Incorporating the Water Research Commission's SA Waterbulletin

THE WATER WHEEL

Your water knowledge hub

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Viewpoint: The fluoridation of water in South Africa

IMPI for mine water treatment

CYANOBACTERIA monitoring getting sophisticated

Environmental biotechnology unlocks the value in polluted wastewaters

Institute for Water and Environmental Engineering, Department of Civil Engineering – University of Stellenbosch

Three Day Short Course on
FLOODS and STORMWATER 2003

2 - 4 April 2003
Reitz Hall
Engineering Complex
Banhoek Road
Stellenbosch
South Africa

PROGRAMME			
	SPEAKER	**ORGANIZATION**	**TOPIC**
2 April	**RIVER FLOWS**		
08h30	A Rooseboom Emeritus Professor	Stellenbosch University	River Hydraulics and Sediment Transport
09h40	A Görgens Consultant/ Professor	Shands/Stellenbosch University	Flood Hydrology
11h20	G Basson Professor	Stellenbosch University	Bridge Hydraulics
13h30	G Basson Professor	Stellenbosch University	Reservoir Sedimentation & Channel Deformation
14h40	A Rooseboom G Basson E Bosman	Stellenbosch University	Water Abstraction from Sediment-laden Streams
3 April	**STORMWATER MANAGEMENT AND DESIGN**		
08h30	M Obree Manager	City of Cape Town	Catchment, Stormwater, and River Management
09h40	A Rooseboom Emeritus Professor	Stellenbosch University	When Things go Wrong
11h20	R Arnold Catchment Manager	City of Cape Town	Drainage Design: Southern Perspective
13h30	N Armitage Senior Lecturer	University of Cape Town	Dealing with Litter
14h40	S Pithey Catchment Manager	City of Cape Town	Stormwater and the Environment
4 April	**STORMWATER MANAGEMENT AND DESIGN**		
08h30	N Armitage Senior Lecturer	University of Cape Town	Stormwater Modelling
09h40	A Rooseboom Emeritus Professor	Stellenbosch University	Road Drainage Manual: 20 Years on: What's New?
11h20	W van Wyk Director	BKS Pretoria	Drainage Design: Northern Perspective
13h30	E Bosman Senior Lecturer	Stellenbosch University	Coastal Flooding
14h40	L Geustyn Director	GLS Consultants Stellenbosch	Information Technology Applications

Scope
The lectures are aimed at engineers and technologists who have to predict flood levels along water courses and oceans and who have to deal with stormwater flows. Lectures on the first day concentrate on floods in rivers and also cover associated sediment-related problems. The lectures on the last two days deal with stormwater management and the design of components of stormwater systems. Case histories are used to illustrate what can go wrong. Good practice and acceptable design norms are highlighted. Laboratory demonstrations will also be organized.

This course, as well as a storm water modeling course (SWMM), to be offered by Prof Bill James (Canada) at the University of Cape Town during June 2003, may be completed as part of the Masters Degree programme at either Stellenbosch or Cape Town University.

Enquiries: Stellenbosch: Prof Rooseboom (Tel 021-8084353; e-mail ar2@sun.ac.za)
Cape Town: Dr N P Armitage (Tel 021-6502589; e-mail armitage@eng.uct.ac.za)

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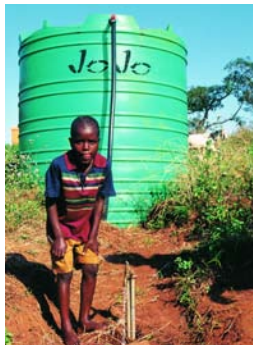
A NOTE FROM THE EDITOR

Earlier this year the Executive of the Water Research Commission (WRC) decided to replace the old SA Waterbulletin with a new publication,as part of the process of transforming the WRC into an innovative organisation "that is continuously providing novel (and practical) ways of packaging and transferring knowledge into technology based products for the water sector and the community at large".

The new publication, called *The Water Wheel* (symbolising the WRC as a dynamic hub for water-centred knowledge) is aimed at the public communication of water science and technology through popular science articles and creative visual material.

Unlike the SA Waterbulletin, the new *Water Wheel* will carry commercial advertising in an effort to defray some of the escalating production costs. Editorial material will also be solicited from sources outside the Water Research Commission. Should you feel that you have a water story that needs to be published or want to advertise your products to 5 000 readers in the water field,please contact the editorial offices of *The Water Wheel*.



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New York

2003 – INTERNATIONAL YEAR OF FRESHW ATER

The United Nations General Assembly proclaimed the year 2003 as the International Year of Freshwater.

The resolution - 55/196 - adopted on 20 December 2000, was initiated by the Government of Tajikistan and supported by 148 other countries.It encourages governments, the United Nations system and all other role players to take advantage of the Year to increase awareness of the importance of sustainable freshwater use, management and protection.

The International Year of Freshwater provides an opportunity to accelerate the implementation of the principles of integrated water resources management.The year will be used as a platform for promoting existing activities and spearheading new initiatives in water resources at the international, regional and national levels.

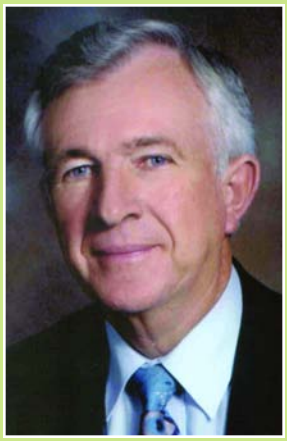
Contact: International Year of Freshwater Secretariat. E-mail: wateryear2003@unesco.org Webpage:http://www.wateryear2003.org

RUSTENBURG - The North West Water Supply Authority has a new name. It is now called Botshelo Water which means "Life". Botshelo Water is responsible for about 50 000 km^2 (42 per cent of the North West Province) which covers parts of Bophirima, Central and Bojanala Platinum District Municipalities.A total of 680 000 people are being served either from water treatment works in urban areas and some 2 300 boreholes in 498 rural villages.

CAPE TOWN - The City of Cape Town reduced water losses to 12,8 per cent of bulk supply over the past financial year. Traditionally, unaccounted water is calculated at 18 per cent of bulk supply. The City of Cape Town supplies 10,5 million kilolitres of water that is not metered to more than 90 000 informal households.

Engineering

BKS APPOINTS NEW MD



Mr Bob Pullen, president of the Engineering Council of South Africa, and prominent water engineering specialist, has been appointed as the new managing director of BKS (Pty) Ltd from 1 October 2002. He fills the position of retiring MD Mr Johann du Plessis. BKS is one of the largest consulting engineering and management companies in South Africa.

Pullen, formerly head of BKS' water division,has been with the company for 18 years. His professional expertise is water resource and environmental development and management, where he has been primarily concerned with engineering hydrology, water resource evaluation,planning and management of water resources, environmental assessments, impact evaluations and management plans and flood management policies.

He was technical editor of an official authoritative book on the management of water resources in South Africa. He was also a member of several specialist teams preparing a flood management policy, an irrigation policy and a policy on integrated water resource management for South Africa.

Pullen is the author of numerous professional publications and a regular participant in international conferences.In 2001 he received the SAICE Gold Medal, the engineering institution's highest award,an honour that has only been bestowed on 16 individuals since its inception in 1953.

Pullen, who is serving a second term as president of ECSA, is also an honorary fellow of the South African Institute of Civil Engineers and a fellow of the South African Engineering Academy.

Contact:BKS (Pty) Ltd,PO Box 3173,Pretoria 0001. Tel:(012) 421-3500.

Groundwater

SABS 0299-SERIES - PART 1: THE LOCATION AND SITING OF WATER BOREHOLES

The distribution of water on planet earth is highly uneven, with most of it (97,4 per cent) being in the oceans and only a small fraction (2,6 per cent) on land. Even this small fraction is not directly available, being on land in the form of ice, snow or groundwater. In fact, only a tiny amount (0,014 per cent) of the earth's total water is readily available to humans and other organisms in the form of lakes, rivers and streams, soil moisture and water in the atmosphere.

Put another way, the importance of groundwater cannot be overemphasised, as it represents 97 per cent of all the available freshwater supplies on Earth. According to a study commissioned by the Department of Water Affairs and Forestry, the total estimated yearly groundwater use of approximately 3 600 million cubic metres in South Africa accounts for 58 per cent of the total quantity of groundwater (6 200 million cubic metres) available for exploitation and development in this country. This percentage takes into account the requirements of the ecological reserve and basic human needs reserve, as defined in the National Water Act (Act No. 36, 1998).

Under these circumstances, ensuring the sustainable use of groundwater is therefore an important priority for South Africa, and something the SABS 0299 series of standards developed under the mutual title of *Development, maintenance and management of ground water resources* makes a significant contribution towards. The latest in this series is **Part 1: The location and siting of water boreholes** .

"The SABS 0299 set of standards brings together, for the first time, a synthesis of all the key elements associated with the use of groundwater in South Africa. It provides both the prospective and the existing groundwater user with a guide and easy reference to the best practices in this field", said Phil Hobbs, a well-known groundwater consultant and member of the technical committee.

"Whilst the set of standards provide the prospective borehole owner with a reference framework within which the necessary services can be secured and evaluated with confidence, more importantly, it also promotes the responsible development and sustainable use of this resource," he continued.

"Anyone contemplating the sinking of a water supply borehole, even drilling contractors, will benefit from the information provided in SABS 0299-1" Hobbs continued. "The standard informs the prospective owner about important factors that need to be considered when deciding on the location of a proposed production borehole: factors that, if ignored, could result in the borehole being condemned for use after the considerable expense of drilling.

"Deciding on the position of a borehole is, however, only the first step to owning a successful borehole. The other parts of the standard each address a specific milestone along this path, and are therefore equally significant in their contribution toward the sustainable use of groundwater" he concluded.

All told, there are nine parts of the standard, five of which are currently in preparation. The titles of the individual parts (those in preparation are indicated by asterisks) are:

- **Part 0:** Glossary of terms*
- **Part 1:** The location and siting of water boreholes
- **Part 2:** The design, construction and drilling of boreholes*
  (There is no Part 3)
- **Part 4:** Test-pumping of water boreholes
- **Part 5:** The design, selection and performance of pumping equipment for water boreholes
- **Part 6:** The installation and commissioning of pumping equipment for production boreholes
- **Part 7:** The rehabilitation of water boreholes*
- **Part 8:** The management of water boreholes*, and
- **Part 9:** The decommissioning of water boreholes*.

To purchase Parts 1,4,5, or 6 of the standard, please contact Magda Timmerman by telephone on (012) 428-6198, fax on (012) 428-6928 or email at timmermm@sabs.co.za)

For technical enquiries, please contact Solly Peteryb telephone on (012) 428-6175 fax on (012) 428-6368 or email at peterm@sabs.co.za.

WHO

THE WORLD HEALTH REPORT 2002 REDUCING RISKS, PROMOTING A HEALTHY LIFE

The World Health Report 2002 represents one of the largest research projects ever undertaken by the WHO, in collaboration with experts worldwide.

The report quantifies some of the most important risks to human health and examines a range of methods to reduce them.The ultimate goal is to help governments of all countries to lower major risks to health, and thereby raise the healthy life expectancy of their populations.

According to the report, at the same time that there are 170 million children in poor countries who are underweight - and up to six million of them die each year as a result - there are more than one billion adults worldwide who are overweight, and at least 300 million who are clinically obese.

Underweight is most prevalent among children under five years of age, and WHO estimates that approximately 27 per cent of children in this age group are underweight. It was a contributing factor in 60 per cent of all child deaths in developing countries.

The report says HIV/AIDS is now the world's fourth biggest cause of death.Current estimates suggest that more than 99 per cent of the HIV infections prevalent in Africa in 2001 are attributable to unsafe sex. In the rest of the world, the 2001 estimates for the proportion of HIV/AIDS deaths attributable to unsafe sex range from13 per cent in East Asia and the Pacific to 94 per cent of the deaths in Central America.

About two million deaths a year worldwide are attributed to unsafe water, sanitation and hygiene, mainly through infectious diarrhoea. Nine out of 10 such deaths are in children, and virtually all the deaths are in developing countries.

Iron deficiency is one of the most prevalent nutrient deficiencies in the world, affecting an estimated two billion people, and causing almost a million deaths a year.

Globally, indoor air pollution is estimated to cause 36 per cent of all lower respiratory infections,28 per cent of chronic obstructive pulmonary disease, 22 per cent of tuberculosis, 11 per cent of asthma and about 3 per cent of lung cancers.

The report shows that obesity is killing about 220 000 men and women a year in the United States of America and Canada alone, and about 320 000 in 20 countries of Western Europe.

The report traces the rapid evolution of the tobacco epidemic by showing that the estimated number of attributable deaths in the year 2000 - 4.2 million - is about 45 per cent greater than what it was in 1990, with the increase most marked in developing countries. Worldwide alcohol caused 1.7 million deaths and loss of 56 million disability-adjusted life years.Alcohol is estimated to cause globally, 20 to 30 per cent of oesophageal cancer, liver cancer, cirrhosis of the liver, homicide, epilepsy, motor vehicle accidents, and other intentional injuries.

To order a copy of the report write to WHO Marketing & Dissemination,CH-1211,Geneva 27,Switzerland. Tel:+41 22 791 24 76. Fax:+41 22 791 48 57.E-mail: bookorders@who.int

THE TOP 10 SELECTED RISKS TO HEALTH

1. Underweight
2. Unsafe sex
3. High blood pressure
4. Tobacco consumption
5. Alcohol consumption
6. Unsafe water, sanitation and hygiene
7. Iron deficiency
8. Indoor smoke from solid fuels
9. High cholesterol
10. Obesity

Water Management

OPPORTUNITY FOR STUDENTS

The Department of Civil Engineering and the School of Geography, Politics and Sociology of the University of Newcastle-upon-Tyne is looking to receive applications for a studentship at the PhD level.The student will carry out research on the mechanisms generating second order water scarcity in Southern Africa under the supervision of Dr Julie Trottier, and will also work under the field supervision of Tony Turton at the University of Pretoria. The studentship is tenable for three years and includes flight tickets to the UK.The student will need to spend some time in the UK at the University of Newcastle-upon-Tyne, but most of his/her time will be spent carrying out research in South Africa.The student will be able to enrol in post-graduate courses at Newcastle to complement his/her research training so as to work efficiently on the project

Applicants with an undergraduate degree or a Master's degree in any field are welcome to apply. Applications from those with a background in sociology, politics, human geography or development are especially encouraged. An interest in the social management of water is necessary. Experience in water management in South Africa, in water legislation in South Africa, in participatory research skills or in field work in rural or urban areas of South Africa will be an asset.

Interested candidates are welcome to contact Dr Julie Trottier to discuss the position and overall research project. Her e-mail address is: julie.trottier@eci.ox.ac.uk

AUSTRALIA - A groundwater levy of $0.02/kℓ is suggested in a study by the Western Australian Division of the Australian Academy of Technological Sciences and Engineering as a funding source for needed research and investigation to ensure sustainability of Perth's underground water supplies.The report says quite a bit more - including championing reuse, becoming WaterWise, considering alternatives such as desalination,water trading and catchment clearing - free report (8pp): http://tinyurl.com/17a

WISA

REVIVAL OF NUTRIENT REMOVAL DIVISION

WISA members have indicated that there is interest in the revival of the Institute's Nutrient Removal Division. According to an announcement, it has however been suggested to widen the scope of the Division to cover nutrient management rather than focusing only on nutrient removal in wastewater treatment.

Examples of areas that would then also fall within the mission statement of the expanded Division would be nitrogen separation at source e.g. toilets, physical management techniques such as re-designed dam walls, curtailing of nitrogen run-off from small-scale farm projects e.g. along the Olifants River, etc.

We would once again like to get responses from members who are interested in getting involved in the broader Nutrient Management Division. Ideas on the objectives and scope of the Division are also welcome. Members interested in becoming Committee members of the newly broadened Division should also indicate their intentions.

Interested members should send their responses to:

Dr Eustina Musvoto
Ninham Shand Consulting Services
Private Bag X136
Centurion 0046
Fax 012 663 3257
Email: eustina.musvoto@shands.co.za

Or

Dot Zandberg
conference@wisa.co.za

CYANOBACTERIA
monitoring getting sophisticated

– By Sue Matthews –

It was a tragic event that in 1996 briefly put the quiet Southern Cape farming community of Kareedouw in the headlines - an entire dairy herd poisoned,with 290 in-milk cows dead,and another 70 that had to be slaughtered to end their suffering from acute hypersensitivity. The culprit? A bloom of cyanobacteria, also known as blue-green algae, which had contaminated the livestock's drinking supply with potent toxins.

"These kinds of events are infrequent though, so cyanobacteria blooms are not on the national agenda," says Dr Bill Harding, co-author of the recently published WRC report, *Cyanobacteria in South Africa: review*. The report had its beginnings in 1999, when participants in two workshops convened by the WRC resolved that a review of South African experiences relating to cyanobacteria should be conducted so that new research proposals and needs could be meaningfully evaluated.

Considerable research effort was focussed on cyanobacteria during a ten-year, multi-departmental investigation that included among its core team of researchers the WRC's own CEO, Dr Rivka Kfir. The conclusions drawn and technical achievements made by the completion of this intensive study in 1987 were recognised internationally as being of enormous significance to the understanding of a global problem.

"South Africa is streets ahead of most other countries on cyanobacteria issues," explains Dr Harding, "and with this review we are the first to publish a summary covering almost a century of work."

Local records of poisoning incidents that can be attributed to cyanobacteria date back to the 1920s, when mass mortalities of thousands of cattle, sheep,

horses and rabbits living around pans in the north-eastern Free State and south-eastern Transvaal were reported.The local farmers referred to the condition as "pan sickness", and although veterinary officers from Onderstepoort suspected algal poisoning, it was only after the construction of the Vaal Dam in 1938 that the causative link could be confirmed.

As the dam filled, it flooded large areas of fertile farmland, resulting in eutrophic conditions that triggered a bloom of cyanobacteria.Before long the water took on the colour and consistency of pea soup, and dense algal mats floating on the surface were driven by winds against the shore. During the summers of 1942 and 1943, thousands of animals on farms adjacent to the dam died from cyanobacteria-induced toxicosis.

Today the Vaal Dam is regularly sampled as part of Rand Water's comprehensive biological monitoring programme. As a bulk water supplier of more than 10 million people, Rand Water must ensure that its product is safe, so it has developed a novel cyanobacteria monitoring protocol and established a sophisticated screening laboratory to test for toxicity. Only Durban's Umgeni Water and Cape Town's municipal water treatment facilities have similar controls and capabilities, all of which add to the cost of supply. The expense is not limited to addressing the health hazard posed by toxic cyanobacteria though.

"The taste and odour problems caused by compounds produced by cyanobacteria push up the cost of water treatment dramatically, approximately doubling it in Cape Town," explains Dr Harding.

Apart from these issues concerning potable water, cyanobacteria blooms impact aquatic ecosystems and their users in a number of other ways.The lurid,paint-like surface scums formed by buoyant aggregations of cyanobacteria cells are aesthetically unappealing, and together with the skin, respiratory and eye irritations caused by the toxins, they inhibit recreational use of waterbodies. In addition,blooms are generally seen as an indicator of environmental imbalance - usually associated with eutrophication - yet they lead to further ecosystem degradation as well as increased sedimentation.

Studies at Hartbeespoort Dam in the 1980s, for example, revealed that nutrient loading enabled the cyanobacteria *Microcystis* to form large buoyant colonies that limited the light available to other phytoplankton species in the water column. Foul-smelling gases were generated as a result of anaerobic conditions, decomposition and photo-oxidation in the dense surface scums that accumulated in sheltered

Wilde voëlvlei - by using helicopters to "bomb" the vlei with coarse rock salt, the salinity levels in the vlei were manipulated, eradicating the microcystis bloom.

sites.The high cyanobacteria cell concentrations also inhibited grazing by zooplankton, possibly through clogging of their filter-feeding apparatus,bringing about a shift to a detrital-based trophic structure with elevated sedimentation and decomposition.

However, in many systems, cyanobacteria concentrations can be effectively contained through the manipulation of zooplankton grazing pressure.

"The most success has been achieved by restructuring the top-down control mechanism," says Dr Harding."Coarse fish such as carp prey heavily on zooplankton, resulting in a food web with low zooplankton numbers and lots of phytoplankton. So reducing the population of introduced fish can have a profound effect in indirectly suppressing phytoplankton concentrations and bloom development."

The maintenance of a healthy waterweed community is also key to keeping cyanobacteria under control.These macrophytes not only take up excess nutrients through their leaves and root zone, but also provide a refuge for zooplankton and an attachment surface for a variety of beneficial epiphytic algae. There have been all too many examples of ill-advised removal of macrophytes - often in response to complaints that recreational pursuits were being hindered - causing a

switch to a phytoplankton-dominated system with all its attendant side-effects of algal blooms, high turbidity and increased sedimentation.

Dr Harding had first-hand experience of the consequences of upsetting the macrophyte-phytoplankton balance in 1998 at Wildevoëlvlei,a small estuary on the Cape Peninsula. Effluent from the adjacent waste water treatment works had long caused eutrophication of the vlei, but much of the nutrient had been absorbed by Sago pondweed, the dominant macrophyte. When the weed in a large portion of the vlei suddenly died off - for reasons still not clear today - a dense bloom of *Microcystis* developed. Toxins were soon detected in surface scums,and later in filter-feeding black mussels in the intertidal zone close to the estuary mouth,raising concerns about public safety.

Microcystis is a freshwater cyanobacteria species that is known to have low salinity tolerance, so Dr Harding recommended manipulating salinity levels in the vlei to eradicate the bloom.By using helicopters to "bomb" the vlei with coarse rock salt,and introducing salt in solution from the waste water treatment works upstream, the local authorities were able to raise the salinity to 8 ppt,which was enough to bring about the decline of the bloom and its successional replacement by a harmless phytoplankton species.

Since then the waste water treatment works have been upgraded, but nutrient levels remain unacceptably high, the macrophytes have not recovered, and cyanobacteria concentrations are still problematic. So Dr Harding conceived a more proactive plan to help rehabilitate Wildevoelvlei. A small team of women from the local community has been contracted to make and install sealed enclosures that are dosed with chemicals to treat the vlei water contained within them, before live and artificial pondweed is added to initiate the creation of suitable habitat and aid the water treatment process. The enclosures will be removed once the pondweed has taken root, and it is hoped that these nodes of growth will kick-start the re-establishment of the macrophyte community.

Dr Harding stresses, however, that the project is entirely experimental, and management of the country's cyanobacteria problems should ideally focus on mitigating the underlying causes of eutrophication and ecosystem degradation in aquatic environments.

"In other words, we need to address the cause rather than the symptoms," he concludes."Fortunately, with the new emphasis on integrated catchment management, we are moving in the right direction at last."

RAND WATER'S MONITORING PROGRAMME FOR CYANOBACTERIA

As a supplier of drinking water, Rand Water has developed and implemented information and management strategies to ensure the production of quality drinking water to more than ten million consumers in five provinces. The importance of cyanobacteria and their toxins to human health has led to the development of a fully equipped laboratory and the employment of specialists in the algal field at Rand Water. This group of specialists has developed a management plan for cyanobacteria that operates on a daily schedule to ensure that the drinking water produced by Rand Water is free from cyanobacteria and do not pose a health risk to their consumers. This management plan is currently a first in South Africa and Rand Water is also the first company internationally that has implemented such a plan for cyanobacteria on a day to day basis. The plan's foundation is a routine monitoring program of source and drinking water for algal species composition and concentration and also algal toxins. The management plan operates between alert levels to which strategic actions are connected. Internationally, the cyanobacteria field is a dynamic one at the moment and Rand Water is doing its best to ensure its is informed on development trends thereby rendering a better service to their clients.

- Leoni van Baalen: Scientific Services, Rand Water

Linking two of South Africa's major water pollution problems, a unique research programme proves the old adage "Where there's muck there's brass", using living systems to clean up sewage and industrially polluted waters, producing sweet water and marketable by-products in the process. **Catherine Knox** spoke to Peter Rose who heads the group that engineered this breakthrough in the quest for sustainable development.

From problem to profit:

Environmental biotechnology unlocks the value in polluted wastewaters

FLAMINGOS – NATURE'S SEAL OF APPROVAL

Several dead flamingos were found on site when work began on an algal ponding system to cope with effluent at Mossop Western Leathers co, near Wellington. Shortly after the system was commissioned, a sizable flock of flamingos occupied the ponds – an eloquent indicator of a healthy and naturally functioning saline aquatic ecosystem.The flamingo was immediately adopted by Rose's group as its emblem and appears on the cover of each of the 12 parts of the study report: *Salinity, Sanitation and Sustainability*

PEOPLE PRODUCTS

South Africans trained to make a difference are one of the most valuable by-products of the Water Research Commission's funded research projects at Rhodes University. High-level skills transfer has been a constant in the decade-long process, involving two Post-doctoral fellows, 11 PhDs and 14 MSc degrees.

Dr Oliver Hart,the WRC's first manager for this programme, accepted a fellowship from Rhodes University when he retired because of the opportunity to work with students."I have been in the water business for 50 years and anything to do with water is exciting to me," he says."But I specially enjoy working with the students."

Other knowledge by-products include 97 conference papers – 24 for overseas and 73 for South African conferences.No less than 19 patents have been registered and 24 journal papers published.

"Inventive and creative" are words clean-water innovator Peter Rose uses almost as often as "sustainable". Professor Rose is the author of the 3-volume, 12-part, 1000-page good news story presented as South Africa's special show-and-tell contribution to the recent World Summit on Sustainable Development in Johannesburg. The work was funded by the Water Research Commission in response to the sustainability objectives articulated in Agenda 21 of the Rio World Summit held in 1992.

In his foreword, Minister of Water Affairs and Forestry Ronnie Kasrils, writes:"We can point with a justifiable sense of pride and achievement to ...the work ... as being 'made in South Africa', at a time when social, environmental, political and economic calls are being made to all of Africa to stand up in the continental and global communities of nations."

Sustainability requires a radical overhaul of the means by which human needs are fulfilled – this has been generally acknowledged. Rose and his Rhodes-University-based Environmental Biotechnology Group (EBG) took up this challenge shortly after it was issued and they have boldly rewritten old paradigms ever since. With unflagging zeal and inventiveness,they tackled salinity and sanitation (the two key pollution problems threatening development), linking them in a way never done before and applying the new thinking of biotechnology (working with living systems rather than synthetic processes to achieve desired ends) with results that often surprised even themselves.

"Salinity and sanitation – which includes clean drinking water and waste disposal – impact severely on six of the seven priority pollution issues facing our region," says Rose. "One of the most pressing of these is the threat to the Witwatersrand of acid mine water decanting from disused mines. The scale and impact of saline pollution are vast and long-term in their effects."

Confirming numerous previous studies, including several by Rose's EBG, the 2000 White Paper on Integrated Pollution and Waste Management identifies salinity and sanitation as critical issues undermining sustainable development in Southern Africa.

In the new paradigm underlying the EBG work, salinity and sanitation are not only linked and dealt with in tandem,they are also re-imagined as resources rather than problems.

"The paradigm has changed from one of 'managing problems' to one of 'engineering opportunities," in Minister Kasrils' words.

MICROBES

The main characters of Rose's narrative are busy microbes and the exciting sub-plots all illustrate a central theme: the mobilisation of living systems to turn harmful waste products into valuable assets.

"Beneficiation is the core of the idea," says Rose, who is understandably partial to the term commonly used for the conversion of raw materials into finished products. Beneficiation writes sustainability into the scenario. Take the example of the toxic water that wells up, threatening to decant from disused mines, and the rising tide of sewage produced by urban sprawl – both threatening the East Rand right now. Nature, in her infinite wisdom, has provided a bug that can sort out the problems in the

acid water drainage, but this bug needs certain nutrients to sustain it.These nutrients just happen to exist in raw sewage. Put the bug, the minewater and sewage together and the bug digests the sewage while it facilitates the chemical reactions that make the metals and other pollutants settle out of the minewater. Clean water (a precious commodity) and useful inorganic by-products come out at the other end.These include sulphur, metals, algal bio-products and sulphuric acid.

Experience has shown that toxic mine-water could continue welling up for centuries – mines dug by the Romans are still decanting. And the sewage problem is here to stay.This means our communities will be dealing with both in the long-term. Expensive, high-tech solutions are not feasible. Biological processes with hard value as a by-product mesh with the development realities of both today and tomorrow, reconciling economic and environmental goals.

The research paradigm is flexible and has been adapted to deal with a variety of related problems with different benefits. In several cases full-scale plants are already operational, completing the cycle of research, development and implementation.

SPIRULINA

A version of the recipe successfully applied to manage tannery waste produces large quantities of Spirulina,a popular dietary supplement which is also used in stock feed.Beta-carotene, used in cancer treatment, is one of the by-product of treating waste from a soda-ash plant in Botswana.

The Environmental Biotechnology Group has demonstrated that integrated algal ponding systems provide the appropriate core technology for the delivery of their objectives. The ponds exposes a large surface area of water to sunlight accelerating the worker-algae's ability to capture radiant energy through photosynthesis. Oxygen is released in the process.The depth of the pond is also important to enable microbes to circulate between aerobic (near the surface) and anaerobic (near the bottom) conditions.

OPUS

The Rose opus is titled "Salinity, Sanitation and Sustainability: a study in environmental biotechnology and integrated wastewater beneficiation in South Africa" and it was almost 12 years in the researching and writing. To the insider, it reads like a thriller: there's danger, good guys,baddies, time-shocks, serendipity, excitement, but no fiction. In forthcoming issues, *The Water Wheel* will retell some of the key moments of a project which is a testament to the sustaining passion for the environment that fired Rose way back in the 1980s.

He recalls that in the 80s there was a widespread passion for the environment manifesting itself in some circles through panic and despondency about the prospects for the future. Rose said he decided to "get stuck in and do something about it."

Environmental biotechnology was "newly-invented" and his study was the first to apply the new thinking to salinity and sanitation with beneficiation as a bonus. He has always been fired by a strong sense of social purpose. He says now that the first chapter of his work is written,"I feel a sense of congruence. We have successfully completed a coherent study around a major theme articulated more than ten years ago."

THE RIGHT MAN FOR THE JOB

Prof Peter Rose's own background is poetically congruent with his work.The son of a mining engineer, he was reared in the arid Northern Cape, spending holidays on his grandparent's irrigated farm (with the attendant problems of salinity) in the Sunday's RiverValley near Addo. As an undergraduate at UCT, Rose proposed to the atomic energy board that the warm water emitted from Koeberg could be used for a range of aquaculture projects and he was awarded funding to flesh out his proposal.His stint as a farmer (on irrigated lands near Grahamstown) provided him with hands-on personal experience of the water problems specific to agriculture. At Rhodes he served as a lecturer, director of LIRI (the Leather Industries Research Institute) and as head of the Department of Biochemistry, Microbiology and Biotechnology. In January 2003 he takes up the position of director of the new Environmental Biotechnology Research Unit which includes an experimental field station which is a joint project of the WRC, Rhodes University and the Makana Municipality.

A FLEXIBLE AND WIDE-RANGING STRATEGY

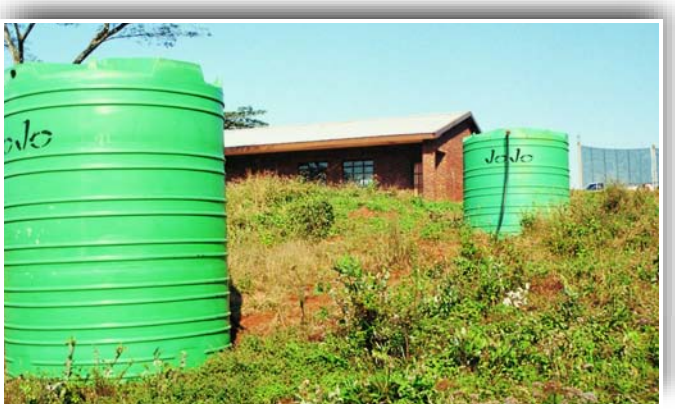
The 12 reports published under the title *"Salinity, Sanitation and Sustainability: a study in environmental biotechnology and integrated wastewater beneficiation in South Africa,"* include an overview and individual reports on successful and integrated projects dealing with wastewaters from

- gold and coal mines, including Grootfontein on the East Rand; municipalities, including Makana and the East Rand
- the Cato Ridge abattoir in KwaZulu/Natal,
  the Brennokem Co wine lees plant near Worcester,
- the Mossop Western Leathers co tannery near Wellington,
- the Botswana Ash Co at Sua Pan,

The story began with a visit to the Rhodes-based Leather Research Industry by Dr Piet Odendaal (then director of the WRC). Following his discussions with Rose, the WRC funded a one-year feasibility study. In his Editor's Note to the full research report, Greg Steenveld who now manages the programme, praises the "clarity, breadth and depth of the vision" expressed in the initial report. "The 'sustainable biotechnology' originally conceptualised by the researchers has ... by dint of rigorous research development, experimentation and testing, been translated into a suite of practicable processes for delivering treated water as well as value-adding organic and inorganic co-products."

Coming in our next issue: the story of the EBG-developed Rhodes BioSURE® process — a sustainable solution to the acid minewater drainage which threatens the Wit watersrand.

The **Namib fog beetle** is a feisty little creature. Every morning he makes an arduous journey to the top of a sand dune, where he turns his body into the wind, straightens out his rear legs and lowers his head. The fog rolling in from the sea gradually collects on his back, forming droplets of water, which glide downwards and hang from the insect's mouthparts. In this way, the *Onymacris unguicularis* is always assured of a healthy morning drink, despite being miles from the nearest fresh water.



Signs of success: Two additional tanks have been erected further down the slope, to collect overflow water from the main storage tank at Tshanowa Primary School, where a fog harvesting system has been installed.

Clouds on tap

Previous experiments have shown that other sites in South African could yield more than four times the volumes of water recorded at Tshanowa.

– By Sophia Dower –

It's an innovative solution to the problem of water shortage - one that researchers have been quick to latch onto, but which many countries have been surprisingly slow to implement.

Professor Jana Olivier of the University of South Africa's Department of Anthropology, Archaeology, Geography and Environmental Studies, explains that the idea of harnessing fog as a source of drinking water has been studied for decades.

"The first experiments were conducted in 1901, on Table Mountain.But it was only in 1987, in the arid coastal desert of northern Chile, that it was implemented on a large scale."

For years the remote fishing village of Chungungo relied solely on trucked-in water. In 1987 it was transformed by the installation of a fog collecting system. With a dependable and affordable water supply, not only did the growing population have domestic water, they were also able to cultivate commercial crops and plant trees.

Although unconventional, the technology behind fog collection is amazingly simple: massive vertical shade nets are erected in high-lying areas close to water-short communities. As fog blows through these structures, tiny water droplets are deposited onto the net. As the droplets become larger, they run down the net into gutters attached at the bottom. From there, water is channeled into reservoirs, and then to individual homes.

In Chungungo, this system saw water flowing from local taps for the first time ever, in 1992, providing more than 40ℓ of water per person, per day.

Like Chile, South Africa is an arid country in which large sections of the population have inadequate water supply. Only 35 per cent of the country gets more than 500mm of annual rain, and - with few unpolluted surface water sources, many contaminated ground water supplies and water tables that drop out of reach during drought - the advantages of an effective alternative water source are obvious.

Professor Olivier, who has been involved in fog collection research since 1995, says the potential for fog collection in South Africa is clearly shown by what has already been achieved at two fully operational sites - one in the Limpopo Province and the other on the West Coast.

WATER FOR THOUGHT

Tshanowa Junior Primary School in Limpopo is frequently shrouded in dense mist and rain, but the nearest water sources are a non-perennial spring located 2km away, and a dam, 5km away. Since most water sources in the province are contaminated, the

WHERE FOG HARVESTING WILL WORK IN SOUTH AFRICA

- For fog collection to be effective, the site must be in an area where fog occurs frequently throughout the year, and lasts for a few hours at a time.The water content of the fog should be high,and the fog must be accompanied by wind to ensure that a large enough volume of moist air is blown through the collecting screens.
- South African Weather Bureau records show that a number of places in South Africa have over 90 days of fog per annum.These are mostly located along the West Coast of southern Africa and in mountainous regions.
- Rain clouds have the highest water content, followed by advection sea fog.Radiation fog has too little water to be successfully collected.
- Ideally, sites should also be more than 1 000m above sea level.Sites in many parts of South African have elevations of more than 2 000m, and according to previous experiments, these sites could yield more than four times the volumes recorded at Tshanowa in the Soutpansberg.

The giant fog screens at Tshanowa Junior Primary School in Limpopo province are providing pupils and members of the community an average of between 150ℓ and 250ℓ of water per day

AN AGE-OLD PRACTICE

In ancient times, fog water was often collected for domestic and agricultural use.

- The inhabitants of what is now Israel used to build small, low, circular honeycombed walls around their vines,so that the mist and dew could precipitate in the immediate vicinity of the plants.
- Historically, in the Atacama, both dew and fog were collected by means of a pile of stones, arranged so that the condensation would drip to the inside of the base of the pile, where it was shielded from the day's sunshine. The same technique was employed in Egypt,with the collected water stored underground in aqueducts.
- In Gibraltar, a similar technique is used: a large area on the slope of the rock has been covered with cement blocks. Fog and rainwater runs downwards and is collected underground where evaporation is minimised.
- On a smaller scale, rain, fog and dew are collected on enormous granite rocks at Cape Columbine lighthouse, on the West Coast.Low retaining walls have been cemented onto the sloping rock surface to channel the water into a reservoir at the base of the outcrop.
- The first fog collection installation in South Africa - prior to the Chilean project - was at Mariepskop in Mpumalanga,in 1969/70. It was used as an interim measure to supply water to the South African Air Force personnel manning the Mariepskop radar station. Two large fog screens, constructed from plastic mesh and measuring about 28m x 3,5m each, were erected at right angles to each other and to the fog and cloud-bearing winds. These yielded more than 11ℓ of water per square meter of collecting surface, per day. Unfortunately, the project was terminated once an alternative water source was found.

quality of the dam water is suspect.The 130 school children rely on what water they can carry with them to school each day.

The school is located at the crest of one of the easternmost promontories of the Soutpansberg, at 1 004m above sea level. Despite its relatively low elevation, this region is ideal for fog collection in that moist maritime air from the Indian Ocean moves over the escarpment and against the mountains during the night and early morning.This cloudiness sometimes persists throughout the day.

Permission was obtained from the relevant local and tribal leaders to erect a fog water collection system on vacant land adjacent to the school. Construction commenced in 1999 and local inhabitants were employed to assist.

Each fog collector consists of three 6m-high wooden poles, mounted 9m apart. Steel cables stretch horizontally between the poles, and from each pole to the ground.A double layer of 30 per cent shade cloth is draped over the cables, and fixed to the poles on each side.Water dripping from the net into the gutter runs through a sand filter and is then emptied into a tipping bucket. From there, it flows into a 10kℓ storage tank further down the slope. Two additional tanks were erected at the school to collect the overflow from the first. An automatic weather station was also installed to record rainfall, wind speed and wind direction.

Within four days of completion, school children and members of the local community were drinking water collected by the fog screen. Although weather conditions have made accurate data collection difficult, daily yields of as much as 3 800ℓ of rain

Hannes Rautenbach, of the University of Pretoria's Department of Geography, Geoinformatics and Meteorology), beside one of the 36m² screens. Water drips from the net into a gutter and runs through a sand filter before being channelled into the storage tank. The automatic weather station (the white box) records rainfall, wind speed and wind direction.

"The costs of fog collection are low, the technology is simple and the source is sustainable for hundreds, even thousands of years."

and fog combined, have been recorded. The average collection rate from March 1999 to April 2001 is over 2,5ℓ per square metre of fog screen.

HEAVY CLOUDS, BUT NO RAIN

The same system was also set up at Lepelfontein, a small missionary station about 400km from Cape Town, and about 5km inland of the West Coast. Although ground water here is abundant, it is of such bad quality that it is considered a health risk. A small solar distillation plant was installed in 1998 to provide limited drinking water, but most water is still transported to the village from elsewhere.

The fog screens were installed in 1999, and the overflow from one of the 10kℓ tanks is now being used to supplement the water from the desalination plant. At least 80 per cent of the water collected at this site is from fog alone, as the region receives very little rain. Fog conditions are mostly associated with onshore breezes originating either from the South Atlantic anticyclone to the south of the continent, or from north westerly and westerly winds on the northern perimeter of a coastal low.

Again, daily yields of over 3 000ℓ have been recorded, with a daily average of about 5ℓ of water collected per square metre of fog screen.

While Lepelfontein's water initially showed high levels of sodium - possibly due to the proximity of the ocean and wind-blown spray - Professor Olivier says that water quality at both sites is good, with no disease-forming organisms present in samples.

"In fact, at Tshanowa, water was rated as Class 0 - ideal quality," she says. "Since the water is used for drinking purposes, quality is tested regularly." She adds that experiments conducted at other high elevation sites around the country have yielded more than 10ℓ per square meter of collecting surface per day. "This shows that in terms of quality and magnitude of yield, fog harvesting could go a long way to alleviating water shortage problems in the fog-prone mountainous regions of the country. "The costs are low, the technology is simple and the source is sustainable for hundreds, even thousands of years."

Virtually all of the materials needed to construct, operate and maintain the system are available locally. And yet, fog harvesting is a rarely used technique in Africa. Despite education and information programmes initiated by the fog collection project team, there seems to be little awareness of it, and even less support in terms of corporate funding or involvement.

Algal control without side effects

A typical example of algal problems in a water feature with koi, which can successfully be removed by WonderStraw.

The "WonderStraw" sachet.

At last a non-chemical product that is able to control algal growth in water features . . .

Water feature and pond owners are quite aware; it is a difficult task to control algae in these water bodies without the risk of poisoning aquatic plants and other water life. The algaecides currently available on the market pose without exception a danger to fish, macro-invertebrates and aquatic flora.

The WonderStraw™ product is packaged in sachets of 25g each. The straw serves as a substrate for a complex mixture of microorganisms (bacteria & fungi). These microorganisms are inactive while housed in the dry sachets. However, when the sachet is placed in the affected water, the microorganisms become active upon contact with the water.

The following process is then initiated . . .

- The inactive microorganisms become active and begin to propagate.
- After 3 to 4 weeks, the microbe population reaches numbers sufficient to initiate the secretion of an organic factor that suppress the growth of algae.
- The factor is an unknown natural organic molecule that is released by the micro interaction in the water. The unknown factor acts algistatic (inhibits the growth of algae) and not algicidic (does not kill algae).
- This means that the algae are allowed to complete their life cycles of about 3 weeks. The natural factor prevents the germination of algal spores (that are already present in the water and would normally give rise to mature algae that could multiply), and prevents therefore further algal growth.

Safety of the WonderStraw™. . .

The unknown product released, has an organic nature that prevents the multiplication of algal cells; no aquatic plants, fish or animals are affected.

The product is completely safe to…
- Humans,
- Pets,
- Birds, and
- Other animals… and they may drink the water after treatment without any danger.

WonderStraw™ is available at leading nurseries in and around Gauteng.
For more information about the product please contact:
E-mail: info@envirokonsult.co.za • Tel: (012) 349-1793 • Cell: (082) 971-2515

Viewpoint:

The fluoridation of water in South Africa

THE ROLE OF THE DEPARTMENT OF WATER AFFAIRS & FORESTRY IN THE FLUORIDATION OF WATER

Mandatory regulations to fluoridate water supplies in South Africa were published (under the Health Act) in the government gazette of 8 September 2000. Water providers were required to register their water works sites with the Department of Health within 12 months of the date of these regulations – i.e. by September 2001, and implement water fluoridation at sites within two years of registration by the Department of Health. The Water Wheel asked a few role players for their viewpoint about this important, and often, controversial development in the water field.

Fluoridation of water is primarily a health issue and therefore the Department of Health is the leading national department. The Department of Water Affairs and Forestry (DWAF) will support the Department of Health in implementing national policy in the same way as DWAF will support other national and provincial departments as well as local government to implement government policy.

DWAF has a duty in terms of the National Water Act to protect the aquatic resources for future generations DWAF has also a regulatory role in terms of the Water Services Act, in other words, to ensure that the objectives of this Act are achieved by all water service institutions. This implies that the implementation of any decision to fluoridate a water supply must be done in an integrated, phased and progressive fashion and take the requirements of both water acts into account.

DWAF'S OVERARCHING RESPONSIBILITIES

- Protect the aquatic resources for future generations.
- Ensure sustainable water services to all South Africans.
- Support other spheres in the spirit of co-operative government

DWAF'S RESPONSIBILITY IN TERMS OF THE FLUORIDATION REGULATIONS

- The Department must evaluate all applications to determine the impact on the water resources.
- The Department must assess the respective institution to ensure that the objectives of Water Services Act will be met.

DWAF'S APPROACH

DWAF will evaluate all applications to fluoridate water supplies, using the following protocol:

- The impact on the environment will be assessed.
- If no negative impact is evident, the application will be considered in terms of the principles of the Water Services Act.
- DWAF's decision and recommendations will be forwarded to the Department of Health.

IMPACT ON THE ENVIRONMENT

Effluents from communities

served by fluoridated water supplies eventually return to the water resources. DWAF therefore insisted that the Water Fluoridation Regulations contain a clause allowing for an impact assessment in cases where one was deemed necessary. Three Scenarios are envisaged:

- The waste water after domestic use is discharged directly to the sea - there is no impact on the water resources
  - The department would favourably consider such applications.

- The waste water is discharged into catchments where studies have shown that downstream fluoride levels are already above acceptable levels or - Fluoridation would raise the fluoride level above that acceptable for human consumption.
- Inland resources where the fluoride level must be established - Impact assessments must be done.

THE PRINCIPLES OF THE WATER SERVICES ACT

The Water Services Act compels all water services authorities to develop water services development plans as part of an integrated development plan. Plans to fluoridate must be part of the development plans and as such must also be communicated to the consumers within that municipality. DWAF will consider the following:

- Whether all citizens supplied by the Water Service Provider have access to at least basic services - If a portion of the community does not have access to a basic water supply, and the cost of fluoridating the water will significantly delay the extension of such services, the Department will advise that the water not be fluoridated at this stage.

- Whether the requirement to fluoridate the water will adversely affect the Water Service Authority's ability to supply free basic water to its consumers. Should a significant adverse effect be indicated, the Department will advise that the water not be fluoridated until free basic water becomes a reality.

- Whether the water service provider has the capacity to operate the service satisfactorily. Smaller operators often do not have sufficient qualified staff to e.g. guarantee the safe operation of fluoride dosing equipment and therefore initially only plants serving more than 100 000 persons will be recommended to practise fluoridation.

CONCLUSION

DWAF believes that if all cases to fluoridate or not to fluoridate water be evaluated in such an integrated, logic and holistic way (without the emotions) then the right decision will be taken to the ultimate benefit of the consumer.

UMGENI WATER

UMGENI WATER · AMANZI

UMGENI'S COST OF WATER FLUORIDATION

Costs for fluoridation implementation varied from site to site, with seven out of thirteen water works calculated to be too expensive to implement fluoridation.At the remaining six sites, costs were estimated at 3 cents/kℓ, at 2001 costs.

UMGENI WATER'S ACTIONS

Over the two-year period since promulgation of the mandatory regulations to fluoridate water supplies (Sep 2000–Aug 2002), Umgeni Water had undertaken various actions, which included: -

- Communication to its customers, namely, water services authorities, water services providers and the general public regarding the content of the regulations;

- Monitoring and assessment of the raw and treated water quality, to assess the baseline fluoride concentrations in its water resources;

- Evaluation and pilot assessment of water fluoridation technology, and assessment of plant personnel requirements;

- Assessment of the costs of implementing fluoridation at each of its water works sites and the resulting tariff implications thereof;

- Submission of registration and/or exemption forms to the Department of Health for thirteen water works sites.

RESULTS OF FLUORIDE MONITORING

Of the entire source water supplies monitored, all but one had low levels of natural fluoride, with average values ranging from 0.100 mg/ℓ to 0.150 mg/ℓ.

One site had an average concentration of 0.450 mg/ℓ and is close enough to the Department of Health's requirement for beneficial effects, not to be considered for water fluoridation.

CUSTOMER'S RESPONSE

Apart from one, all bulk water supply customers requested that their water supplies not be fluoridated. No discussions have therefore proceeded to a level where fluoridation agreements could be considered. Umgeni Water has thus at this stage not proceeded to implement water fluoridation at any of its sites.

NATIONAL DEBATE AND INITIATIVES

At a recent Department of Water Affairs and Forestry Portfolio Committee Meeting (June 2002), where various presentations by professionals on the subject of water fluoridation were made, (including by the Department of Health, Department of Water Affairs and Forestry, African Health and Development Organisation and Rand Water), it was concluded, after hearing the various perspectives, that the current level of national information and knowledge was insufficient to show the benefits or lack thereof of water fluoridation and more research needed to be done in the South African context before proceeding with this intervention.

The Water Research Commission is currently considering a project to collect the necessary information with regards to several key areas relating to water fluoridation (namely, social, environmental, health, technical and economic) that would inform and advise this debate.

Umgeni Water's current position is therefore to await the outcome of the national research work and anticipates a further directive once this information has been made available.

FLUORIDATION OF WATER SUPPLY IN CAPE TOWN

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

The fluoridation of the water supply to the City of Cape Town is posing a considerable challenge to the Bulk Water Department of the City. A number of technical and logistic problems will have to be overcome in order to implement fluoridation in terms of the promulgated regulations under the Health Act.

The City owns and operates eleven different treatment facilities ranging from 3 Megalitres per day to 500 Megalitres per day and treatment varies from an unattended groundwater treatment facility to a state of the art full water treatment plant. The City believes that the requirements in the regulations with respect to the class of operator required at any time is in practice not achievable for most water service providers. This also does not make sense in, for example, instances of intermittently attended groundwater treatment facilities where the water normally requires minimal treatment.

Of the technical aspects identified as potential problem areas is the point of introduction of the fluoride into the water stream during the treatment process. It has been identified from literature research that the addition of a very commonly used coagulant, namely aluminium sulphate, will form complexes with the fluoride, which are potentially problematic from a health point of view. The addition of lime also interferes with the effectiveness of the fluoride potentially leading to fluctuations in fluoride levels to totally wasted expenditure due to precipitation of the calcium fluoride. The latter is a particular problem with the treatment of the typical acidic brown coastal waters that require lime dosing and the addition of carbon dioxide to stabilize the water as a late stage water treatment process. This needs to be investigated before full-scale implementation.

The City's water supply is a totally integrated system with the result that not a single area of the City is supplied continuously by a single treatment plant. This is a particular problem in selecting any pilot implementation scheme and monitoring the results of fluoridation on the affected community.

The cost of implementing fluoridation of Cape

National Short Course on Aquatic Biomonitoring in Water Resources Management

Course for 2003

Monday 10 to Friday 14 February

Continuing Education Centre
Rhodes University, Grahamstown
Initiated by CSIR's Division of Water, Environment and Forestry Technology (Environmentek) and
The Institute for Water Quality Studies (IWQS) of the Department of Water Affairs and Forestry

Currently coordinated by
The Institute for Water Research
and Coastal & Environmental Services, Grahamstown

Aim of the course

Aquatic biomonitoring, or response monitoring, is increasingly used as a monitoring and assessment tool in water resource management. This course will provide a basic understanding of the concepts, advantages, limitations and results associated with different biomonitoring techniques, including field bioassessments. The course is designed to address the relevant concepts and the interplay between biomonitoring and resource management, rather than the technical details of how to conduct the monitoring.

Who should attend?

Mid-level managers, planners and other officials from government or private institutions who need and want to improve their knowledge and use of biomonitoring in general.

Cost of the course:

Course - R5 000
Accommodation - R1 000
Total cost of course - R6 000 (incl VAT)

For more information, please contact:
Dr Patsy Scherman - Coastal & Environmental Services
Tel: 046-622 2364 • Fax: 046-622 6564 • E-mail: p.scherman@cesnet.co.za
Ms Lisl Griffioen - Coastal & Environmental Services
Tel: 046-622 2364 • Fax: 046-622 6564 • E-mail: lisl@cesnet.co.za

Town's water supply has been estimated to be a capital cost of more than R15 million and an ongoing operating cost of about R6,5 million per annum.

A "Front Runner" concept was proposed at a work session between the South African Association of Water Utilities, the Department of Health, the Department of Water Affairs and Forestry and the South African Local Government Association. A possible pilot implementation plant will have to be assessed based on the criteria already selected for identification at this workshop.

Arne SingelsHead:Bulk Water Department - City of CapeTown
2002 – 11 – 21

RAND WATER – FLUORIDATION OF RAND WATER DRINKING WATER

In September 2000 the Department of Health legislated regulations in respect of fluoridation of potable water in South Africa. Fluoridating potable water is considered by some as being unconstitutional in that the use of fluoridated water is forced on consumers who have no choice in the matter. During the past five years water boards, and Rand Water in particular, made several submissions to the appropriate ministries. A key aspect of these submissions is that Rand Water sought indemnity from the Department of Health against any claims arising from the fluoridation of water that may give rise to possible health implications or impact on the environment or industrial water users. The Department of Health responded that any claims regarding possible health implications or impact on the environment on industrial water users must be made against the Minister of Health.Fluoride, in the correct concentration,is effective in protecting teeth and is especially necessary in children within the one to ten year age group. The rationale for supplementing potable water with fluoride is that South Africans, particularly those in rural areas who do not use fluoridated toothpaste, would benefit. Given that most people in rural areas do not receive piped water the benefit will not reach the target population.Furthermore only 0,65 per cent of the water produced by Rand Water is used for drinking purposes. This equates to 19 000 m^3 of the 3 000 000 m^3 sold daily, which means that 99,35 per cent or R25 000 of the direct costs (chemical costs per day) is not effectively utilised for the intended purpose.The question thus arises, how cost effective is this method of augmenting dietary fluoride intake? Rand Water will introduce 1 500 kg of fluoride daily into potable water. Approximately 1 000 kg of fluoride per day will find its way into water streams. This may have long-term negative consequences on the water environment. The cost of de-fluoridation can amount to as much as R5.50/m^3 if reverse osmosis is used and the cost of using alternative methods of removing fluoride from water such as the use of activated aluminia is estimated at R1.80 m^3. Who will be expected to pay this cost? Rand Water does not consider fluoridation of water as the highest priority for South Africa. In fact, the total estimated national cost of R30 million per annum should rather be used to extend the provision of free water to South Africans.Based on Rand Water's experience the R30 million could extend water provision to some 300 000 unserved consumers. Considering the above costs and the large sector of the targeted population, that will not be reached through water fluoridation,the question raised is whether alternative methods of fluoride augmentation such as supplementing milk, sugar, salt, maize meal have been thoroughly investigated. These may have a much better chance of reaching the target population, especially if fluoridated foods are subsidised such that it is cheaper than non-fluoridated foods. Rand Water does not wish to challenge the rationale for augmenting diets with fluoride. Rand Water does however express major concerns with the decision to fluoridate potable water. It is apparent, from the above, that the social and financial viability of fluoridating potable water supplies requires further consideration. It is therefore proposed that government reconsider the matter of fluoridating potable water supplies and that other options are investigated. In the meanwhile, Rand Water will abide by the regulations regarding fluoridation.

ESTIMATED COSTS OF WATER FLUORIDATION TO RAND WATER

Capital cost estimates are based on a study conducted during 1996 for five different water fluoridation plants for The Metropolitan Water District of Southern California.The treatment capacity of these plants varies from 123 500 to 2 850 000 m^3 of water per day and the required fluoride dosage was estimated at 0,6 mg/ℓ. For all practical purposes the size and dosages required are comparable to what would be envisaged for Rand Water.

The capital cost required to treat 1 000 m^3 per day would be R3 695.The estimated capital cost for a fully automated state of the art fluoridation dosing plant for Rand Water would then be:

Capital costs

Vereeniging Water Treatment Plant : R4 850 000
Zuikerbosch Water Treatment Plant: R14 000 000
Total: R18 850 000

The capital amount takes into account the following components: 20 per cent for Planning and Design, 10 per cent for Contract Administration and 15 per cent for Contingencies.

Capital redemption at 13,47 per cent per annum for 20 years is calculated at R3 298 700 per year, which equates to 0,30 cent per m^3 of water treated.

Operating costs

Irrespective of the type of fluoride compound that will be used,a team of highly trained operators will have to be employed to operate several dosing sites and to oversee the offloading,storage and distribution of the concentrated product (as well as operating the dosing plant). Additional staff will have to be trained to deal with emergencies that could arise after spillage or contamination. All concentrated fluoride compounds are toxic and extreme care must be exercised during handling such compounds. This fact cannot be over emphasised and the design of storage and handling facilities must incorporate all the required safety aspects.

The minimum number of personnel required per site would be:

Four dedicated shift operators to monitor the performance of the dosing plants

- Three operators to receive and distribute the product to the various dosing plant
- One senior operator to supervise the fluoridation of water

The total annual remuneration for these personnel is estimated at R 1 322 000 which equates to 0,12 cent per m^3 of water treated.

Maintenance costs

Maintenance costs on the fluoridation plant are expected to be high due to the highly dangerous and corrosive nature of the product. Annual maintenance cost is estimated at five per cent of the capital cost, this is estimated at R950 000 which equates to 0,1 cent per m^3 of water treated.

Based on the above assumptions the annual cost of fluoridation to Rand Water would be:

Item	Value	Cost in cents per m^3
Capital redemption	R3 298 700	0,30
Chemical treatment cost	R9 351 000	85
Personnel	R322 000	12
Plant maintenance	R950 000	0,10
Total	R14 921 750	1,37

The present fluoride concentration in both the raw water used for purification and the water put into supply varies within the range of 0,18 to 0,2 mg F^-/ℓ. To meet the 0,7 mg F^-/ℓ required by the new legislation it would require Rand Water to increase the concentration level of fluorides in its potable water supply by an average of 0,5 - 0,6 mg F^-/ℓ.

Based on the above information the estimated cost in respect of fluoridation is 1.37c/m^3.

Based on the latter, the following calculations were done for a 3000 000 m^3/day plant (rounded off):

Total costs per day = R41 000
Total costs per annum = R15 million

Studying the above information it is noted that an increase of 0,85c/kℓ over our present chemical costs of 6,97c/kℓ would imply an increase of 12,2%. Expressed as a percentage increase in the water treatment costs (chemical and operational costs) this equates to an increase of 0,97c/kℓ over the current purification costs of 13,2c/kℓ, an effective increase of 7,3%. (Figures relate to November 2001).

When meeting basic water needs of 25 ℓ per person/day this will result in an increase in costs to the consumer of 13c per person/annum and for the average household usage of 30 m^3/month,which will result in an increase of R4.93 per household/annum.

ESTIMATED COSTS OF WATER FLUORIDATION TO SOUTH AFRICA

It is estimated that the total volume of water treated by water boards, metropolitan councils and the larger local authorities is 6 000 000 m^3/day. Based on the assumptions made above, the estimated cost of fluoridation to the country is estimated at:

Total cost per day R82 000
Total costs per annum R30 million

IMPACT OF WATER FLUORIDATION ON THE ENVIRONMENT

Generally the environment is tolerant to fluorides and little impact has been seen at fluoride concentration levels below 2 mg/ℓ.

High fluoride concentrations may be harmful in certain industries, particularly those involved in the production of food,beverages,pharmaceuticals and medical items. Fluorides in boiler feed water also present problems in steam generation plants and need to be removed prior to use. The disposal of mineralised wastewater from steam generation plants with high fluoride concentrations may become a problem in future. The present fluoride effluent standard is set at 1 mg F^-/ℓ and this value has also been used as in-stream water quality standards in newly established river forums.

As water is a scarce commodity in South Africa it is recycled and this should be considered in the overall water use strategy. Fluoridation of Rand Water's supply at a rate of 0,5 mg F^-/ℓ will introduce 365 tons of fluoride per annum into the environment. If 0,5 mg F^-/ℓ is added to our water supply this would theoretically imply (during periods of drought or the dry season) that the effluent concentrations will also increase by 0,5 mg F^-/ℓ as fluorides are not appreciably removed through the wastewater treatment process. This for example could increase the average fluoride concentration in the effluent emanating from a works near Alberton to approximately 0,9 mg F^-/ℓ which is only 0,1 mg F^-/ℓ less than receiving water quality criteria.This may start presenting a problem to both the receiving streams and the downstream users if not managed with care. The fluoride levels in other works investigated were much lower and would therefore not present a problem.

A study of the present in-stream fluoride concentrations of the major streams and water bodies that will receive water emanating from wastewater treatment works treating water supplied by Rand Water was conducted.The fluoride concentration in most of these streams varies between 0.3 and 0,4 mg F^-/ℓ and would therefore have to be monitored carefully once fluoridation is implemented. Of concern is the high average fluoride values recorded for the Rietspruit (Loch Vaal) and the Vaal River downstream of the Barrage at Lindeques Drift.Fluoride concentrations in these streams at times will exceed the 1 mg F^-/ℓ level if the water supplied by Rand Water is augmented by 0,5 mg F^-/ℓ, especially during the dry seasons or periods of drought.The question is raised, to what extent Rand Water will be held liable if down-steam users are required to de-fluoridate in order to comply with set standards.If it is the intention to manage fluoride concentrations in potable water to levels below 0,7, mg F^-/ℓ it will be necessary to protect the raw water supplies of down-stream users.It will therefore be necessary to consider existing in-stream fluoride concentrations when establishing Rand Water's dosage rates.

THE DEPARTMENT OF HEALTH

Tooth decay is the most common chronic disease known to human kind. In South Africa 70 per cent of six year old children have dental decay and by the time they reach adulthood it rises to more than 90 per cent. Over R2 billion is annually being spend on dental treatment in our country. In spite of this high figure the majority of the population could still not receive comprehensive dental treatment.

More than 50 years of research worldwide, published in reputable scientific journals, proved the safety and cost-effectiveness of water fluoridation. This academic information are taught to dental students at under- and post-graduate levels at universities.

Water fluoridation is endorsed by a number of national and international organisations.

At an optimum concentration it reduces tooth decay by up to 60 per cent.The cost for water users is about R2,00 per person,per year, at the major water providers.It is 18 times cheaper than toothpaste, and 61 times cheaper than filling one tooth.

In practice fluoridation means:

- Less toothache;
- Fewer and smaller dental bills;
- Better looking teeth;
- Reduced need for dentures, crowns and bridges which are expensive dental treatment services;
- Fewer school and working days lost due to dental disorders or visits to the dentist;
- Less fear and anxiety about visits to the dentist as

treatment would be less complicated, with less anaesthesia and drilling.

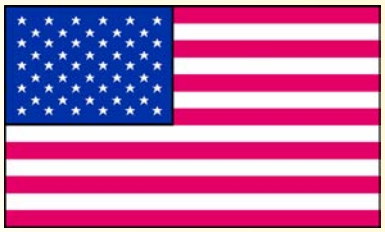
Tooth decay is strongly associated with social deprivation. Water fluoridation is one of the most successful health disease preventive programmes ever initiated.It has the potential to benefit all age groups and all socio-economic strata, especially the lower deprived group, who has the highest unmet dental treatment needs and the least accessibility to oral health services, due to inafordability and shortage of services.

The higher socio-economic group will also benefit because they will save on expensive advanced treatment services and do not have to buy fluoride supplements for their children.

The Department of Health has therefore accepted a policy to fluoridate the water supplies of South Africa.

Dr Johan Smit
Head of Oral Health

THE UNITED STATES OF AMERICA COMMENTS FROM THE SURGEON GENERAL



Since the 1950s, each U.S. Public Health Service Surgeon General has committed his or her support for community water fluoridation. Below is the most recent endorsement supporting community water fluoridation from Surgeon General, David Satcher, MD, PhD.

For more than half a century, community water fluoridation has been the cornerstone of caries prevention in the United States.As noted in my May 2000 report, **Oral Health in America: A Report of the Surgeon General** , community water fluoridation continues to be the most cost-effective, practical and safe means for reducing and controlling the occurrence of tooth decay in a community. In thousands of communities in the United States where naturally-occurring fluoride levels are deficient, small amounts of fluoride have been added to drinking water supplies with dramatic results. More than 50 years of scientific research has found that people living in communities with fluoridated water have healthier teeth and fewer cavities than those living where the water is not fluoridated.

Almost two-thirds of the United States population served by public water supplies consume water with optimal fluoride levels. Of the 50 largest cities in the country, 43 are fluoridated.A significant advantage of water fluoridation is that anyone, regardless of socioeconomic level, can enjoy these health benefits during their daily lives – at home, work, or at school or play – simply by drinking fluoridated water or beverages prepared with fluoridated water. Water fluoridation is a powerful strategy in our efforts to eliminate health disparities among populations. Unfortunately, over one-third of the United States population (100 million people) is without this critical public health measure.

The U.S. Centers for Disease Control and Prevention has recognized the fluoridation of drinking water as one of ten great public health achievements of the twentieth century. Water fluoridation has helped improve the quality of life in the United States through reduced pain and suffering related to tooth decay, reduced time lost from school and work, and less money spent to restore, remove, or replace decayed teeth.Fluoridation is the single most effective public health measure to prevent tooth decay and improve oral health over a lifetime, for both children and adults.

Water fluoridation continues to be a highly cost-effective strategy, even in areas where the overall caries level has declined and the cost of implementing water fluoridation has increased. Compared to the cost of restorative treatment, water fluoridation actually provides cost savings, a rare characteristic for community-based disease prevention strategies.

While we can be pleased with what has already been accomplished,it is clear that there is much yet to be done. I join previous Surgeons General in acknowledging the continuing public health role for community water fluoridation in enhancing the oral health of all Americans.

David Satcher, MD, PhD
Surgeon General
December 3,2001

IMPI
for mine water treatment

– By Edith Webster –

IMPI - Integrated Managed Passive Treatment Process technology - has been developed and patented by William Pulles of Pulles Howard & De Lange and Professor Peter Rose of Rhodes University in response to the urgent need for a low-cost, self-sustaining, low-maintenance passive treatment system to address the problems of acidification and salinisation (in terms of sulphate) at operating, defunct and closed mines throughout South Africa.

The IMPI process, says Dr Ralph Heath, a director of Pulles Howard & De Lange, can do this at less than half the capital cost required for an active system, which would use, among other capital-intensive elements, electricity and chemical dosing.

Indeed, IMPI can treat a megalitre per day of mine water at a relatively low capital cost of R3-million to remove one tonne per day of sulphate at an operating cost which translates to 60c per cubic metre. "Operational costs are less than one-tenth of an alternative system," Dr Heath points out.

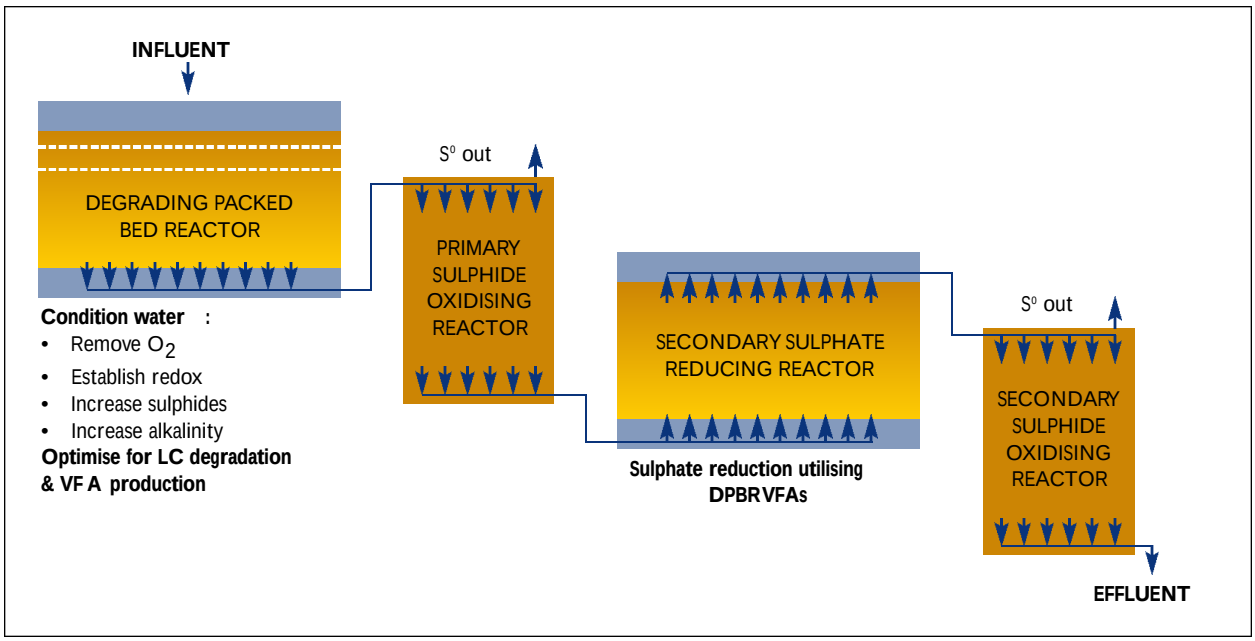
Although it realises significant cost savings,the IMPI is able to do more than any similar passive treatment system has ever been able to do - it can

- sustain high levels of SO_4 reduction;
- remove SO_4 at high efficiencies (100 times higher than it could when research began);
- remove toxic heavy metals very efficiently (87-95%);
- neutralise acid mine drainage;and
- passively and biologically remove elemental sulphur from the process.

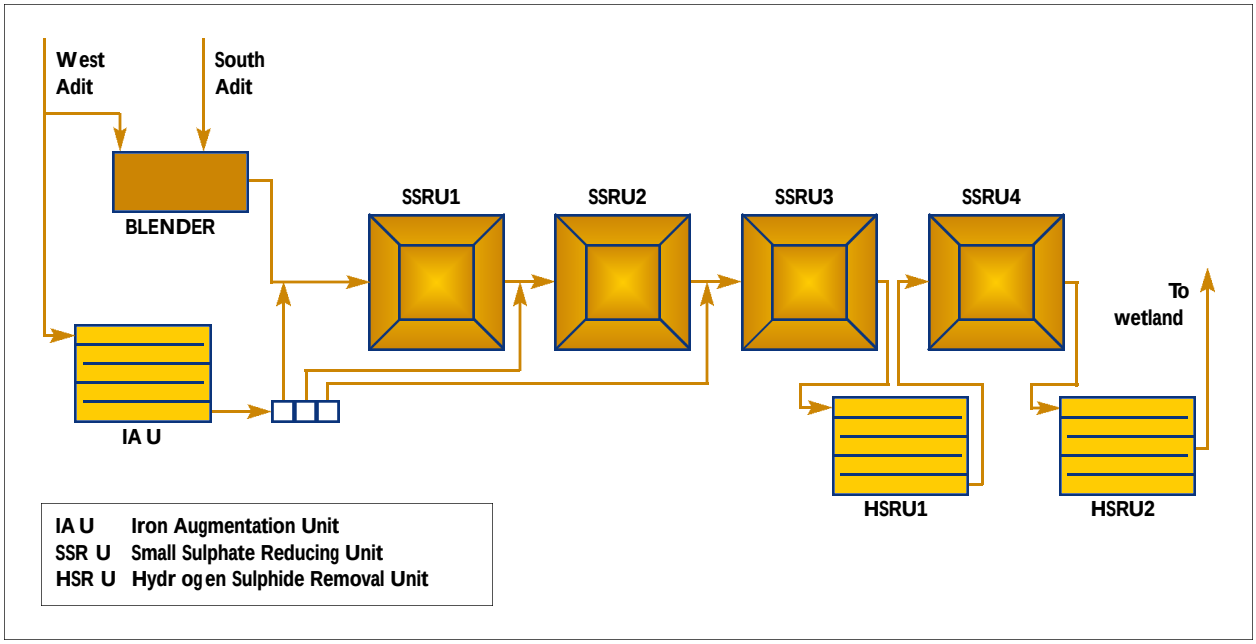
IMPI,explains Dr Heath, is the product of research into "a water treatment system that utilises naturally available energy sources such as topographical gradient, microbial metabolic energy, photosynthesis and chemical energy and requires regular but infrequent maintenance to operate successfully over its design life." The minimum design life of an IMPI treatment plant is 15 years.

THE IMPI PROCESS

Essentially, continues Dr Heath, the IMPI process



Schematic diagram of the IMPI process



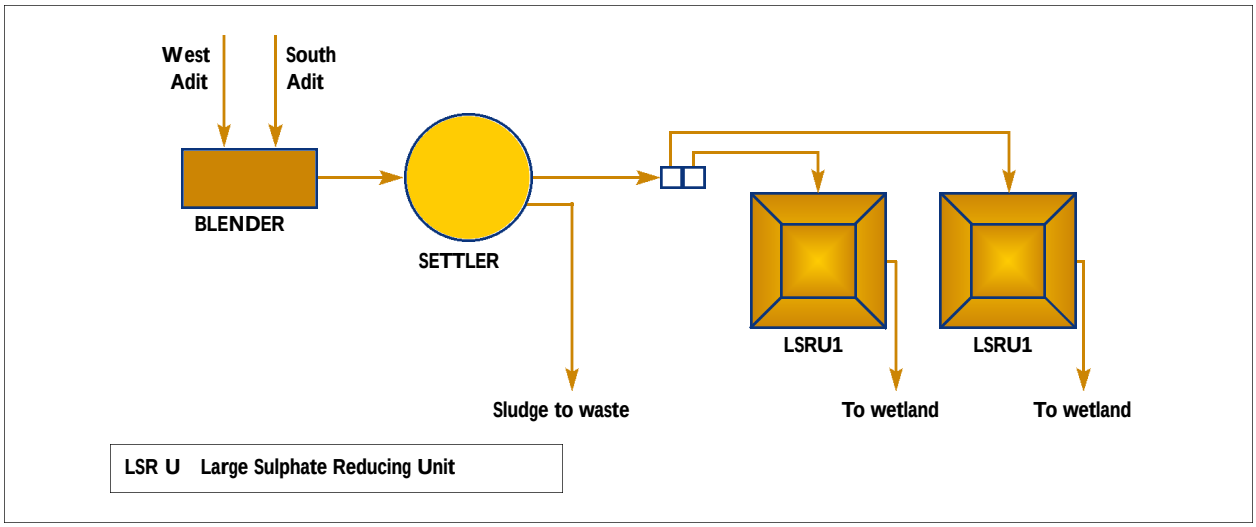
Configuration of small sulphate reducing units

involves the subdivision of the overall mine-water treatment process into individual units, each designed and optimised to perform a key function (see Schematic of the IMPI process).There are four different stages in the IMPI process:

1. Degrading Packed Bed Reactor (DPBR):This reactor is packed with multiple layers of specially selected carbon sources (electron donors) and also receives regular inputs of readily available carbon. Primarily, this unit rapidly conditions the influent by removing dissolved oxygen, establishes the desired redox conditions and produces elevated levels of sulphides and alkalinity in the first portion of the reactor.The remainder of the reactor is devoted to the optimised hydrolysis of lignocellulose material and the production of volatile fatty acids (VFAs). The effluent from this reactor will contain reduced levels of metals and sulphate and elevated levels of sulphides,alkalinity,VFAs and nutrients.

2. Primary Sulphide Oxidising Bioreactor (PSOB):This reactor contains very little carbon source and mainly oxidises sulphides to elemental sulphur for removal from the reactor while minimising changes to the VFAs, nutrients and redox conditions.

3. Secondary Sulphate Reducing Reactor (SSRR):This



Configuration of large sulphate reducing units

reactor contains a specially selected single carbon source rather than a multiple layer, multi-carbon source. It primarily utilises the volatile fatty acids produced in the degrading packed bed reactor and removes additional sulphate down to the required level. The effluent from this reactor contains reduced levels of metals, sulphate, VFAs and nutrients and elevated levels of sulphides and alkalinity.

4. Secondary Sulphide Oxidising Bioreactor (SSOB): This reactor contains very little carbon source and principally oxidises sulphides to elemental sulphur for removal from the reactor.

"If required,a final aerobic polishing stage could be added, primarily to remove residual levels of volatile fatty acids and nutrients.The individual units could be combined in a tapered-up or tapered-down configuration (one DPBR to many SSRRs or vice-versa),depending on the design duty of the reactors," says Dr Heath.

DESIGN

IMPI technology has been designed in three primary configurations:

- IMPISURE for the reduction of sulphates, metals and acidity;
- IMPIMATE for reducing metals and acidity;and
- IMPIPLUME for in-situ remediation of contaminant plumes.

"The technology has been designed so that it can be maintained regularly (every two to four weeks) but infrequently. One of the major reasons previous attempts at passive treatment technology have failed to perform over the long term is the lack of a maintenance programme," Dr Heath points out.

THE PILOT PLANT

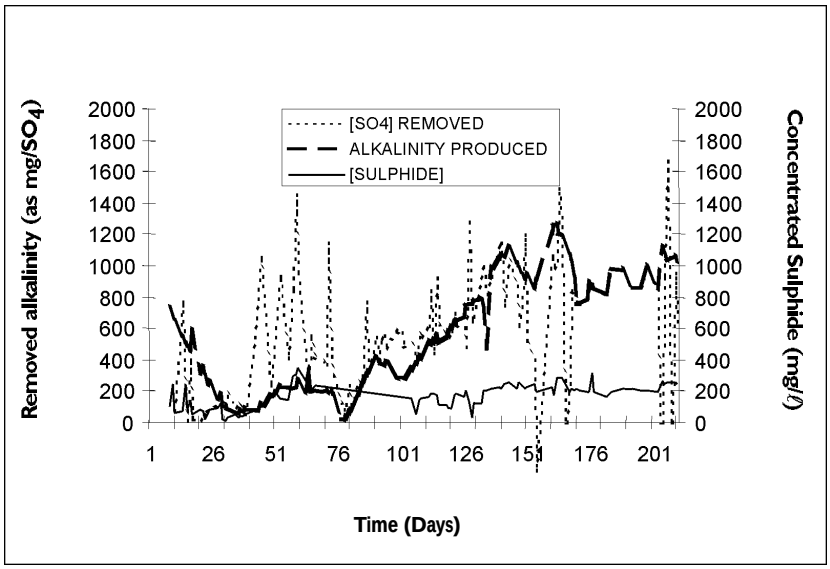
IMPI is now ready to be implemented throughout the mining industry, based on the knowledge gained over seven years from a pilot plant,designed by Pulles Howard & De Lange, at Vryheid Coronation Colliery, with fundamental research funding from the Water Research Commission (WRC), the mining industry and the Department of Arts Culture Science & Technology's Innovation Fund. Dr Heath explains that this plant has been divided into four primary components:

1. Four small sulphate reducing units (SSRUs) arranged in series with additional units intended to remove the sulphides (see Configuration of small sulphate reducing units).
2. Two large sulphate-reducing units (LSRUs) operating in a single step and arranged in parallel (see Configuration of large sulphate reducing units).
3. Six organic substrate testing units (OSTUs) operating at very small scale in parallel.
4. Post treatment units comprising an aerobic wetland and oxidation cascade to address contaminants added or not removed in the sulphate-reducing units.

PERFORMANCE

The performance of IMPI, says Dr Heath, can best be evaluated by studying the effective removal of sulphates, increasing pH and removal of metals (see Typical performance of a DPBR column)."We know that the process is highly effective. Now we just have to refine it, through full scale implementation, to achieve higher rates and more concentrated sulphur," says Dr Heath.

With additional funding from the WRC, the pilot plant at Vryheid Coronation Colliery will continue to operate until March 2004 and the sulphide oxidation process is currently being refined. "The Water Research Commission continues to play an integral role in the development of the IMPI process - without the WRC, we would not have come this far," says Dr Heath.



Typical performance of a degrading packed bed reactor (DPBR) column.

SOUTHERN AFRICA & AFRICA 2003

PESTICIDES
JANUARY 21 - 23

A joint European-Southern African international conference on pesticides in non-target agricultural environments - environmental and economic implications will be held at the University of Cape Town.
Enquiries: Jenny Day.
Tel:(021) 650 3635/6.
Fax:(021) 650 3301. E-mail: pest@botzoo.uct.ac.za Web: http://www.uct.ac.za/depts/zoology/fru/mainindex.html

WATER & POVERTY
JANUARY 21 - 23

An international symposium on water, poverty and productive uses of water at the household level will be held in South Africa.
Enquiries:http://www.irc.nl/themes/management/prodwat/index.html

WATER RESOURCES
JANUARY 22 - 24

The 2nd international symposium on integrated water resources management (IWRM) with the theme - Towards sustainable water utilisation in the 21st century - will be held at the University of Stellenbosch, Western Cape.
Enquiries:Mrs Estelle Hettasch.
Tel:(021) 808 3479.
Cell: 083 226 4639.
Fax:(021) 808 4351.
E-mail: hettasch@sun.ac.za

WATER MANAGEMENT
FEBR UARY 1

A one-day seminar on integrated water management in the city of Cape Town will be held at the University of the Western Cape. Themes covered will include: Water governance, Managing urban water demand, Water and society, Water, value and price, Water, technology and innovation and Water and the environment.
Enquiries: Gail van Rensburg - tel: (021) 487 2430 or fax:(021) 487 2213 or e-mail: gail.van-rensburg@capetown.gov.za

BIOMONITORING
FEBR UARY 10 - 14

A national short course on Aquatic biomonitoring in water resources management will be held at the Continuing Education Centre, Rhodes University, Grahamstown.
Enquiries:Ms Lisl Griffioen, Coastal & Environmental Services,PO Box 934, Grahamstown 6140.
Tel:(046) 622 2364.
Fax: (046) 622 6564.
E-mail:lisl@cesnet.co.za

WATERTREATMENT
MARCH 31 - APRIL 2

The 5th WISA Membrane Technical Division (MTD) workshop will be held at the Vaal River Resorts, Gauteng.
Enquiries:Dr Andre Maartens, PO Box 2264,Evander 2280.
Tel:082 326 3820. E-mail: amaartens@buckman.com

FLOODS
APRIL 2 - 4

A three-day short course on floods and stormwater will be held at the Institute for Water and Environmental Engineering, Department of Civil Engineering, University of Stellenbosch. Topics include: River hydraulics and sediment transport,Flood hydrology, Reservoir sedimentation and channel deformation,Dealing with litter, Stormwater and the environment,Road drainage, Coastal flooding and Information technology applications.
Enquiries: Mrs Estelle Hettasch.
Tel:(021) 808 2100.
Fax:(021) 808 4351.
E-mail:hettasch@sun. ac.za

ENVIRONMENTAL MANAGEMENT
MAY 6 - 8 & OCTOBER 7 - 9

A short course on environmental management will be held at the Post-Graduate Centre of the University of Pretoria.
Enquiries:Ms Marina Nell.
Tel:(012) 420 5010.
Fax: (012) 362 5285.
E-mail:marina.ce@up.ac.za

WASTE MANAGEMENT
MAY 20 - 21

A short course on waste management will be held at the Post-Graduate Centre of the University of Pretoria.
Enquiries:Ms Marina Nell.
Tel: (012) 420 5010.
Fax:(012) 362 5285.
E-mail:marina.ce@up.ac.za

OVERSEAS 2003

GROUND WATER
JANUARY 20 - 23

An international conference on soil and groundwater contamination and cleanup in arid countries will be held in Muscat, Sultanate of Oman.
Enquiries:Dr Anvar Kacimov, Department of Soil & Water Sciences, Sultan Qaboos University, PO Box 34 Al-Khod 123,Oman. Tel:+968 515 223.
Fax:+968 513 418.
E-mail:anvar@squ.edu.om or arkasimov@yahoo.com
Web: www.squ.edu.om

SOIL & GROUND WATER
FEBR UARY 26 - 28

An international workshop on diffuse input of chemicals into soil and groundwater - assess-

ment and management - will be held in Dresden, Germany. Enquiries: Mrs R Kühne, Intercom Conference Service TU Dresden GmbH,Zellescher Weg 3, D-01069 Dresden,Germany. Tel:+49 3 51463 33933. Fax:+49 3 51463 37049. E-mail: rkuehne@intercom-dresden.de Web:www.tu-dresden.de/fgh-higw/workshop/index.htm

WATER & WASTEWATER
MARCH 4 - 6
A conference and exhibition - Water & Wastewater Europe 2003 - will be held in the Acropolis Congress Hall,Nice, France. Over 1 000 products and services will be present on the exhibition floor, including pumps, valves,desalination equipment, water treatment plants,UV disinfection and filtration systems, engineering,drilling,etc. More than 40 papers will be presented at the conference covering desalination, water re-use, water quality, privatisation,finance and legislation.
Enquiries:Ms Charlotte Gliddon-Bush, Conference Co-ordinator. Tel:+44 (0) 1992 656 634. Fax:+44 (0) 1992 656 704. E-mail:charlotteg@pennwell.com

WATER FORUM
MARCH 16 - 23
The 3rd world water forum will take place in Kyoto, Japan. A ministerial conference will be held during the Forum,where ministers will work towards framing and adopting a political declaration concerning global water problems.
Enquiries: Forum Secretariat. Tel: 81-3-5212-1645.E-mail: office@water-forum3.com Website:http://www.worldwater-forum.org

AQUATIC ECOSYSTEMS
MARCH 23 - 27
The 5th international conference on the future of the environment - environmental future of aquatic ecosystems - will be held in Zurich,Switzerland. Delegates will assess threats to the resilience and likely changes in 21 major aquatic systems over the next 25 years.
Enquiries:Christiane Rapin Nussbaumer, Swiss Federal Institute for Environmental Science and Technology. Tel:41-1-823-5336. Fax:41-1-823-5315. E-mail:icef@eawag.ch Website:http://www.icef.eawag.ch/

CORROSION
MARCH 25 - 27
The first IWA international conference on scaling and corrosion in water and wastewater systems will be held at the Cranfield University, United Kingdom.
Enquiries: Conference Secretary, School of Water Sciences, Cranfield University, Cranfield, MK43 OAL,UK. Tel: +44 (0) 1234 754902. Fax:+44 (0) 1234 751671. E-mail:iwa@cranfield.ac.uk

AQUIFER MONITORING
MARCH 30 - APRIL 2
The second international conference on salt water intrusion and coastal aquifer monitoring, modelling and management will be held in Merida, Yucatan,Mexico.
Enquiries:Prof Luis E Marin, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico CP 04510. Tel: +52 555 622 4212. Fax:+52 555 550 2486. E-mail: imarin@tonatiuh.igeofcu.unam.mx Web:www.igeofcu.unam.mx/swica2/

URBAN WATER SUPPLY
APRIL 2 - 4
The 2nd international conference on the efficient use and management of urban water supply will take place in Tenerife, Canary Islands,Spain.
Enquiries: Efficient 2003,Consejo Insular Aguas de Tenerife, C/Leoncio Rodriguez 7, 2 Edificio "El Cabo" 38003 Santa Cruz de Tenerife, Espana. Tel:+34 922 208800. Fax:+34 922 208 863. E-mail: efficientwateruse @iwatenerife 2003.org

HYDROLOGY
APRIL 7 - 10
An international conference on hydrology in the Mediterranean and semi-arid regions will be held in Montpellier, France.
Enquiries:Conference 2003, Laboratoire HydroSciences Montpellier, UMR 5569,BP 5045, 34032, Montpellier Cedex, France. Tel: +33 4 6714 9020. Fax: +33 4 67149010. E-mail: montpellier2003 @msem.univ-montp2.fr Webpage:http://mpl.ird.fr/montpellier2003

WATER RESOURCES
APRIL 7 - 11
An international workshop on integrated water resources management will be held in Denver, Colorado, USA.
Enquiries: US Bureau of Reclamation. Tel:1-303-445-2127. Fax: 1-303-445-6322. E-mail: lprincipe@do.usbr.gov Website: http://www.usbr.gov

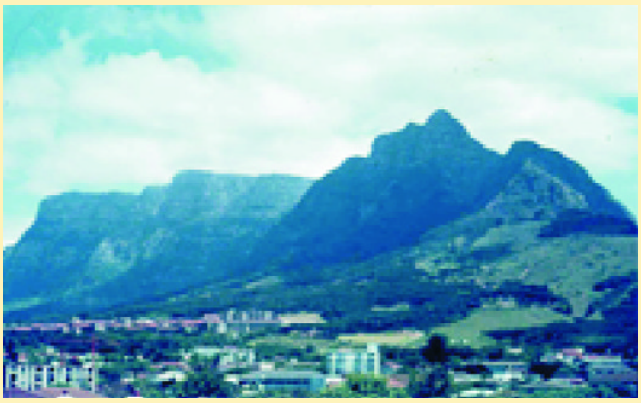
PEDS 2003
APRIL 22 - 25
The first international conference on pumps, electromechanical devices and systems (PEDS) will be held in Valencia, Spain.
Main topics will include: pumps and pumping stations in urban water management,pipe characteristics,materials and installation techniques,leak detection, water audit techniques, pressure surges control and urban water systems operation.
Enquiries: Dr Enrique Cabrera. E-mail: qcabrera@gmf.upv.es Webpage: http://www.iahr.upv.es

Joint European - Southern African international conference

Pesticides in non-target agricultural environments: environmental and economic implications

January 21-23, 2003
University of Cape Town, South Africa

THEME
Both Europe and Africa are experiencing intensified agricultural development and the inevitable environmental pressures that result. At the same time there is a growing need for 'environmentally friendly' products. Good examples are the fruit and wine industries in South Africa, where competition for world markets requires specialisation and diversification of cropping systems but there is also a need to harmonize production systems with the increasing ecological demands of consumers. It is thus anticipated that ecotoxicological assessments and risk mitigation strategies leading to environmentally acceptable methods of crop production will become increasingly important.



THE MAIN OBJECTIVE of this conference is to bring together scientists, agriculturalists and representatives of government and industry to discuss the various issues, including methods for assessing the effects of exposure to agricultural pesticides, strategies for risk management, and the economic implications of pesticides in non-target terrestrial and aquatic environments. The situation in southern Africa as a developing region will be of particular interest but delegates from elsewhere in the developing and the developed world are encouraged to participate.

The conference is to be structured according to the following main topics:

- pesticide exposure: monitoring and predictive approaches
- ecotoxicological effects at different scales: terrestrial and aquatic individuals, populations and communities, biomarkers, modeling
- risk assessment: policies, risk management and mitigation, probabilistic approaches
- economic implications: links between production processes and consumer needs, resource economics, socio-economic aspects and certification systems

Invited speakers from academia, governmental organisations and industry will cover the different topics in a series of keynote lectures.

CONTACT DETAILS

Local organisers of the conference may be contacted at:
E-mail:pest@botzoo.uct.ac.za • Fax:+27 21 650 3301
or telephone: Jenny Day (Cape Town, South Africa):
Tel: +27 21 650 3635/6 • http://www.uct.ac.za/depts/zoology/fru/mainindex.html
Ralf Schulz (Braunschweig, Germany):
Tel: +49 531 391 3184 • Fax: +49 531 391 821 • R.Schulz@tu-bs.de, • http://www.tu-bs.de/~raschulz

WATER & DRAINAGE
APRIL 28 - 30
This conference and exhibition which addresses the water supply, wastewater and drainage industry will be held in the Putra World Trade Centre, Kuala Lumpur, Malaysia.The theme is "Managing our Resources - the changing value of water".
Enquiries: Water & Drainage 2003 Secretariat. E-mail:melissa@protemp.com.my Website: http://www.water-drainage.com/

RIVER BASINS
APRIL 28 - 30
The 2nd international conference on river basin management will be held in Las Palmas, Gran Canaria,Spain.
Enquiries: Stacey Hobbs.E-mail: shobbs@wessex.ac.uk
Website: http://www.wessex.ac.uk/conferences/2003/

GROUND WATER
MAY 2003
The third international symposium on water resources in karst and hard formations will be held in Esfahan,Iran.
Enquiries:Dr A Afrasiabian, Director of National Karst Study and Research Centre, PO Box 15875-3584, Teheran,I.R.Iran.
Tel: +98 21 7520474.
Fax: +98 21 7533186.E-mail: karstsympo2003@yahoo.com

IRRIGATION
MAY 12 - 15
The 2nd international conference on irrigation and drainage will take place in Phoenix,Arizona, USA.Theme:"Water for a sustainable world - limited supplies and expanding demand.
Enquiries:Larry Stephens.
Tel:303 628 5430.
Fax: 303 628 5431.
E-mail:stephens@uscid.org

AQUACULTURE
MAY 19 - 23
The annual meeting of the world aquaculture society - Aquaculture 2003 - will be held at the Bahia Convention Centre in Salvador, Brazil.Theme -" Realising the potential:Responsible aquaculture for a secure future".
Enquiries:Conference Manager. 2423 Fallbrook Place, Escondido, CA 92027,USA. Tel:+1 760 432 4270. Fax:+1760 432 4275.
E-mail: worldaqua@aol.com

AQUIFERS
MAY 28 -30
The first international workshop on aquifer vulnerability and risk will be held in Salamanca,Gto Mexico. The aim will be to develop a multidisciplinary network forum for groups working with aquifer vulnerability and risk assessment methodologies.
Enquiries: Dr Ramiro Rodriguez.
E-mail: rrdz@tonatiuh.igeofcu.unam.mx
Web:http://www.igeofcu.unam.mx/avr03 or http://www.cotascerca.com/avr03

FOREST WASTEWATERS
JUNE 2 - 4
The 7th international symposium on forest wastewaters will be held in Seattle, USA.
Enquiries:Ms Sirpa Sandelin, Satakunta Polytechnic, Centre for Adult & Continuing Education, Tekniikantie 2,FI-28600 Pori, Finland. Tel: +358 5050 20130.Fax: +358 26203 105. E-mail:sirpa.sandelin@tp.spt.fi

AWWA 2003
JUNE 15 - 19
The American Water Works Association will hold its annual conference and exhibition in Anaheim, California.Membership in AWWA is not a requirement for presentation.
Enquiries: AWWA, 6666 W. Quincy Ave., Denver, CO 80235.
Tel:303 794 7711.
Fax:303 794 3951.
Web:http://www.awwa.org

WATER POLLUTION
JUNE 18 - 20
The 7th international conference on modelling, monitoring and prediction of water pollution will be held in Cadiz, Spain.
Enquiries: Rachel Green, Conference Secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southhampton, SO40 7AA. Tel: 44 (0) 238 029 3223. Fax:44 (0) 238 029 2853.
E-mail: rgreen@wessex.ac.uk

WASTEWATER
JUNE 23 - 25
An international conference on wastewater sludge as a resource will be held in Trondheim, Norway.
Enquiries:Prof Hallvard Odegaard, Dept of Hydraulic and Environmental Engineering, N-7034 Trondheim,NTNU. E-mail: hallvard.odegaard@bygg.ntnu.no
Tel:+47 73 594759.
Fax:+47 73 590 544.

WATERSHED MANAGEMENT
JUNE 29 - JULY 3
An international conference on Watershed management for water supply systems will be held by the American Water Resources Association (AWRA) in New York City, New York, USA. Topics will be from the fields of science and technology, policy and management and education and outreach.
Enquiries: Peter E Black, Organising Chair, SUNY College of Environmental Science and Forestry, Syracuse, NY 13210 USA. Tel:1(315) 470 6571.
E-mail: pebchair@esf.edu (or bestweb.net)

ROCK DRAINAGE
JULY 12 - 18
The 6th international conference on acid rock drainage (6th ICARD) with the theme "Application and Sustainability of Technologies" will be held in

Cairns, North Queensland, Australia.
Enquiries: Ms Miriam Way, Events Manager, The AusIMM, PO Box 660, Carlton South VIC 3053 Australia.
Tel:61 3 9662 3166.
Fax: 61 3 9662 3662.
E-mail: miriam@ausimm.com.au

BASIN MANAGEMENT
AUGUST 17 - 22
The 7th international conference on diffuse pollution and basin management will be held in Dublin, Ireland.
Enquiries:IWA Conference Secretariat, Centre for Water Resources Research, Civil Engineering Department, University College Dublin, Earlsfort Terrace, Dublin 2, Ireland. Tel:00 353 1 7167 499. Fax:00 353 1 7167399.
E-mail: dipcon@ucd.ie Web: www.ucd.ie/~dipcon/dipcon.htm

BIOFILM SYSTEMS
SEPTEMBER 2003
The 5th international conference on biofilm systems will be held in Noordwijkerhout,the Netherlands.
Enquiries:Mark van Loosdrecht, TU-Delft, Julianalaan 67,2628 BC Delft, the Netherlands.
Tel:+31 15278 1618.
Fax: +31 152 78 2355.
E-mail: m.c.m.vanloosdrecht @tnw.tudelft.nl

WASTEWATER PLANTS
SEPTEMBER 1 - 4
The 9th conference on the design, operation and costs of large wastewater treatment plants will take place in Prague, Czech Republic.
Enquiries:Prof Dr Jiri Wanner, Dept of Water Technology and Environmental Engineering, Prague Institute of Chemical Technology, Technicka 5,CZ-166 28 Praha 6,Czech Republic. Tel: +420 2243 53149.E-mail: jiri.wanner@vscht.cz

IRRIGATION
SEPTEMBER 1 - 5
The 4th international symposium on irrigation of horticulture crops will be held in Davis, California,USA.
Enquiries:Conference & Event Services,One Shields Avenue, Davis, CA 95616, USA.Fax:(530) 752 5791.Webpage: http://www.cevs.ucdavis.edu

DRAINAGE
SEPTEMBER 10 -13
The 9th international drainage workshop - drainage for a secure environment and food supply - will be held in Utrecht, the Netherlands.
Enquiries:Alterra-ILRI,PO Box 47, 6700 AA Wageningen, the Netherlands. Tel:+31 317 495 549. Fax:+31 317 495 590.
E-mail: drainage2003@ilri.agro.nl or ilri@ilri.nl

ODOUR CONTROL
SEPTEMBER 14 - 17
The second IWA international conference on the development of odour measurement, regulation and control techniques will be held in Singapore.
Enquiries:Ms Tan Kim Suan, Corporate Communications Manager, Institute of Environmental Science & Engineering Innovation Centre (NTU),Block 2,Unit 237, 18 Nanyang Drive, Singapore 637723. Tel:+65 6794 1533/1534. Fax:+65 67921291. E-mail: KSTAN@ntu.edu.sg or KSTAN@iese.ntu.edu.sg Web: www.eti.org.sg or www.iese.ntu.edu.sg

ICID
SEPTEMBER 14 - 19
The 54th IEC meeting and 20th ICID regional conference on irrigation and drainage will be held in Montpellier, France.
Enquiries: Mr Francois Lacroix, AFEID, Parc de Tourvoie, 92160 Antony, France. Tel:+33 01 40 966197. Fax:+33 01 40 966196.
E-mail:francois.lacroix@cemagref.fr
Web:http://afeid.montpellier.cemagref.fr/cei2003.htm

FRACTURED ROCKS
SEPTEMBER 15 - 19
A conference on groundwater in fractured rocks will be held in Prague, Czech Republic. The conference is organised by the IAH Working Group on hard rock hydrogeology.
Enquiries:Jiri Krasny. E-mail: krasny@natur.cuni.cz
Web: http://www.natur.cuni.cz/gwfr2003

GROUND WATER
SEPTEMBER 17 - 19
The international groundwater modelling centre (IGMC) will present a short course - MODFLOW and More 2003: Understanding through Modelling - in Golden,Colorado, USA.
Enquiries:IGMC - tel: +1 303 273 3103.Fax:+1 303 384 2037.
E-mail:igwmc@mines.edu

WATER RESOURCES
OCTOBER 5 - 9
The 11th world congress on water resources - water resources management in the 21st century will be held in Madrid, Spain.
Enquiries:E-mail:wwater2003@cedex.es Web:www.cedex.es/iwracongress2003/

WASTE MANAGEMENT
OCTOBER 6-10
The 9th international waste management and landfill symposium will be held in Cagliari,Sardinia, Italy.
Enquiries:Professor R Cossu, Image Department, University of Padua,Via Loredan 20,35131 Padova,Italy.
Tel:+39 049 8726986.
Fax:+39 049 8726987. E-mail: eurowaste@tin.it or info@sardiniasymposium.it

Call for registration!

INTERNATIONAL COMMISSION FOR WATER RESOURCE SYSTEMS

OF THE INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES

2ND INTERNATIONAL SYMPOSIUM ON INTEGRATED WATER RESOURCES MANAGEMENT (IWRM): Towards Sustainable Water Utilisation in the 21st Century

Wednesday, 22 to Friday 24 January 2003

University of Stellenbosch, Western Cape, South Africa

SYMPOSIUM OBJECTIVES

- To promote understanding of the inter-connectedness of the physical and biotic components of water resource systems
- To report on decision support systems and model applications in support of all aspects of IWRM
- To explore the roles that statutory, legal, institutional and administrative measures and processes may play in the implementation of IWRM
- To contribute to the search for a balance between the ecological protection of water resources and the social and economic contexts of water requirements
- To review the prediction of hydrological extremes - floods and droughts - and to explore their impacts on human communities
- To promote understanding of the impacts of large-scale land-use, system operating rules and climate change on the water quality and the assurance of supply of water resource systems.

NB: The Proceedings of the Symposium will be post-published as part of the IAHS "Red-Book" series.

ENQUIRIES

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NB: This announcement, as well as information about the University of Stellenbosch, is available on the following web-site: http://www.civeng.sun.ac.za