapid molecular screening methods are allowing scientists to test up to a thousand compounds each day. According to the publication six compounds from sea creatures already have reached clinical or late pre-clinical trials in the US and Canada.

Artificial streams help determine water needs of the environment

"If water requirements of the natural environment are not met, the capacity of rivers to meet the needs of other users is threatened," says Dr Carolyn Palmer, Research Officer in the Institute for Water Research (IWR) at Rhodes University, Grahamstown.

She says one of the most sensitive requirements of riverine invertebrates is flowing water and specific hydraulic conditions."If we have to work experimentally, we have to do so in a flowing water system. This entails the development of artificial streams."

Artificial stream research is well established world-wide. The streams range in size from small bench-top channels to huge outdoor systems where rivers are partially diverted to experimental channels.

"Naturally functioning rivers have a self cleansing and purification capacity," she says. "They provide water for supply and recreation and habitats for microbial communities algae, higher plants, invertebrates, fish, birds and mammals. However, if rivers do not have a water supply which adequately approximates to the pattern of quality and quantity, to which flora and fauna are adapted, natural processes are interrupted and functions are impaired."

During a workshop in 1989 it became apparent that rivers that flow through the Kruger National Park are threatened by the huge demand for water supply and efficient disposal capacity in their upper reaches. The rivers of the Kruger National Park have a generally accepted conservation status and the definition of their water requirements is urgently required.

Methods for estimating water quality requirements are being developed by the Department of Water Affairs and Forestry and other research centres country wide. One of the methods of determining water quality tolerances is ecotoxicology where organisms are experimentally subjected to a range of concentrations of selected variables, for defined periods of time under controlled conditions.

Researchers from the IWR at Rhodes University visited artificial stream facilities in England, Canada, the United States and Australia in 1992 and began a Water Research Commission funded project to build an artificial stream laboratory with the first objective of investigating water quality tolerances of South African riverine invertebrates.

"We have a flexible, well replicated artificial stream laboratory with huge potential for investigating a wide range of responses of natural stream fauna to changing conditions in terms of water quality and quantity. The facility provides a unique opportunity for co-operative, multi-disciplinary research in collaboration with water managers, industry and other water user sectors," says Dr Palmer.

UP bied kortkursus in Watergehaltebestuur aan

Sowat 45 verteenwoordigers uit die privaatsektor in nywerheid, mynbou en ander instansies het onlangs 'n weeklange kortkursus in Watergehaltebestuur by die Universiteit van Pretoria (UP) bygewoon. Suksesvolle afhandeling van die kursus, wat 'n reeks toetse insluit, word met 'n sertifikaat erken. Dié kortkursus is 'n verkorte weergawe van die opleidingskursusse wat tans deur die Afdeling Waterbenutting van Departement Chemiese Ingenieurswese, UP, aangebied word vir personeel van Departement Waterwese in die Direktoraat: Watergehaltebestuur.

SA WATERKALENDER

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

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

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

Legend:

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

See conferences and symposia pages for events.

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

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

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Fax: (012) 331-2565

Gids:

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

Sien Konferensies-en Simposiumbladsy vir aangeduide geleenthede.

1995

JUNE 1995

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SOUTHERN AFRICA

1995

FLUORIDE AND FLUOROSIS
AUGUST 10

A workshop on fluoride in the natural environment and fluorosis in humans and animals - the status of South African research - will be held in the Manyane Centre, Pilanesberg National Park, North West Province. Enquiries: Mr Lewis McCaffrey, Department of Geological Sciences, University of Cape Town, Rondebosch 7700. Tel (021) 650-2912 Fax (021) 650-3783. Email: lmcc@geology.uct.ac.za

HYDROLOGY
SEPTEMBER 4 - 6

The 7th national southern African hydrological symposium will be held in Grahamstown.
Enquiries: Prof Denis Hughes, Institute for Water Research, Rhodes University, Grahamstown 6140. Tel (0461) 24014
Fax (0461) 25049. E-mail: Denis @ iwr.ru.ac.za.

IWSA
SEPTEMBER 9 - 15

The 20th biennial congress and exhibition of IWSA will be held in Durban.
Enquiries: Mrs Ginny Eslick, Congress International, 18 Rapson Road, Morningside, Durban 4001. Tel (031) 233 494. Fax (031) 232 405.

GROUNDWATER
SEPTEMBER 26 - 28

A conference and exposition on groundwater recharge and rural water supply - Groundwater '95 - will be held at the Volkswagen Conference Centre in Midrand.
Enquiries: Conference Co-ordinator, Groundwater Division, GSSA, PO Box 75728, Lynnwood Ridge 0040.

ACTIVATED SLUDGE PLANTS
OCTOBER 16 - 20

A short course on the operation of activated sludge plants will be presented by the Water Utilisation Division of the Department of Chemical Engineering at the University of Pretoria.
Enquiries: Prof WA Pretorius Tel (012) 420-3566 Fax (012) 43-6683.

ENVIRONMENT
OCTOBER 23-25

The SADC Training Workshop on Mining Environmental Legislation to be held in Johannesburg, is organised jointly by the Chamber of Mines of South Africa, the Mining Sector Co-ordinating Unit of the Southern Africa Develop-ment Community (SADC) and the Industrial Environmental Forum of Southern Africa (IEF).
Enquiries: Dr John Kilani, Chamber of Mines, PO Box 61809, Marshalltown 2107.
Tel (001) 4987421/ 4987100
Fax: (011) 498 7429

ENVIRONMENT
OCTOBER 25-27

The SADC Conference on Mining and the Environment will be held in Johannesburg. CALL FOR PAPERS.
Enquiries: Dr John Kilani, Chamber of Mines, PO Box 61809, Marshalltown 2107.
Tel (011) 498 7421/498 7100.
Fax: (011) 498 7429/498 7446

ANAEROBIC PROCESSES
OCTOBER 25

The first open meeting and mini-workshop of the Water Institute of Southern Africa's Anaerobic Processes Division will be held in Midrand. The theme of the workshop is "Experiences with anaerobic processes in South Africa".
Enquiries: Contact Mr JR Hoffmann at Wates, Meiring and Barnard. Tel (011) 315-0316, Fax (011) 315 0317.

WATER CARE
NOVEMBER 29 & 30

The 4th Western Cape water care seminar and trade fair will be held at the Faure Water Treatment Plant, Faure.
Enquiries: Seminar secretary, Peter Novella, tel: (021) 4002-437
Fax: (021) 253-848.

1996

WISA '96
MAY 20 - 23

The WISA '96 conference will be held at the Feather Market Centre in Port Elizabeth. Enquiries: Conference Planners, PO Box 82, Irene 1675. Tel (012) 63-1681. Fax (012) 63-1680.

AQUATIC SYSTEMS
JULY 15 - 19

A conference on aquatic systems will be held at the Vic Falls Hotel in Zimbabwe.
Enquiries: Ms Lesley Stephenson, Conference Secretary, PO Box 327, WITS 2050. Tel: (011) 716-5091 Fax: (011) 339-7835
E-mail: Stephenson @ egoli.min.wits.ac.za.8

HYDRAULIC RESEARCH
AUGUST 5 - 7

The International Association for Hydraulic Research - African Division's biennial congress with the theme "From flood to drought" will take place at Sun City. Papers are invited on topics including Problems of temporal distribution, Water schemes due to uneven spatial distribution, Environmental and sociological problems in arid regions and Innovative ways of conserving water.
Enquiries: Miss Stephenson, Conference Office, PO Box 327, WITS 2050. Tel (011) 716-5091 Fax (011) 339-7835.

AFRIWATER
SEPTEMBER 2 - 5

The AFRIWATER Conference and Exhibition will be held at the Gallagher Estate in Midrand.
Enquiries: Nigel Walker at
Tel: (011) 318 - 2009 / 1189
Fax: (011) 318 1189.
International code: (+27 11).

ISIAME '96
NOVEMBER 4 - 8

An international symposium on industrial applications of the Mössbauer effect will be held in Johannesburg.
Enquiries: Prof Herman Pollak (Chairman), Mössbauer Laboratory, Department of Physics, University of the Witwatersrand, Private Bag 3, Johannesburg 2050. Tel: (011)716-4053 Fax: (011) 339-8262. E-mail: 005KLKS@ WITSV-MA. WITS.AC.ZA

OVERSEAS

1995

POLLUTION EVENTS
JULY 24 - 26

An inter-disciplinary symposium on uncertainty, risk and transient pollution events - Acute Risk to the Aquatic Environment will be held in Exeter, UK.
Enquiries: Dr JD Boyle, School of Engineering, University of Exeter, North Park Road, Exeter EX4 4QF, UK.

WATER SYMPOSIUM
AUGUST 13 - 18

The fifth Stockholm water symposium, including the award ceremony of the prestigious Stockholm water prizes, will be held in Stockholm, Swedwen.
Enquiries: Stockholm Water Company, S-10636, Stockholm, Sweden. Tel +468 736 2021
Fax +468 736 2022

DIFFUSE POLLUTION
AUGUST 14 - 18

A symposium on diffuse (non-point) pollution will be held in Prague, Czech Republic.
Enquiries: Ing Vladimir Chour, Hydroprojekt AS, Taborska 31, CZ 140 43 Praha 4, Czech Republic.

LARGE WATER BODIES
AUGUST 22 - 25

An international conference on long-term changes of large water bodies will be held in Visby, Gotland, Sweden.
Enquiries: IHP/ IAWQ Conference Secretariat, Dept of Water and Environmental Studies, Linköping University, S-581 83 Linköping. Sweden.Tel: +46 13 282286. Fax: +46 13 133630.

BIOFILM STRUCTURE
AUGUST 30 - SEPTEMBER 1

A workshop on "biofilm structure, growth and dynamics - need for new concepts" will be held in Noordwijkerhout, the Netherlands
Enquiries: Mark van Loosdrecht, Julianalaan 67, 2826 BC Delft, the Netherlands.
Tel: +31 15 781618.
Fax: +31 15 782355

WATER & SANITATION
SEPTEMBER 4 - 8

The 21st WEDC conference on the sustainability of water and sanitation systems will take place at the international conference centre, Kampala, Uganda.
Enquiries: Prof John Pickford, WEDC, Loughborough University LE11 3TU, England.

SEWER SOLIDS
SEPTEMBER 6 - 8

A seminar on sewer solids - characteristics, movements, effects and control will be held in Dundee, Scotland, UK.
Enquiries: Maureen Golden, WWTC, University of Abertay Dundee, Bell St, Dundee, DD1 1HG, UK.

SANITATION SYSTEMS
SEPTEMBER 18 - 19

A symposium on technology transfer - achieving high performance at low cost in environmental and sanitation control systems will be held in Salvador, Bahia, Brazil.
Enquiries: Francisco Fontes Lima, CETREL SA, Caixa Postal 011, CEP 42.810-000 Camaçari, Bahia, Brazil. Fax: +55 (71) 832 2562.

WATER MANAGEMENT
SEPTEMBER 26 - 30

A symposium on integrated water management in urban areas will be held in Lund, Sweden.
Enquiries: Dr Janusz Niemczynowicz, Dept of Water Resources Engineering, University of Lund, PO Box 118, S-221 00 Lund, Sweden.

LANDFILL
OCTOBER 2 - 6

The fifth international landfill symposium will take place at S. Margherita di Pula (Cagliari), Sardinia, Italy.
Enquiries: CISA, Environmental Sanitary Engineering Centre, Via Marengo 34, I-09123 Cagliari, Italy. Tel +39 70 271652-281237. Fax +39 70 271371

WASTEWATER RECLAMATION
OCTOBER 17 - 20

The 2nd international symposium on wastewater reclamation and reuse will be held in Iraklio, Crete, Greece.
Enquiries: Mrs T Furnaraki, Municipal Enterprise for Water Supply and Sewerage of Iraklio, 1 Vironos Str., 71202 Iraklio, Greece. Tel: +30-81-229913/ 225833 Fax: +30-81-22 9991

WEFTEC '95
OCTOBER 21 - 25

The Water Environment Federation's 68th annual conference and exposition will be held in Miami Beach, Florida, USA.
Enquiries: Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994 USA. Fax 1-908-885-6417.

WEFTEC '95
OCTOBER 21 - 25

The Water Environmental Federation's 68th annual conference and exposition will be held in Miami Beach, Florida, USA.
Enquiries: Water Environmental Federation, 601 Wythe Street, Alexandra, VA 22314 - 1994 USA. Fax 1-908-885-6417.

LAKE MANAGEMENT
OCTOBER 23 - 27

The 6th international conference on the conservation and management of lakes will be held in Tsukuba and Tsuchiura, Japan.
Enquiries: The Secretariat, Kasumigaura '95, 1-5-38 Sannomaru, Mito, Ibaraki 310, Japan. Tel +81-292-24-6905
Fax +81-292-33-2351.

WASTEWATER PLANTS
OCTOBER 30 - NOVEMBER 1

The 3rd international specialised conference on design and operation of small wastewater treatment plants will be held in Kuala Lumpur, Malaysia.
Enquiries: Mrs Lorraine Meiring, Water Research Commission, PO Box 824, Pretoria 0001. Tel (012) 330-0340. Fax (012) 331-2565.

WASTEWATER
OCTOBER 30 - NOVEMBER 1

An IAWQ/IWSA workshop on the "Separation of microorganisms from water and wastewater: theory and practice/ New developments and opportunities" will be held in Amsterdam, the Netherlands.
Enquiries: Amsterdam Workshop '95, International Association on Water Quality, 1 Queen Anne's Gate, LONDON SW1H 9BT UK.
Tel +44-71-222-3848
Fax +44-71-233-1197.

OVERSEAS 1996

MICROBIAL PHYSIOLOGY
JANUARY

An advanced course on microbial physiology and fermentation technology will take place at the Delft University of Technology, the Netherlands.
Enquiries: Dr LA van der Meer-Lerk, Kluyver Laboratory, Julianalaan 67, 2628 BC Delft, the Netherlands. Tel: 31-(0)15-785140 Fax: 31-(0)15-782355.

BATCH REACTOR TECHNOLOGY
MARCH 18 - 20 1996

A conference on sequencing batch reactor technology will be held in Munich, Germany.
Enquiries: Prof. Dr-Ing. Peter Wilderer, Lehrstuhl für Wassergüte und Abfallwirtshaft, Technische Universität München, Am Coulombwall, D-85748 Garching, Germany. Tel: +49 (089) 3209 3700. Fax: +49 (089) 3209 3718.

HYDROGIS '96
APRIL 16 - 19

An international conference on the application of geographic information systems in hydrology and water resources management will be held in Vienna, Austria.
Enquiries: HydroGIS '96, c/o Austropa-Interconvention, PO Box 30, A-1043 Vienna.
Tel: +43(1) 588 00110
Fax: +43(1) 586 7127.

MICROPOLUTANTS
MAY 6 - 7

A workshop on "Natural origin inorganic micropolutants: arsenic and other constituants" will take place in Vienna, Austria.
Enquiries: Mr Pierre Schilhof,, Compagnie Générale des eaux, Quartier Valmy - 32, Place Ronde, 92982 Paris La Defense CEDEX. Fax: (+33) (1) 46 35 31 50.

FOREST INDUSTRY WASTEWATERS
JUNE 10 - 13

The 5th IAWQ symposium on forest industry wastewaters will be held in Vancouver BC, Canada.
Enquiries: The organiser, Forest Industry Wastewaters symposium, c/o Venue West Conference Services, 645 the Landing, 375 Water Street, Vancouver BC, Canada V6B5C6. Tel: +1 604 681 5226.
Fax: +1 604 681 2503.

IAWQ
JUNE 23 - 28

The 18th biennale conference and exhibition of the International Association on Water Quality will be held on the tropical island of Singapore. CALL FOR PAPERS.
Enquiries: IAWQ, 1 Queen Anne's Gate, London SW1H9BT, England.
Tel: 44 - 171 - 222 - 3848.
Fax: 44 - 171 - 233 - 1197.

K·O·R·T·K·U·R·S·U·S

UNIVERSITEIT VAN PRETORIA

AFDELING WATERBENUTTING
DEPARTEMENT CHEMIESE INGENIEURSWESE

bied aan

BEDRYF VAN GEAKTIVEERDE SLYKRIOOLSUIWERINGSAANLEGTE

16-20 Oktober 1995

Kursus behels teorie, laboratorium- en rekenaaroefening in

- Rioolvloei en -eienskappe
- Fisiese behandelingstappe
- Biologiese behandelingstappe
- Ontsmetting
- Slykhantering
- Vloeipatrone en -karakterisering
- Mikroskopie
- Rekenaartoepasssing

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Raadgewende ingenieursfirmas, plaaslike owerhede,
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Ervare ingenieurs en wetenskaplikes bied die kursus aan
onder leiding van professor W A Pretorius

- Beperk tot 40 kursusgangers.
- Koste per kursusganger R1 750-00 (kursusliteratuur, rekenaarprogramme, etes en sertifikate ingesluit).
- Die kursus word in Afrikaans aangebied.
- Vul toepaslike registrasievorm in hierdie Bulletin in en pos aan:

Die Hoof, Afdeling Waterbenutting
Dept. Chemiese Ingenieurswese
Universiteit van Pretoria
0002 PRETORIA

Navrae:
Mev Hettie du Toit
(012) 420-3566 (Tel.)
(012) 43-6683(Faks.)

INTERNATIONAL ASSOCIATION OF APPLIED ALGOLOGY

7th International Conference on Applied Algology

16 - 19 APRIL 1996

Knysna, Southern Cape

Theme

The theme of the conference will be opportunities from micro and macro algae.

The following topics for sessions are suggested:

- Molecular biology: Challenges and prospects
- Microalgal growth and production systems
- Photosynthesis and algal physiology
- Macroalgal growth and production systems
- Products and constraints
- Algae as bioindicators
- Algae and wastewater treatment
- Downstream processing (harvesting, etc.)
- Economics and commercial ventures

Tours

A number of pre and post conference tours will be offered, ranging from three to ten days. These will include visits to the Kruger National Park, the Cape area withwinelands and flora of the Cape and Table Mountain and a trip along the Garden Route. Dr John Bolton of the University of Cape Town will arrange a scientific excursion for those interested in seaweeds.

Registration

Deadline: 30 November 1995.
The registration fee will be R750.
Late registration (after 30 November 1995) will be R950.

The registration fee will cover the costs of the conference together with the banquet, mid-conference excursion, lunches during the conference and all tea and coffee during breaks.

Enquiries

Prof Johan Grobbelaar, Department of Botany and Genetics, University of the Free State, Bloemfontein 9300 Tel: (051) 401-2514 Fax: (051) 488-772 E-mail: pjg@rs.uovs.ac.za