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DRINKING WATER TREATMENT
Water stabilisation breakthrough by SA researchers

GROUNDWATER

Evaluation guidelines for rural water supply and groundwater published

HYDROLOGY
WRC Report on reservoir sedimentation published

00020051



University of the Free State Institute for Groundwater Studies

presents



Applied Groundwater Modelling using Processing Modflow

27-30 September 1999

Applications of MODFLOW, a modular three-dimensional finite-difference groundwater model of the US Geological Survey to describe and predict the behaviour of groundwater systems, have increased significantly over the last few years.

Since the publication of MODFLOW various codes have been developed. Examples of these codes are the advective transport (particle tracking) models PMPATH for Windows and MODPATH, the solute transport models MT3D, MT3DMS and MOC3D, and the parameter estimation programs PEST and UCODE. These models require complex data structure, several

graphical software have been developed to facilitate the use of these codes.

Processing Modflow for Windows (PMWIN) is one of the most complete groundwater simulation systems in the world. PMWIN provides full support to all of the above codes. The totally integrated graphical user-interface provides sophisticated modelling tools, such as zone-wise data input or data interpolation, and includes tools for presenting results in static pictures with labelled contours or by means of animation of flow lines, head changes and contamination plumes.

Course Contents

The four-day course presented by the Institute of Groundwater Studies aims to provide theoretical background and hands-on exercises with PMWIN, PMPATH for Windows, MODFLOW, UCODE and MT3DMS. The lectures and computer sessions will focus on basic modelling concepts, definition of boundary conditions, data interpolation, parameter specification, automatic calibration, evacuation of pumping test data, calculation of path lines, delineation of three-dimensional well capture zones and simulation of geotechnical measures, such as cut-off walls or funnel-and-gate.

The first day of the course will introduce the basic knowledge of numerical groundwater modelling using the finite difference model MODFLOW. The modules of MODFLOW and the use of PMWIN and PMPATH for Windows will be explained with hands-on-exercises. The second and third days of the course will focus on a series of exercises where each team (of two participants) will solve problems of different topics. On the last day, each team will solve a real groundwater flow problem, starting with site-map, evaluation of pumping test data and ending with the animation of contaminant plume development.

Lecturers

Professors Wen-Hsing Chiang and Gerrit van Tonder will present the course.



The course fee is R3 600 (excluding VAT) for the four days (inclusive of refreshments). Please note: Registration does not include accommodation. However, a list of local hotels will be provided with the registration details.



Department of Computer Science at the University of the Free State, Bloemfontein, South Africa.



For further information and registration please contact:

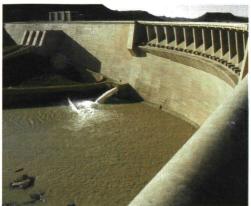
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Cover: Groundwater is an important source of water in rural areas. (Photo: Helene Joubert)

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INTERDESIGN '99 focus on WATER

group of designers, water specialists and other experts from South Africa and overseas recently gathered in Pretoria under the auspices of Interdesign '99 Water for a two week workshop. The aim of the workshop was to address the water collection and storage problems of users in arid regions, through innovative designs which would be applicable both in South Africa and in other arid regions of the world. According to Adrienne Viljoen of the Institute at the Interdesign '99 Water brought the skills, knowledge and experience of designers, water experts and other specialists together in an interactive and co-operative problem-solving effort.

The group in Pretoria was one of three Interdesign '99 groups which gathered simultaneously in South Africa, Mexico and Australia, with the challenge to put forward creative concepts and innovative products as well as projects which would benefit the grassroots water users in arid regions.

The three trans-continental groups were able to interact and keep track of developments daily by means of continuous electronic links. The continental groups were divided into five smaller focus groups, so that each small group could focus on a specific subject. Interdesign focussed in particular on the problems of the users and the supply of water, as this had been identified as a definite need of developing communities in both urban and rural areas, requiring innovative products for water transportation, clean catchment of rainwater, domestic water conservation, prepaid water and supply, water points of sale, unbreakable waterpumps, water conservation taps, etc. The Interdesign workshop started with explorative visits to developing communities and sites to see and hear interactively what the real life situation is. The communities eagerly participated, talking about their water-related problems and needs.

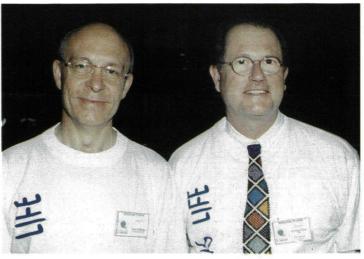
CONCEPTS AND IDEAS

One of the focus groups addressed problems encountered in the harvesting of rainwater and accessories required to reduce water consumption. A system was devised whereby rainwater is collected from the roof of a house using a flexible gutter system and stored in a high volume sand dam, lined with plastic, under the house. The water is pumped up to a pressure tank when required. An additional water bag carrying system is used to complement the water supply while jobs could be created within the community in the production of both the bags and the system's pump. An efficient system for the transportation and payment of water was conceived through the construction of large moulded carriers that could be filled with water, joined together and then pulled along and sold to households in rural and peri-urban areas, creating local employment both in the manufacture of the carriers and in their eventual distrib-

Another focus group concentrated on improving products and systems used in peri-urban households and communities. Their storage concept collects and stores water in a tank for reticulation through the home, with a 'grey' water collection system situated at a lower level for garden irrigation purposes.

The question of how to explain the difference in cost between various water systems to unsophisticated people in rural areas was overcome by the development of a communication kit with drawings of different components within each system depicted on cards. By linking each piece together it is easy to see that one system has more components than the other and consequently more





Water expert Dr Gerhard Offringa (Water Research Commission) and designer Gianfranco Zaccia (Design Continuum Inc., USA) attended the Interdesign '99 Water workshop.



Sanitation focus group leader, Dan Buchner (Design and Innovation, Moen Corporation, Canada) was part of the team of international designers who participated in Interdesign '99 Water.

benefits but a higher cost.

The distribution, transportation and storage of water in 25 litre dedicated containers which are filled from the stand tap, loaded onto a donkey cart and delivered direct to households is the basis of a profitable small business idea. The production of the containers, a water token-used as a means of pre-payment and a special hygienic stand pipe would also profit the local community.

The sanitation focus group's main consideration was the need for latrines to be upgraded and made more user friendly if

they are to be accepted by the 21 million South Africans who do not have access to sanitation. Concepts included mother and child units constructed on moulded platforms with seat designs that draw the air down for better ventilation, and an easy-to-make water dispenser for washing hands.

SCRATCHING THE SURFACE

Initiated and sponsored by the SABS Design Institute, the Interdesign '99 Water represented two weeks of intensive exploration of regional and globally important issues by nominated accom-

plished international designers, experienced local designers, design students, and community representatives who were quick to learn that a community's acceptance of a product was absolutely vital to its success.

Under normal circumstances at least two years is required to analyse, conceptualise, develop, implement and test a new product or concept. The two week effort really only scratched the surface for ideas which, with more investigation and adaptation, would enhance the quality of life for people who live in water-scarce regions.

WATER RESEARCH FUND SOUTHERN AFRICA

Addressing sustainable utilisation of water resources in Southern Africa

Water Research Fund has been established to support research projects addressing sustainable utilisation of water resources in the Southern African region. The purpose of the Fund is to build research capacity among regional institutions and individuals, as well as to promote the utilisation of research results in the planning and management of water resources in the sub-region. This is in appreciation of the fact that research activities in the water sector in most countries of the Southern African Development Community (SADC) are limitlargely due to lack of capacity to develop and carry out sound research projects as well as funding constraints.

The Research Fund is managed by the Institute of Water and Sanitation Development (IWSD), in Harare, Zimbabwe, with initial funding from the Swedish International Development Agency (SIDA).

FUND AIMS

Development objective:

to contribute to the sustainable development and management of water resources in the SADC region in order to ensure the availability of water required for social and economic development.

Immediate objectives:

- to promote and facilitate the implementation of multi-disciplinary research projects in integrated water resources management in the
- to promote the utilisation of research results for decision making aimed at ensuring sustainable development of water resources in

CALL FOR RESEARCH PROPOSALS

Research proposals are hereby invited from the Southern African Development the Southern African Development
Community (SADC) nationals and residents
for possible research grants from the Water
Research Fund. Research projects can fall to
any of the following priority research areas
addressing Integrated Water Resources
Management (IWRM):

- Water use, conservation and technologies

 Sustainable management of water
 - resources using an integrated approach.
 - . Vater demand management. Vastewater reuse.

 - Micro-catchment management practices.
 - Land use practices and their influence on water resources
 - Systems approach in IWRM.
- □ Social, political and economic issues
 - Social and economic influences of water on community development.

- Cost recovery and willingness to pay. Environmental sanitation.
- Water allocation and reallocation strategies at micro- and macro-river
- Gender issues related to IWRM.
- Water and politics.
- □ Policy and legal issues
 - Water and security (in a conflict related perspective on a local, regional and international level).
 - Management of shared water courses.
 - Institutions and their role in IWRM.
 - Legal framework for transboundary water.
 - Water harnessing and release policies and their influence on river systems (river morphology, sediment transport and other ecosystems).
 - Interbasin transfers

Funds and Deadlines Maximum allocation per project will be US \$50 000. Allocation of funds will be done in March and October of each year. Applications for consideration during October should be submitted to the IWSD by 30 July of each year, while 20 December is the deadline for submission of proposals to be considered in March.

Eligibility for grants

The research grants will be available to researchers and/or research teams who are attached to recognised institutions Preference will be given to applicants from SADC nationals and residents, but North-South collaboration will be encouraged. Research projects must originate from a SADC country.

Selection criteria

In reviewing projects, the relevance, quality of proposals and feasibility will be assessed. Projects which address capacity building and implementation of results will be given

FUND MANAGEMENT AGENCY

The Research Fund is managed by the Institute of Water and Sanitation Development (IWSD), Harare, Zimbabwe, a Non Government Organization (NGO) working to build capacity within the water and sanitation sector in Zimbabwe and Southern Africa through research, training, information and consultancy activities.

RESEARCH BOARD

Decisions about allocation of funds to projects are made after a rigorous review process. Project proposals will be sent to at least two referees for comments. If the project receives a satisfactory review it is placed before the Research Board for a decision on funding. The Research Board is made up of respected regional and intern tional researchers who control the operation of the Water Research Fund and to whom the management agency is accountable

APPLICATIONS / SUBMISSION OF PROPOSALS

Applicants should contact the Institute of Water and Sanitation Development (IWSD) for application forms and details on application procedures. Information on the Fund will be soon available on the Web site of IWSD and Africa water page.

Applicants are requested to consult the detailed application guidelines before making submissions. Project proposals should include the following:

- Summary Introduction Literature review Rationale

- Study design
- Outputs
- **Assumptions**
- **Activities** Indicators & means of verification
- Anticipated use of outputs in integrated

water resources management

- Budget justification Project justification Project implementation methods
- Workplan/timetable

The proposal should not exceed 20 pages (font 12, single spacing). An application form and a CV page summarising the research achievements of each member of the research team should be attached to the proposal.

Applications should be sent to:

The Research Board • Institute of Water and Sanitation Development (IWSD) • P 0 Box MP 422 • Mount Pleasant • Harare • Zimbabwe Tel: (263-4) 735017/26/35 • Fax: (263-4) 738120 • E-mail: jndamba@iwsd.icon.co.zw

Filter performance predicted from sludge data

iltration is widely applied in the water industry for the clarification of suspensions, the concentration of suspensions and the dewatering of sludges. In most instances the cakes formed are compressible, that is, it undergoes changes to its structure and properties during the filtration process. This can significantly affect the performance of the filter as well as introduce seemingly spurious system behaviours. It is therefore necessary for workers in the filtration field to have a knowledge of the mechanisms that determine cake compression and the effects that compressible cakes have on systems. This is said by a researcher of the Pollution Research Group, Department of Chemical Engineering at the University of Natal, in a report released by the Water Research Commission on the filtration of compressible cakes.

The researcher, VL Pillay, says the design and optimisation of filtration systems would be significantly improved if the performance of the filter under different operating conditions and configurations could be predicted. This would be possible if the compressibility characteristics of the cake could be quantified and applied in appropriate filtration equations. The prediction of filter performance from sludge characteristics would also greatly assist in determining the effectiveness of sludge conditioners and coagulant aids, prior to implementing them in an operating plant.

The aim of this study was to acquaint workers in the water field with the effects associated with compressible cakes and to identify and develop methodology that would enable workers to characterise compressible cakes and predict the performance of large scale filters from laboratory tests and the basic filtration equations.

RESULTS

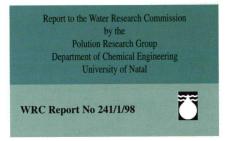
According to the report the major cause of cake compression in filters is hydraulic compression, where fluid frictional forces cause particles to irreversibly infiltrate existing void spaces, leading to a more densely packed cake of reduced voidage and permeability. As a result of

hydraulic compression, solids compressive pressure, permeability and voidage profiles are established through the cake. Further, the resistance of the cake layers to fracture by axial shear forces also varies along the thickness of the cake. A major feature of hydraulic compression is that it is irreversible - once a layer in a cake is exposed to a higher pressure it maintains the consolidation appropriate to that pressure even if the pressure is subsequently lowered.



Research on the Filtration of Compressible Cakes

VL Pillay



The hydraulic compression of the cake has various effects on the cake properties and the filter performance. These include the skin effect, where most of the resistance of the cake becomes confined to a thin skin adjacent to the filtration medium, an insensitivity to operating variables, and a sensitivity to the operating path taken to reach the operating point. This last aspect is of special significance in the control of filtration systems, since the filter "remembers" the worst conditions that it was exposed to and performs accordingly irrespective of subsequent operational changes to improve it. This dependence of the filter's performance on the operational path is due to the irreversibility of hydraulic compression.

Methods to characterise the compression-permeability-voidage (CPV) relationships for a cake have been investi-

gated. The theory, apparatus and experimental procedure for three characterisation tests are presented in the report, namely, the compression-permeability cell, the settling test and the centrifuge test. The tests were also performed on a waterworks clarifier sludge to determine their applicability and ease of implementation. All tests yielded results with meaningful trends. The results for the centrifuge tests were somewhat inconsistent with those of the compression-permeability cell and the settling tests, calling the validity of that method into question. The repeatability of the settling test was good, but there was some scatter in the results obtained in the compression-permeability tests.

The basic equations for planar, internal cylindrical and external cylindrical filtration are presented together with a solution algorithm. The equations for the internal cylindrical filtration of compressible cakes were not previously reported in the literature and were developed during the course of this project. The compression-permeability-voidage data for the waterworks clarifier sludge was used to predict the performance of a planar filter and an internal cylindrical filter. These predictions were compared to results experimentally obtained on a planar filter and the tubular filter press. A very good correlation was found between predicted and experimental filtrate fluxes and average cake solids contents. The predicted values are closer to the experimental values when only the CPV data from the compression-permeability cell and the settling tests are used, excluding the data from the centrifuge tests.

Overall, the study indicated that a good prediction of filter performance may be obtained from employing sludge characterisation data in the appropriate filtration equations.

Copies of the report entitled **Research** on the filtration of compressible cakes (WRC Report 241/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, via surface mail).

Evaluation Guidelines focus on rural water supply and groundwater

Countless examples of inappropriate rural water supply schemes are the results of planners having failed to take all the contributing factors into account. Schemes are planned which simply will not work, or schemes are implemented without a knowledge of how they will be managed, and boreholes are equipped with inappropriate pumps because the groundwater resources were not quantified correctly.

The Water Research Commission has published a report entitled **Guidelines for the Evaluation of Water Resources for Rural Development with an Emphasis on Groundwater**. The report aims to identify key issues which influence the sustainability of a water supply system in order to develop a systematic, holistic approach towards planning and assessing water sup-

ply options. It presents a comprehensive set of quantitative guidelines and methodologies to assess key issues and to identify a sustainable water supply option. The guidelines described are designed to assist planners in choosing appropriate rural water supply schemes which fit into the new community water supply policy for South Africa. The researchers K Sami and EC Murray say they hope that these guidelines will serve as the foundation for planning of rural water supply schemes in the rest of southern Africa as well.

The report (WRC Report 677/1/89) is available, free of charge, from the Water Research Commission, Box 824, Pretoria 0001. (E-mail: library@ wrc.org.za). Foreign orders: US \$45 per copy, via surface mail.

he provision of sustainable water and sanitation to all is presently a top priority. This is an immense task complicated by hydrological, logistical, economical, sociological as well as political issues. Water supply schemes need to be properly planned and all options considered if hasty decisions resulting in unsustainable systems are to be avoided. Sustainability must be defined not only in hydrological terms but also according to the ability of the community to take responsibility for the long term operation and maintenance of their scheme. Technology choices need to be based on the ability of the recipient community, or local supporting agencies, to maintain the scheme at an affordable cost. This requires that adequate mechanisms are in place for sufficient cost recovery through the payment and collection of tariffs, and that ade-

quate management and technical skills are cultivated at the community or local government level.

Problems in assessing the appropriateness of a rural water supply option/scheme can be ascribed to:

- lack of a systematic approach which takes all factors into account when evaluating a community's water supply options
- □ lack of guidelines on how to evaluate or assess the factors which influence the supply options, and
- ☐ lack of proper quantification of small scale surface and groundwater resources

AIMS

The project aimed to address and provide guidance on the abovementioned

issues by:

- developing guidelines for assessing the water supply alternatives for relatively small scale rural development projects:
- establishing the factors which affect the type of water source and infrastructural system to be developed.
 These factors fall within the categories of water source quantity and quality, demand, infrastructure, economics and management;
- developing guidelines on how to evaluate or assess the factors identified above, and how to address the issues which arise from these factors:
- carrying out the initial development of a "Decision Support System" that presents a methodical, holistic approach to assessing the most suitable water source and infrastructure for rural water supply projects.

RESULTS

A comprehensive process was followed in identifying the major factors associated with the planning of rural water supply schemes. A workshop was held in the early part of the project, followed by a process of wide consultation, to both identify these factors and prepare quantitative guidelines and methodologies to assess them.

GROUNDWATER

Due to an increasing demand to solve rural water supply problems using groundwater, the report focuses strongly on the assessment of groundwater resources and related issues.

Many rural water supply schemes fail due to the over-abstraction of groundwater from a single borehole, this being as a result of inappropriate borehole vield recommendation methods. Therefore considerable emphasis was placed on reviewing existing methods and establishing new methods for recommending borehole abstraction rates in fractured rock aquifers. Both borehole yield and aquifer yield assessment methods were investigated. borehole vield methods based on the analysis of pumping test data, none of the existing methods proved to be reliable, However, the yields obtained using two newly developed methods compared favourably to the established vield of production boreholes. Both of these methods are based on the Cooper-Jacob approximation of the Theis equation.

The aquifer yield assessment methods are based on estimates of recharge to the aquifer, the volume of water held by the aquifer in storage and the rate at which water can pass through the aquifer. A method was developed by the research team based on computer simulations of an aquifer with different hydraulic properties. From these, a formula which describes the relationship between the recharge and the abstractable portion of recharge was developed.

CRITICAL FACTORS

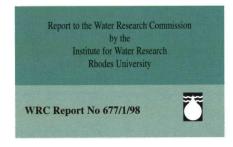
Apart from the very detailed assessment procedures documented in the ground-water section, the report examines economic, social, technical and other hydrological factors which influence the types

of source that can be developed and provides quantitative guidelines on how these factors can be addressed to identify a sustainable water supply option. Furthermore, it identifies obstacles critical to the success or failure of a scheme and assists implementing agents by providing a systematic method of planning sustainable rural water supply. For example, the complex yet vital component of community interaction is examined, listing a recommended process to ensure sustainability and effectiveness. Factors resulting in the failure of rural water supply schemes are also documented.



Guidelines for the Evaluation of Water Resources for Rural Development with an Emphasis on Groundwater

K Sami • EC Murray



SUCCESS KEYS

The key elements in the success and sustainability of a water supply system were identified as:

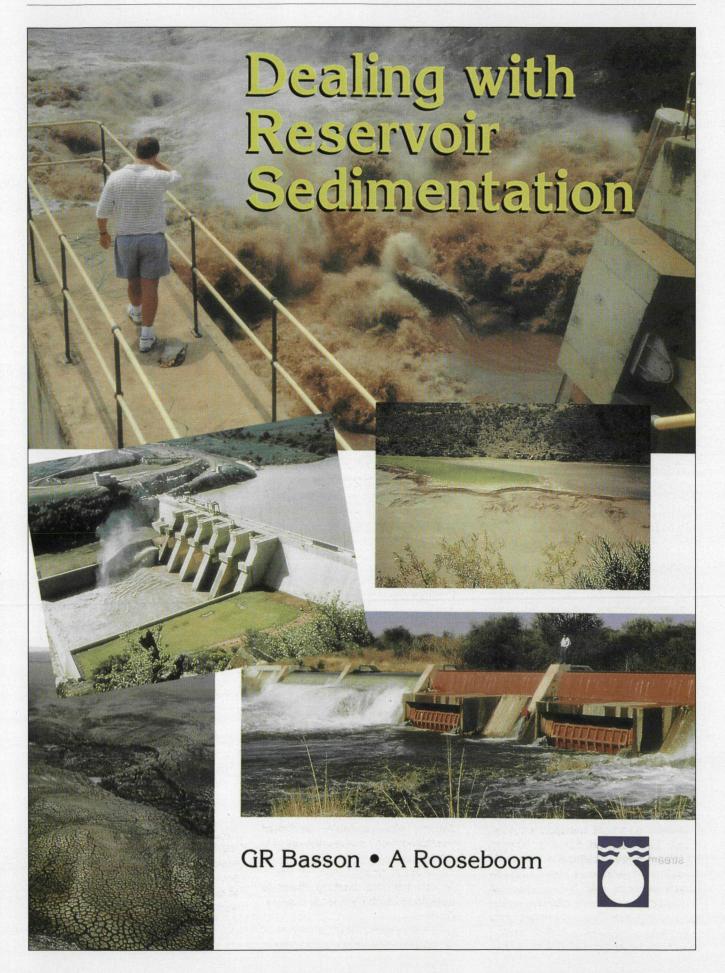
- ☐ The effective involvement of the community in the design, implementation, operation and maintenance and financing of the system so that their needs and wishes are reconciled with system requirements and so that a willingness to pay for the service provided is fostered;
- the provision for full recurrent cost recovery (operation and management as well as replacement costs) so that the system remains sustainable over the long term;
- the selection and development of a source which can meet community requirements in terms of quantity, quality, accessibility and reliability;
- $\ \square$ the selection of technology to match

- the environment and the human, economic and logistic resources available to sustain it;
- the initiation of institutional and human resource development programmes which match the operational requirements of the system.

The issues requiring consideration when planning a rural water supply scheme include:

- benefits to the community, in terms of health, economic and social issues:
- the various role players and their responsibilities: such as community members, water committee, local government, Department of Water Affairs and Forestry, etc;
- community involvement, to ensure amongst others that local leadership is representative and accountable, and that the technology choice is supported by the whole community:
- political issues, including community expectations and to ensure that delivery is in line with national policies;
- legal issues, including those relating to ownership of infrastructure, the Water Law and water rights;
- technical issues, to ensure that both the water source and infrastructure will meet the requirements in terms of quantity, quality and reliability, and that the infrastructure is appropriate to the community;
- training, to build the skills required to manage and operate a water supply scheme;
- local management issues, to ensure that financial accounting and O&M Management takes place effectively at local level;
- logistical issues, to cover the availability of spare parts, etc.;
- economic issues, including implementation costs, O&M costs, replacement costs, affordability, willingness to pay and tariff collection; and
- the setting up of systems for monitoring and evaluation.

The report presents a systematic approach to ensure that planners take into account all the factors affecting rural water supply options. The fact that such a methodology will of necessity require that practitioners become more aware of issues outside their own specific field of expertise, is good reason to build the methodology into a decision support system (DSS). This task is presently being carried out in a follow-on research project.



Reservoir sedimentation investigated

he results of a study focusing on the hydraulics of sediment transport through reservoirs are available from the Water Research Commission in the form of a report titled "Dealing with reservoir sedimentation".

Written by GR Basson and A Rooseboom from the University of Stellenbosch, the report says the study was undertaken to:

- evaluate reservoir sedimentation theory and to make contributions where possible;
- define and evaluate the most important measures to control reservoir sedimentation with the emphasis on engineering methods at the reservoir; and
- evaluate the impact of the implementation of structural or operational measures on reservoir sedimentation at existing and future reservoirs on the long-term viability and sustainable use of reservoirs.

Sedimentation generally limits the life span of reservoirs. The replacement of lost storage capacity is a worldwide problem and the need therefore exists to limit reservoir sedimentation as much as possible. Since sediment transport capacity is the dominant parameter in determining both sediment deposition and re-entrainment patterns, the theoretical analysis of turbulent suspended sediment and density current sediment transport processes has been studied in detail. According to the report the stream power theory provides the basis for accurate descriptions of all the hydraulic processes involved in reservoir sedimentation.

RESULTS

Key theoretical developments and findings from the study are summarised in the report as follows:

□ A new sediment transport equation has been derived, based on applied stream power. Calibration and verification with laboratory, river and reservoir data has also been carried out succesfully. The new total load equation provides the interrelationship between sediment concentration, energy dissipation and bed rough-

- ness in the lower and upper flow regimes. Comparison of the prediction accuracy of the new sediment transport equation with other generally used equations, indicates a high degree of accuracy.
- □ A new bed roughness predictor has been developed, based on the new sediment transport equation.
- □ Non-uniform sediment transportation processes and reservoir sediment deposition patterns were evaluated and found to be important as the sorting process is interrelated with reentrainment, consolidation, cohesion,
- Non-equilibrium sedimentation transport of fine sediment was found to be very important in the accurate description of deposition processes. A new methodology, calibrated with canal and reservoir data, has been developed.
- ☐ The density current velocity, shear stress and suspended sediment distributions are described theoretically in terms of stream power principles. A mathematical expression for the layer thickness of a density current was calibrated with laboratory and field data.
- Sediment transport by means of density currents was verified using Chinese and South African reservoir data
- ☐ The formation of a density current can be predicted in terms of the minimum stream power concept. Verification against laboratory data was successful.
- Density current velocities are described by using a Chezy type equation, which was calibrated with laboratory data.
- ☐ Densities of sediment deposits and consolidation of fine sediments are described by means of a new method as well as by incorporating an effective time approach to predict consolidation with variable sediment yield/deposition or erosion/re-entrainment rates.
- Width-depth relationships for South African reservoir flushing channels were found to be similar to those in China.
- Critical conditions for mass erosion of cohesive sediments can be related to

- shear strength, sediment density and clay content.
- ☐ By combining the theory in an existing mathematical model (MIKE 11), it is possible to model reservoir sedimentation comprehensively. Calibration and verification of the model for flood flushing at the Welbedacht Reservoir were carried out successfully. Long-term sustainable reservoir capacities were also determined for changed reservoir operation rules and modified outlets.
- A database on reservoir sediment transport through a number of South African reservoirs was established. The data were obtained under conditions of flushing, sluicing and storage operation, while density current data were also gathered.
- ☐ Guidelines for sustainable design of reservoirs for long-term sedimentation have been established in the report. Two empirical indices can be used in preliminary judgement to decide on the mode of operation of sedimentation control, namely the capacity-inflow ratio and the capacity-sediment inflow ratio.
- □ According to the report most reservoirs have been designed to accommodate 50 to 100 years' sediment accumulation. Since the capacity-inflow ratio for these reservoirs is greater than 0,2, not enough excess water is available for flushing or sluicing operations. Therefore density current venting is practised and then only in certain cases.
- □ Aspects of reservoir dredging have been investigated, especially with regards to cost. While the report contains a short description of reservoir dredging, a separate document entitled "Dealing with reservoir sedimentation - Dredging", provides comprehensive information.

Copies of the report entitled Dealing with reservoir sedimentation (WRC report TT 91/97) can be ordered from the Water Research Commission's library, PO Box 824, Pretoria 0001. The report is sold for R171-00 in South Africa and US\$70 in countries abroad.

Modelling rainfall over large areas using radar data

ainfall has traditionally been measured by raingauge. These are good instruments for understanding rainfall processes in time at various points, but are poor (even in fairly dense networks) at giving reliable information about the spatial distribution of rainfall in small time intervals. This is because of the great variability of rainfall in space as well as in time. To counter this problem, radar has in the recent past been used, with increasing success, in the measurement of rainfall. Not only does the radar technology give rainfall amounts at any specific location to a high degree of accuracy with fine time-resolution, it also gives an accurate (and to those accustomed to raingauge data, a revolutionary) estimate of the spatial distribution of rainfall over large areas. This is something that raingauges cannot provide, except when they are used to give average values over relatively long intervals of time like months or years.

A recent study, funded by the Water Research Commission, set the stage for forging meaningful links between the rainfall measured by radar and by raingauges. The aim of the study was to build a good stochastic rainfall generator operating both in time and space. It was carried out by a researcher of the Department of Civil Engineering at the University of Natal, GGS Pegram and his co-worker, AW Seed.

The researchers say in their final report to the Water Research Commission (WRC) that they wished firstly to continue the development of a rainday model (devised during an earlier WRC contract) into a more complete model able to preserve the temporally varying rainfall distribution throughout the year. A second aim was to investigate methods to stochastically generate rainfields to fit a random set of point measurements in space. This aim was later modified to the fitting of a spatial model to the images of rainfall measured by radar rather than by networks of raingauges.

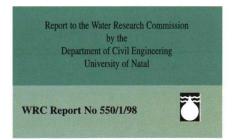
The researchers say it is known that the temporal and spatial distribution of rain-

fall depends on the type of causative weather system. Therefore, before working with the relatively short set of radar data, the set of raingauge data (from between 158 and 330 raingauges) was examined to determine the frequency of the different weather types. As a first step, these were classified as Dry days, Scattered raindays and General raindays. In future work a finer classification might perhaps be used, but for the purposes of this first exploratory model, a three-state classification was thought to be adequate.



The Feasibility of Stochastically Modelling the Spatial and Temporal Distribution of Rainfields

GGS Pegram • AW Seed



The report describes the extension of the model to allow for time-varying parameters using finite Fourier series with a small number of harmonics. The model exploits the same strategy as the earlier one, namely the generation of a sequence of daily weather types. For each weather type, the model randomly selects (with replacement) an appropriate historical day's pattern of rainfalls. Statistical comparisons were made between the average rainfalls over the set of gauges as recorded and as generated and were found to be "close" to each other.

The conclusion drawn is that the daily

weather model is useful as a pilot model for simulation of daily rainfall over a large area (22 500 square kilometres) and will faithfully reproduce the temporal distribution of rainfall at each of the raingauges. The surprise of the modelling procedure was that, unlike the models for individual raingauges, the three-state climate model used in this study is adequately described by a one-day lag Markov chain, and is thus easy to use.

The report introduces the idea of random (fractal) cascades to model rainfall spatially and also temporally. The information that is modelled is the rainfall measured by the radar at Bethlehem in the Free State. The measurements of reflectivity from the precipitation are converted to rainrate over approximate areas of 1 kilometre square on the 200 kilometre square grid centred on the radar, computed at a constant altitude above the radar - typically three kilometres. These constant altitude plan position images (or CAPPIs) are collected every four to five minutes using the MRL5 radar, while rain is falling, giving very detailed information in time and space. Rather than integrate these up to daily totals and model them, it was decided to model the instantaneous CAPPIs taken at four minute intervals, and then, if successful, to aggregate each in the future, to further test the correspondence.

In summary, this report examines the feasibility of usefully modelling rainfall in time and space, provides some partial answers and confirms that some methodologies such as climate modelling of raingauge data and the spatial description of CAPPI images by fractals are not only feasible but practically realisable.

Copies of the report entitled The feasibility of stochastically modelling the spatial and temporal distribution of rainfields (WRC Report 550/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, via surface mail). E-mail order address: library@wrc.org.za

Linking groundwater chemistry to atypical lymphocytes

n the early 1980s the Atomic Energy Corporation sampled groundwater from a number of boreholes in the Pofadder area in the North Western Cape as part of a geological programme. Hydrochemical analyses indicated that certain aquifers contained relatively high concentrations of uranium, arsenic and fluoride as well as elevated levels of radioactivity. As this was not considered to be of any economic significance, no further action was taken.

Meanwhile the departments of Internal Medicine and Community Health of the Faculty of Medicine at the University of Stellenbosch have noted that a number of cases of people suffering from haematological anomalies have been reported from the area around Pofadder. These haematological values differed from the normal ranges to a significant extent.

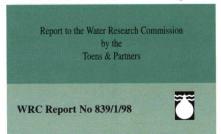
According to Dr B de Villiers, head of the Departement of Community Health at the University, it would be of tremendous medical value if a correlation could be shown to exist between the abnormal haematological values found in Pofadder and the high uranium, chloride, nitrate, sulphate and fluoride levels in some of

and engineering consultants. Funding for the research project was provided by the Community Water Supply and Sanitation programme of the Department of Water Affairs, and Forestry and the Water Research Commission (WRC).



The Association of Groundwater Chemistry and Geology wih Atypical Lymphocytes (as a biological indicator) in the Pofadder area, North Western Cape, South Africa

PD Toens • W Stadler • NJ Wullschleger



research project was thus to develop a GIS based methodology which can be applied to investigations of a similar nature. This methodology would not only be limited to haematological and hydrogeological measurements, but could also be applied to further studies focussing on community health and environmental conditions.

The final report presented to the WRC by Toens & Partners is confined largely to the earth science aspects of the investigation and does not address the significance of the haematological abnormalities.

RESULTS

The hydrochemical analyses indicated that uranium, arsenic and fluoride are present in excessive amounts that could pose potentially severe health risks. Electrical conductivity was included in the final results as a broad indicator of groundwater quality. Other elements such as copper, cobalt and cadmium and the anions nitrate and chloride were included in the original analyses, but do not occur in amounts that are known to pose a significant risk. The correlation matrix (Table 1) displays the results of the

	CORRELATION MATRIX												
LAYER	ARSENIC	URANIUM	ARSENIC & URANIUM	FLUORIDE	ELECTRICAL CONDUCTIVITY	ATYPICAL LYMPHOCYTES							
Arsenic	1.00000	0.30617	0.82138	-0.16880	-0.08021	0.40886							
Uranium	0.30617	1.00000	0.79412	0.20266	-0.13309	0.57309							
Arsenic & Uranium	0.82138	0.79412	1.00000	0.01367	-0.13075	0.60387							
Fluoride	-0.16880	0.20266	0.01367	1.00000	-013038	-0.21590							
Electrical conductivity	-0.08021	-0.13309	-0.13075	-0.13038	1.00000	-0.22674							
Atypical Lymphocytes	0.40886	0.57309	0.60387	-0.21590	-0.22674	1.00000							

the groundwater samples from the area.

To investigate the matter further and try and establish a statistically verifiable correlation between the various hydrogeological parameters and haematological abnormalities found in the area, Dr De Villiers approached Toens & Partners, a company of geological, hydrogeological

GIS

The rapid growth of the Geographic Information Systems (GIS) industry and related analytical and modelling techniques have made it possible to study the relationships among variables in new and accurate ways, even in cases where these variables cannot be spatially referenced to each other. A further focus of the

statistical analyses. In terms of community health the recognition of the results are important, in that it enables the identification of potential areas where long-term residence and utilisation of groundwater could be regarded as undesirable, or alternatively, where the consumption of untreated groundwater should be avoided.

Copies of the report entitled The association of groundwater chemistry and geology wih atypical lymphocytes (as a biological indicator) in the Pofadder area, North Western Cape, South Africa (WRC Report 839/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, via surface mail).

Guidelines developed for toxicity bioassaying of South African drinking water

arious countries are currently applying toxicity tests to assess and control water pollution, because chemical analysis cannot provide all the information to adequately protect people and the environment in the face of the increasing volume and growing complexity of environmental pollutants. Elsewhere in the western world, experience in this field strongly indicates that chemistry (identification of causes) and biology (identification of effects) should join forces to holistically address toxicity hazards.

In South Africa, where industrial effluents and hazardous waste are becoming a growing problem, the demand for biological water toxicity testing is also rapidly increasing, as water quality is currently only being monitored by physical and chemical parameters. This is said in a report published by the Water Research Commission (WRC) on the development of guidelines for toxicity bioassaying of water in South Africa. The report was compiled by a team of researchers from the Division of Water Environment and Forestry Technology at the CSIR, namely, JL Slabbert, J Oosthuizen, EA Venter, E Hill, M du Preez and PJ Pretorius.

According to the report the importance of toxicity as a parameter for the evaluation of water quality has recently been acknowledged by the Department of Water Affairs and Forestry. It is expected that the new approach of the Department will result in an increased use of such tests in the country. To ensure that standardised protocol and procedures will be introduced for use in South Africa it is essential to establish guidelines for toxicity testing. The aim of this research project sponsored by the

WRC therefore was to formulate biotoxicity guidelines which will assist decision makers in their future policies on water quality management.

TESTS

The report says locally available toxicity bioassays were applied to different types of water to evaluate the efficiency and applicability of the tests. Acute toxicity was established by means of the following tests: fish and water flea lethality tests; a protozoan oxygen uptake test; algal and bacterial growth inhibition tests; luciferase, urease and acetylcholinesterase enzyme inhibition tests; and a mammalian cell colony formation test were used for chronic toxicity detection.

Tests were carried out on raw and treated drinking water, ground water and river and dam water. Reference toxicants, e.g. cadmium, pentachlorophenol, carbofuran and malathion (acetylcholinesterase enzyme test only), and sodium selenite and methyl viologen (toad embryo test only) were included in each series of tests. In addition, synthetically prepared moderately hard water and tap water were evaluated as alternative controls

With the exception of the water flea, luciferase and urease tests, all the other acute toxicity tests detected toxicity in one or more of the drinking water samples. In general the effects on the test systems were slight. However, the algal, mammalian cell and toad embryo tests showed high levels of toxicity for a number of samples. Toxicity was detected in both raw and treated water. No specific pattern in the responses and sensitivities of the test systems were observed. The negative results obtained with the

urease and acetylcholinesterase enzyme tests indicated that heavy metals and organophosphate and carbamate pesticides were either absent or present at low concentrations. Mutagenicity was detected in three raw water samples, while none of the samples showed teratogenicity.

All the acute toxicity tests, except the oxygen uptake and luciferase tests, were adversely affected by the groundwater samples. The water flea test proved to be highly sensitive to groundwater, showing adverse activity in 75 per cent of the samples. A large number of samples were also toxic to algae, bacteria and fish. For some of the tests the effects were slight, but a high toxicity was generally observed with the water flea, algal, bacterial and luciferase enzyme tests. Two of the groundwater samples were slightly mutagenic while one of the samples caused teratogenicity. In a few instances three to four of the standard aquatic toxicity tests showed toxicity, indicating some pattern in the responses.

All the bioassays detected toxicity in one or more of the surface water samples. The highest toxicity was obtained with the Illiondale stream, near the Kelvin power station, which exhibited toxic effects on nine of the bioassays. The BGM mammalian cell test showed the highest sensitivity, detecting toxicity in six of the samples. Effects exhibited by the samples ranged from slight to high. The mutagenicity and teratogenicity tests showed positive results on three occasions.

GROUNDWATER

Chemical analyses showed that, in gen-

eral, potentially toxic chemicals in the groundwater and surface water samples were low, and that effects were probably due to a combination of chemicals. Some of the groundwater samples contained low oxygen levels which could have contributed to adverse effects. The Winterveld 2 sample contained a high zinc level which could have caused the toxicity detected by several bioassays. The Illiondale sample contained high levels of zinc, cadmium, iron, manganese and cyanide, as well as an organic compound, ethylenechlorophosphate (a fire retardant), which individually or in combination could have caused the toxicity in test systems. Although chemical data were available it was found that toxic effects could not be explained by simple comparison. The high adverse activity of groundwater was of particular concern. As alternative, chemical equilibrium modelling was used to interpret toxicity results. The findings of this evaluation are presented as Appendix A in the report.

Many of the tests showed enhanced activity when exposed to the water samples. This is usually attributed to the presence of nutrients in the water. It is also possible that the stimulating effects were due to low levels of toxic chemicals. Stimulation in sub-lethal responses such as growth and respiration has been reported when organisms and cellular systems were exposed to low levels of individual toxic chemicals. This phenomenon is known as hormesis. However, extensive research is required to verify that stimulation by water samples which contain complex mixtures of chemicals can be attributed to toxic activity. In the case of the urease test, the high density readings could have been due to precipitation rather than increased activity. Some of the samples caused precipitation in the algal and bacterial growth inhibition tests, which could have interfered with the interpretation of results.

A good reproducibility was found with most of the tests (CV: <10 per cent). The reproducibility was in agreement with the precision of tests used in other countries, or even exceeded it.

The good agreement established between results calculated as percentage effects and by means of Student's ttests indicates that the use of detection limits could be adequate to decide whether or not effects are significant. In a number of instances detection limits

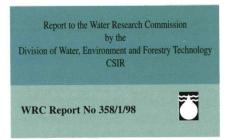
might provide false positive results. However, the possibility that significant effects might not be detected when using this method is limited.

In general, both the acute and chronic tests showed an appropriate response with the reference chemicals, indicating that the tests were successfully applied. Some degree of variation was observed in the sensitivity of the tests, which generally reflected the natural variation in the sensitivity of test organisms. Methyl viologen was found to be more suitable as positive control in the toad embryo teratogenicity test than sodium selenite.



Development of Guidelines for Toxicity Bioassaying of Drinking and Environmental Waters in South Africa

> JL Slabbert • J Oosthuizen • EA Venter • E Hill • M du Preez • PJ Pretorius



CHEMICALS

Reference chemicals are used to establish the validity of toxicity data generated by laboratories. It is recommended in the report that all laboratories involved in toxicity testing should carry out tests with recommended reference chemicals so that inter- and intra-laboratory precision can be monitored.

The evaluation of alternative controls indicated that moderately hard and hard water did not drastically change responses in the majority of tests. However, large variations occurred in some of the tests (algal and urease enzyme tests). The researchers, therefore, recommend the continued use of de-ionized water as control in microbial, enzyme and mammalian cell tests. Tap water showed inhibition in several instances, indicating that this water was unsuitable as control in these tests. The

results obtained with fish and toads showed that moderately hard water was an ideal substitute for tap water as control

Most of the biological tests used in this study are well established. However, in certain cases a need for optimisation was indicated. Most of the changes that were recommended were carried out. Apart from the luciferase test, which was found to be unsuitable for water testing. the algal test still showed a low growth in certain instances. This was mainly due to deficient lighting, erratic subculturing and insufficient nutrients as a result of medium precipitation. Problems were experienced with the reproduction of fish and toads, particularly in winter months. Furthermore, fish were very prone to disease.

In order to solve breeding and disease problems with fish, it is recommended that fish for toxicity testing purposes are bred and supplied from a central facility. satisfactory results Although obtained with guppies, attention should be given to the development of procedures employing indigenous species. According to the report the algal test problems can be rectified by appropriate optimisation. Algal growth was measured at 450 nm instead of at the standard wave lengths of 600 - 650 nm used in the USA and Europe. This wavelength was selected for density determinations because studies conducted during technique development showed that higher and more acceptable readings can be obtained for microplate use. A wavelength of 450 nm is also used in Canada in their miniaturised algal test. Any interferences by organic or other chemicals at this wavelength should be detected in the blanks.

In conclusion, the researchers say this study showed that with the exception of the luciferase enzyme test, all the biological toxicity tests employed have a viable role to play in water quality monitoring and control in the country.

Copies of the report entitled Development of guidelines for toxicity bioassaying of drinking and environmental waters in South Africa (WRC Report 358/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001.(Overseas price: US\$25, via surface mail)

South African water researchers have with their latest technology development produced simple but effective water stabilisation systems utilising limestone to stabilise aggressive and corrosive water. The systems, designed and developed by researchers at CSIR Stellenbosch, which are robust, simple to operate and cost- effective, have been designed for small to medium size users. Following the successful development of these Spraystab, Presstab and Calcostab processes, the researchers designed a novel side-stream stabilisation process (SSP), which is intended for large scale waterworks (city-size volumes) and able to saturate and stabilise the water completely with limestone.

n a report to the Water Research Commission the researchers say that the small rural users systems, Spraystab and Presstab, have proven to be effective and financially attractive water treatment system in a market niche where there are no viable alternatives. The report entitled Stabilisation of Soft Acidic Waters with Limestone by GS Mackintosh, HA de Villiers and GJ du Plessis of Environmentek, CSIR Stellenbosch, and their co-workers RE Loewenthal and U Kornmuller of the University of Cape Town, which documents the aims and results of the initial research, is available from the Water Research Commission (WRC).

The results reported by the researchers for the two small systems developed in the course of the WRC funded project, are significant, says Dr Gerhard Offringa, research manager at



Mr Grant Mackintosh at the SSP laboratory scale pilot plant.

the WRC . The systems, one for ground water stabilisation ("Spraystab") and a similar model for surface waters ("Presstab"), are most suitable for use by all small water users, as no other practical stabilisation systems are currently available for the small user. He says that a few of these cost-effective systems are already in use for borehole water, membrane permeate and soft surface water stabilisation and have drawn favourable comments.

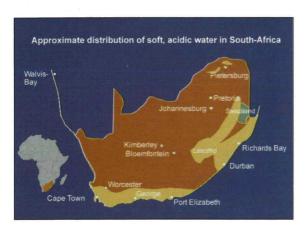
The success achieved with the Spraystab and Presstab systems along with simple operation, robustness, low maintenance and low running costs, provided the incentive for the researchers to investigate the feasibility of replacing conventional water stabilisation at waterworks treating larger volumes of water with limestone mediated stabilisation. However, the last chapter in the WRC project report only touches on the initial research and development of a fluidised limestone bed system.

SA Waterbulletin visited Mr Grant Mackintosh, projects manager of the CSIR Cape Water Programme, and spoke to him about their continued research and innovative designs which produced the Calcostab system and Sidestream Stabilisation Process (SSP).

SOFT, ACIDIC WATERS

Approximately forty percent of the surface waters in South African, and all the surface waters of Lesotho, are soft and acidic, characteristically with low calcium and alkalinity (0-20mg/@as CaCO3), low conductivity (5-50 mS/m) and low pH (4.0-7.0) values. Virtually all of the groundwaters on the southern and eastern fringes of South Africa (up to approximately 200 km inland) have similar characteristics (see map below).

The surface waters rarely have pH values greater than 6,5, while groundwaters (brought to the surface) have pH levels ranging between 4,0 and 6,0. Surface waters of the south western Cape region can have pH as low as 4,0 as a result of the presence of dissolved humic substances. Furthermore, conventional water purification using floc agents such as ferric chloride, ferric sulphate and aluminium sulphate, further depresses pH and total alkalinity prior to release of the purified water into the distribution network.



Map indicating soft, acidic water areas in South Africa.



Corroded valve, showing metal corrosion.

AGGRESSION AND CORROSION

Both surface and groundwaters with these soft and acidic characteristics, are aggressive to cement concrete and corrosive to metals.

Aggressive waters attack the cement matrix by dissolving free lime, calcium carbonate, as well as aluminates and silicates, causing material collapse which results in leakages, bursts and structural failure of cement conduits and structures

Corrosion of metals results from oxidation and reduction reactions which dissolves the metal into the bulkwater solution, and leads to loss of pipe function and conduit failure.

Water conditioning to prevent aggression and/or corrosion can be achieved through stabilisation (chemical conditioning). In areas with soft acidic waters, stabilisation is a prerequisite to prevent aggressive and/or corrosive attack of

conduits, reservoirs and other components of distribution networks.

Failure to achieve effective stabilisation can not be afforded. The cost of reservoir and pipe repairs, as well as the loss of treated water, can be significantly high for water supply authorities. At consumer level corrosive attack can necessitate expensive replacement of pipes and Corrosive geysers. attack of metal conduits and valves can also cause a decrease in water quality as a result of dissolved metal corrosion products in drinking water.

CONVENTIONAL STABILISATION

Conventional stabilisation of soft, acidic waters to prevent aggression and corrosion is attained currently by addition of lime (Ca(OH)₂) and carbon dioxide (CO₂), or simple

pH adjustment by addition of lime. The stabilisation process using lime and carbon dioxide (or simple pH adjustment by addition of lime) is both expensive and difficult to control, requiring on-site expertise which is not available in rural areas and small towns receiving such waters. For example, at Heidelberg, Cape (which has a colour removal, stabilisation and disinfection water treatment plant) more than half of the chemical cost of treating water results from stabilisation. Furthermore, good quality lime is in scarce supply in South Africa and becoming increasingly more expensive.

LIMESTONE STABILISATION

An alternative means of stabilising low pH, calcium and alkalinity deficient waters is by contact with solid calcium carbonate (CaCO₃) generally known as limestone. Limestone contact naturally increases both the alkalinity and carbonate species concentration of water, until the CaCO₃ dissolution potential (CCDP) of the water is naturally satisfied. Treatment in such manner has a number of advantages over the traditional use of powdered lime and carbon dioxide:

- The water treats itself, taking up calcium and alkalinity to satisfy equilibrium requirements
- pH is controlled naturally at desirable upper limits as it approaches two phase equilibrium
- ☐ The process is robust and problemfree, with low supervision and maintenance requirements
- □ Lime dosing equipment is notoriously troublesome, and completely impractical in small scale water treatment plants
- ☐ Limestone is significantly cheaper than lime (approx. R190/t vs R600/t at 1999 prices)
- Complicated dosing of expensive carbon dioxide is not required
- ☐ Chemical cost of stabilisation is greatly reduced

WRC PROJECT RESULTS

The WRC project had the objectives of investigating limestone mediated stabilisation for both small user systems, and medium to large user systems. Two types of small user systems (about 50 m³/day) were designed to treat groundwater and surface waters respectively,

and shown to be effective for the stabilisation of a range of soft, acidic waters. A fluidised bed approach was investigated for the suitability of stabilising water for medium to large users.



The Spraystab unit for small rural users.

Spraystab

The small user groundwater stabilisation unit, called "Spraystab" after the treatment configuration, was found to be highly effective at treating soft, acidic groundwater with no iron or manganese present. It was shown that a limestone bed retention time of about three minutes was sufficient to significantly reduce the calcium carbonate dissolution potential (CCDP), and increase pH, calcium and alkalinity to desirable levels. The Spraystab process was shown also to be effective at treating soft, acidic groundwater with low levels of iron (about 2 mg/ ℓ). In this case, the process was shown to stabilise the water satisfactorily and to remove the dissolved iron with a limestone bed retention time of about five minutes. The system is compact and robust, requiring minimal operator attention and/or maintenance. The Spraystab system has proven itself to be an effective and financially attractive water treatment system in a market niche where there are no viable alternatives available.

Presstab

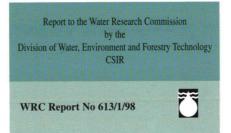
According to the report the small surface water stabilisation unit, called "Presstab", is effective for the stabilisation of a

range of surface waters. Waters tested varied from "white" water, to strongly coloured "brown" water, while dissolved iron levels varied between 0 and 2 mg/R. The process was found to be effective, provided that (i) turbid waters containing suspended matter are filtered prior to stabilisation, and (ii) it is accepted that when treating highly coloured waters there will be a reduction in efficiency owing to the "coating" of the limestone pebbles with time. It was shown that the Presstab process operates effectively at a contact time of around ten minutes for a range of waters. This system, like Spraystab is compact, robust, affordable for the small user, requiring minimal operator attention and/or maintenance.



Stabilisation of Soft Acidic Waters with Limestone

GS Mackintosh • HA de Villiers • GJ du Plessis RE Loewenthl • U Kornmüller



Fluidised bed

The fluidised bed process was investigated using a pilot plant. The investigation found that the fluidised bed system could significantly reduce the CCDP aggressive of Stellenbosch mountain catchment water, almost eliminating aggressiveness, within satisfactorily reduced retention times. However, a cost benefit analysis showed that energy costs involved in the fluidised bed approach were high and negated chemical running cost savings usually associated with limestone stabilisation.

FURTHER RESEARCH

Following the conclusion of the WRC project, and encouraged by the general results of the WRC project, the CSIR researchers continued with other developments of the limestone stabilisation concept for possible application with larger volumes of water. The Calcostab limestone contactor and the Sidestream Stabilisation Process was born out of the continued research and developments.

Calcostab

Mr Grant Mackintosh told SA Waterbulletin that the limestone contactor process which they have developed, is basically a simple fixed bed reactor design in which aggressive water is contacted with limestone pebbles. Whilst the use of limestone in this manner is not novel, it is important to note that other attempts to use limestone for municipal potable water stabilisation have been unsuccessful. The CSIR developed limestone contactor, named Calcostab, is effective as a result of careful consideration regarding critical aspects of reactor design. The Calcostab limestone contactor design comprises a minimum of two identical reactor units, each containing a bed of graded limestone pebbles through which the water percolates in an upward flow direction.

According to Mr Eddie Delport, town engineer of Stellenbosch where the initial pilot plant was installed, it works per-



A full-scale Calcostab unit in use at Stellenbosch.

fectly and is a cost-effective system with low maintenance and operation requirements. Stellenbosch Municipality now utilises three full-scale Calcostab units to stabilise the chlorinated mountain catchment water.

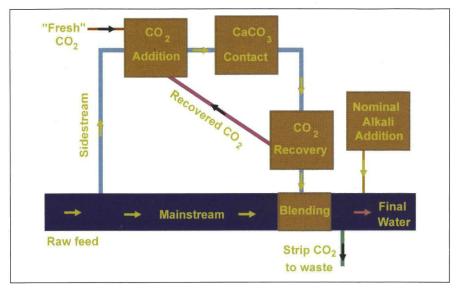
A number of full-scale Calcostab limestone contactors have been installed elsewhere in the Western Cape (at Bredasdorp, Franschoek, Wellington, Porterville, Montagu and Napier). Mr Mackintosh says the installation, operation and assessment of these units has shown that partial stabilisation with limestone contactors has significant benefits over the traditional use of lime and carbon dioxide.

The limestone stabilisation process effectively provides a well buffered, stabilised water, and thereby greatly reduces aggressive attack of concrete and corrosive attack of copper and iron piping. It is an excellent stabilisation system for small municipal water purification works (1M ℓ to 30 M ℓ), with significant savings in running costs.

The Calcostab has also generated interest internationally; in particular as a result of the failure of other attempts to use limestone. Professor Letterman, technical editor of the American Water and Waste-water Associations water treatment handbook and stabilisation expert, has commended the Calcostab process for its simple yet effective approach.



Limestone contactor outlet.



Conceptual diagram of the Sidestream Stabilisation Process (SSP).

THE BIG ONE

The Calcostab system success in turn gave rise to the development of the new Sidestream Stabilisation Process (SSP), which is designed for large scale water purification works. The motivation for developing an alternative process for large scale stabilisation of water was:

- to circumvent problems associated with lime mediated stabilisation, such as the unavailability of high quality (white) lime in South Africa, and the notorious difficulties associated with dry lime dosing equipment and lime saturators; and
- the potential cost savings afforded by this alternative process.

The application of limestone mediated stabilisation has, to date, been limited to smaller users as a result of the large contact tanks required. However, use of limestone for large treatment works is now a viable option through the novel Sidestream Stabilisation Process developed by CSIR researchers.

SSP design/concept

The SSP concept involves taking a side-stream of unstabilised water, dosing it with high levels of gaseous CO_2 and then contacting the CO_2 acidified stream with limestone. The acidified stream takes up considerable amounts of the solid CaCO_3 (limestone), thereby increasing the alkalinity and calcium. Thereafter the CO_2 is stripped and recovered for re-use. The CO_2 stripped

sidestream is then blended with the main waterstream water in the correct proportions to allow for a fully stabilised mainstream. Further adjustment of the CCPP can be achieved with nominal addition of an alkali. CO2 recovery and re-use can be such that the use of "fresh" CO2 in the process would be minimal. Pilot plant findings have indicated similar advantages over the lime process as those described above, and have raised considerable interest both locally, and in the United Kingdom and North America. CSIR has patented the SSP system and entered into a partnership with Technifin, a technical licensing company, to license the technology both locally and internationally.

FURTHER INFORMATION

Please direct all enquiries for more information regarding the Calcostab and SSP limestone stabilisation processes, or the availability of Spraystab and Presstab units, to: Mr Grant Mackintosh, Cape Water Programme, CSIR Stellenbosch. Tel (021) 888-2400, or Fax: (021) 888-2682. E-mail: gmackint@ csir.co.za.

The report entitled **Stabilisation of soft acidic waters** (WRC Report no 613/1/98) which describes the initial research and the Spraystab/Presstab systems, is available free of charge from the Libarian, Water Research Commission, PO Box 824, Pretoria 0001. (Email: library@wrc.org.za) Foreign orders: US \$20 per copy, via surface mail.

Drought Management Conference: Authors and papers

he International Drought Conference organised by SA National Committee of the IHP will be held in Pretoria from 20 - 22 September 1999. (See advertisement on back cover of this Bulletin). The following keynote addresses and papers will be presented at the conference:

Monday, 20 September 1999

- Opening address: Prof Kader Asmal, Minister of Water Affairs and Forestry (South Africa)
- Keynote address: R T Mugwara, SADC Food Security Sector (Zimbabwe)
- □ Keynote address: D Wilhite, International Drought Information Centre (USA)

Theme: Challenges of forecasting for sustainable natural resources management

- □ Keynote address: Integrated drought early warning – the Botswana example – C B Sear, University of Greenwich (UK) and K Campbell
- Warm ENSO event of 1997/98: NDVI precursor and drought pattern prediction for southern Africa A Anyamba, NASA (USA), J Ronald Eastman and C J Tucker
- VegSat a real-time early warning satellite system for drought and flood – D Bannert, BGR (Germany) and W Kruck
- ☐ The effect of higher-latitude sea-surface temperature anomalies on the 1996/97 GCM simulated rainfall and sea-level pressure over South Africa F A Engelbrecht, University of Pretoria (South Africa) and C J de W Rautenbach
- Drought monitoring and forecasting in southern Africa – M R Jury, University of Cape Town (South Africa)
- □ Role of regional climate system monitoring and prediction in drought management B J Garanganga, Drought Monitoring Centre (Zimbabwe)
- ☐ Drought severity assessment model

- (DSAM) an application J M Maina, Drought Monitoring Centre (Kenya)
- ☐ Use of climate information and prediction services in integrated drought management in eastern and central Africa regions – L A Ogallo, University of Nairobi (Kenya)
- □ From global to regional scale: the use of regional case studies to improve global forecast methods for drought management in the Sahel of Burkina Faso – M W Kappas, University of Mannheim (Germany)
- ☐ The four tiers of seasonal prediction at the South African Weather Bureau — W A Landman, SA Weather Bureau (South Africa)
- □ Numerical rainfall predictions for the South African 1998/99 summer season using the CSIRO-9 (R21) AGCM
 − C J De W Rautenbach, University of Pretoria (South Africa)
- □ Improved seasonal weather forecasts for southern Africa – can they make a difference? – C B Sear, University of Greenwich (UK) and M S J Harrison
- Comparison of trend and general circulation model based projections of seasonal and annual rainfall in the east African region F M Mutua, University of Nairobi (Kenya) and J M Maina

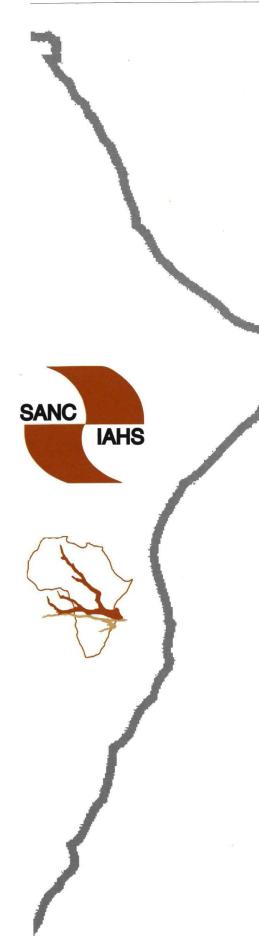
Theme: Climate variability implications for susteinable natural resource management

- □ Keynote address: Title to be advised. M Seely, Desert Research Foundation of Namibia (Namibia)
- □ Methods for identification and monitoring of river flow drought in southern Africa J Meigh, Institute of Hydrology (UK) and Emma Tate
- □ Small scale spatial rain distribution: the effect of temporal and spatial rain distribution on drought and crop yield at village level – E A R Mellaart, Agricultural Research Council (South Africa) and A Langa
- ☐ Assessing vulnerability to drought and possible effects of climate

- change on water resources in a semiarid country – A Mostert, Ministry of Agriculture, Water & Rural Development (Namibia), G van Langenhove and B de Bruine
- ☐ The role of drought in rangeland dynamics: a model and applications J C Venter, Agricultural Research Council (South Africa)
- ☐ Title to be advised. K Day, Queensland Department of Natural Resources (Australia)
- Effects of meterological parameters on Sahelian drought, North Africa – A M Abdelmegeed, South Valley University (Egypt)
- □ Achieving stronger general circulation model El Nino/Southern Oscillation variability – S Wilson, CSIRO (Australia)
- □ Application of standardized principal component analysis to drought temporal and spatial characterization using long time series AVHRR data in support of food security planning in the western Sahel – A K Thiam, University of Arizona (USA)
- Analysis of meteorological droughts in Tanzania – M M KAVISHE, Directorate of Meteorology (Tanzania), B S Nyenzi, I R Nassib and F F Tilya
- Drought and flooding effects on an arid and semi-arid environment in the eastern part of Kenya – S M Kithiia, University of Nairobi (Kenya) and G S Ongwenyi
- Recent climatic trends in northern interior Savannah zone of Ghana – G Kranjac-Berisavljevic, University for Development Studies (Ghana)
- □ Monitoring drought in Australia and Papua New Guinea using reflective and thermal AVHRR data – T R McVicar, CSIRO (Australia), D L B Jupp and P H Bierwirth

Tuesday, 21 September 1999

□ Rainfall cycles, population growth and perceptions of drought: a case study from south east Zimbabwe – P B Moriairty, Institute of Hydrology



(Zimbabwe)

- Pastoral vulnerability to drought in semi-arid parts of Laikipia District, Kenya – J K Musingi, University of Nairobi (Kenya)
- ☐ The partnership between government and the private sector (insurance/reinsurance) in the management of drought B T Chiwota, Munich Re-insurance Co of Africa (South Africa)
- □ Characterisation of meteorological drought in Mozambique – M J Santos, Institute of Water (Portugal) and A G Henriques
- ☐ Food security vulnerability assessment in Zimbabwe P Masanganise, Ministry of Agriculture (Zimbabwe)

Theme: Building drought resilience for the 'at risk': Strategies that reduce vulnerability of fragile ecoystems and communices

- ☐ Keynote address: The human dimensions of drought constraints to sustainable drought management M Glantz, National Center for Atmospheric Research (USA)
- ☐ Integrated catchment management in the Mlazi River catchment: is there really an opportunity to involve local people in optimising natural resource use? — Rautenbach, Ntshongweni Catchment Management Programme (South Africa)
- □ Water harvesting: a means to drought mitigation problems within the Athi River drainage basin, Kenya
 − S M Kithiia, University of Nairobi (Kenya) and G S Ongwenyi
- □ The role of wetlands in drought mitigation N van de Giesen, University of Bonn (Germany), T Steenhuis, P Windmeijer and P L G Vlek
- □ Planning for groundwater drought in Africa – R Calow, British Geological Survey (UK), B Orpen, N Robins and A MacDonald
- □ Productive groundwater development as a means of coping with drought –
 C J Lovell, Institute of Hydrology (Zimbabwe)
- □ Avert impact of drought on some health issues – W S Goma, Meteorological Department (Zambia)
- □ Sustainable planning of desert land reclamation project as related to drought management: an integrated approach – S M El-Zoghby, Desert Research Centre (Egypt)
- Strategies to reduce drought vulnera-

- bility: with special emphasis on coping strategies of the poor: sub-Sahara semi-arid area, western Sudan A H I Elfaig (Malaysia)
- □ Rural periodical markets: their role in drought and food crisis mitigation and early warning systems: case study from northern Kordofan State in Sudan – A S Mustafa, FSKK-UKM (Malaysia)
- □ Title to be advised A Holloway, University of Cape Town (South Africa)
- Critical factors that predispose people and landscape to drought vulnerability and key combatant measures to reduce that vulnerability – R Mwenda, University of Zambia (Zambia)
- □ Integrated drought management in Cape Verde Islands – A A Sabino, PDH-INGRH (Rep of Cape Verde)
- Addressing desertification: combination of traditional methods and new technologies for sustainable development – W Van Cotthem, University of Ghent (Belgium)

Wednesday, 22 September 1999

Theme: Integrating drought considerations into policy: Key principles

- □ Keynote address: Drought considerations into policy: key principles J Kanyangwa-Luma, Household Food Security, Health and Nutrition Information System, FAO (Zambia)
- Policy issues in combating desertification – H M Mushala, University of Swaziland (Swaziland)
- □ Environmental education, drought and the rural man: implications for policy makers and farmers in West Africa – A A Ladele, University of Ghana (Ghana)
- ☐ Speaker and title of paper to be advised Department of Agriculture (South Africa)
- □ Networking of institutions to support efforts in combating desertification in north Africa: possible scope of implementation – A K Hegazy, University of Cairo (Egypt)
- □ Analysis of Zimbabwe's grain loan scheme of 1995 – E Makaudze, University of Zimbabwe (Zimbabwe)
- □ Integrating drought policy, assessment and management D H White, ASIT Consulting (Australia).

Optional workshops on topical issues will be held throughout the conference. Please note that the programme is subject to change.

New reports published by the Water Research Commission

The following reports are available free of charge from the Water Research Commission in Pretoria. To order a copy please contact the Librarian, WRC, PO Box 824, Pretoria 0001. Tel (012) 330-0340. Fax: (012) 331-2565. E-mail address: library@wrc.org.za



Species from Water by Membrane

ExtractionJJ Smit • LR Koekemoer • AM van Wyk

Report to the Water Research Commission by the Department of Chemical Engineering University of Potchefstroom for CHE

WRC Report No 761/1/98



Report 761/1/98 - The Extraction of Ionic and Chemical Species from Water by Membrane Extraction. Report to the Water Research Commission by the Department of Chemical Engineering, University of Potchefstroom for CHE.

Authors: JJ Smit, LR Koekemoer, AM van Wyk **Overseas price:** US\$ 30 (via surface mail)

This research was an extended investigation into the extraction potential of supported liquid membranes (SLM) for dissolved chemical species from aqueous solution. The integrity and the technical feasibility of the SLM and capsulated membrane extraction (CME) were pointed out in previous research (refer to WRC Report No. 617/1/97. This emerging new technology involves the concept of an unconfined reactor which entails the membrane to be configured in the form of a capsule, which implies that no expensive reactor containment is necessary.

Supported liquid membrane (SLM) systems are characterised by the extraction of cations, anions or other chemical species from a feed solution through a membrane into a strip solution. The membrane is interposed between the two solutions and is impregnated with a suitable extractant dissolved in a suitable diluent.

The extraction of nickel with suitably formed membrane capsules gave extraction rates and total extraction values which were dependent on the following five variables:

- Temperature
- · Speed of agitation on the feed side
- Acid concentration in the strip (inside) solution
- Special ligand concentration in the feed side solution
- · Extractant concentration in the membrane.

Each of the variables increased the extraction rate and the combined nett effect was an increase of at least 100 times greater extraction than reported in literature. An empirical rate equation was developed which yielded a polynomial expression in terms of all the independent variables mentioned.

Extraction of pure metals, such as nickel proved to be very successful and shows good potential for future use in the removal of metals from effluents. However, it is obvious that SLM will only be technologically feasible for a small portfolio of high-value metals, and although the technical aspects of the technology are exciting, the economy of the process currently makes for a low probability of implementation in practice.

Optimisering en Gebruik van die Fungus *Geotrichum* soos Gekweek op 'n Industriële Uitvloeisel

TH van der Westhuizen • WA Pretorius

Verslag aan die Waternavorsingskommissie deur die Departement Chemiese Ingenieurswese Universiteit van Pretoria

WRC Verslag No 315/1/98



Verslag 315/1/98 - Optimisering en Gebruik van die Fungus *Geotrichum* soos Gekweek op 'n Industriële Uitvloeisel. Verslag aan die Waternavorsingskommissie deur die Departement Chemiese Ingenieurswese, Universiteit van Pretoria.

Skrywers: TH van der Westhuizen en WA Pretorius

'n Unieke proses is aan die Universiteit van Pretoria ontwikkel waardeur enkelspesies van mikroörganismes uit multi-spesie kulture geselekteer kan word onder nie-aseptiese toestande. Deur 'n verfyning van die proses is daarin geslaag om monokulture van sekere spesies fungi in die reaktore te kweek en onbepaald te handhaaf. Die proses is verder ontwikkel deur organiese nywerheidsuitvloeisels as substraat te gebruik en sodoende die uitvloeisels te suiwer. Die groot voordeel wat die proses inhou, is dat die fungi wat gekweek word relatief maklik geoes en gedroog kan word en dan die potensiaal het om as 'n alternatiewe proteïenbron gebruik te word. Die verslag beskryf die optimisering van die mikrosifproses met die gebruik van petrochemiese uitvloeisel as substraat en die seleksie van spesifieke spesies van die fungus Geotrichum, naamlik G. ingens, G. fragrans en G. candidum.



Research on the Rapid Biological Assessment of Water Quality Impacts in Streams and Rivers

FM Chutter

Report to the Water Research Commission by Environmentek CSIR

WRC Report No 422/1/98



Report 422/1/98 - Research on the rapid biological assessment of water quality impacts in streams and rivers. Report to the Water Research Commission by Environmentek, CSIR.

Author: FM Chutter

Overseas price: US\$ 30 (via surface mail)

World wide it has long been known that the composition of communities of aquatic organisms is responsive to the nature of the physical and chemical environment in which they live and many attempts have been made to use this fact in detecting water pollution and managing water quality. In this project a method developed in England has been modified, adapted to South African conditions and applied widely to confirm its applicability. The method is called the South African scoring system (SASS). The field procedures of the SASS method consist of collections of invertebrates which are made from streams and rivers using a standardised net and following defined methods. The types of invertebrates found are recorded on a score sheet. The score sheet consists of space to record when and where the samples was collected, instructions for collecting the sample and analysing it and a long list of invertebrate groups, mainly at family level, and a number between one and fifteen opposite each name. These numbers have been allocated to each family according to its perceived sensitivity to water quality change, the most tolerant families being scored 1 and the most sensitive 15. The families present at a sampling site are marked on the score - the SASS score which is the sum of the numbers against each taxon present, the number of taxa recorded and the Average Score Per Taxon (ASPT), which is the SASS score divided by the number of taxa. The less altered the water quality, the higher the SASS score and the ASPT. Severe pollution results in very low SASS scores.

SASS data was collected from highly polluted streams in Gauteng, from the Letaba River in Northern Province, from the Crocodile, Sabie and Olifants Rivers in Mpumalanga, from the coalfields, the Mgeni catchment and the Pinetown/Durban area of Kwazulu/Natal, from the eastern Cape, from the southern Cape, from the Western Cape and from Lesotho. The results are presented in eight appendices in the report addressing each of these areas.

The SASS method may be used to assess water quality in broad terms and is therefore useful in water quality monitoring. It is sensitive to all types of water quality change, perhaps less so to increases in TDS than to other types of chemical change, but places where there is pollution are unambiguously identified using SASS and the ASPT value.

Towards a Regulatory Framework for the Management of Groundwater in South Africa

Peter Lazarus

Report to the Water Research Commission and the Department of Water Affairs and Forestry

WRC Report No 789/1/98 DWAF Report No Geo 2.2 (389)



Report 789/1/98 - Towards a Regulatory Framework for the Management of Groundwater in South Africa. Report to the Water Research Commission and the Department of Water Affairs and Forestry by Peter Lazarus

Author: Peter Lazarus

Overseas price: US \$20 (via surface mail)

Groundwater is a strategic resource in South Africa; however, it is also vulnerable to poor management. Prior to the promulgation of the new Water Act, the distinction between the legal status of surface and groundwater in South Africa resulted in over-abstraction and pollution of groundwater in some areas, while in other areas the importance of the resource, and in particular its relationship to surface water, was completely overlooked. International trends toward Integrated Water Resource Management (IWRM) and Integrated Catchment Management (ICM) encouraged those involved in the Water Law Review process to consider the entire hydrological cycle in developing enabling legislation.

Four inter-related components provided the aims for this research project, intended to assists drafters of the new water legislation:

- the formulation of a coherent national groundwater policy
- the development of a broad enabling legal

- framework which gives effect to the national groundwater policy
- the development of practical procedures for the implementation of the national groundwater policy
- the development of scenarios to inform the drafting team of provisions to be included in regulations to the new Water Act which provide for the practical implementation of the national groundwater policy.

The approach of the researcher was to develop a regulatory frame work which would address the groundwater problems experienced in practice by water managers and others working in the groundwater field.

The contents of the report are divided into six chapters (parts). Part 1 is an introduction to the research. Part 2 outlines the legal framework which governed groundwater management in South Africa until 1998 and some of the legal problems that were encountered. Part 3 deals with the practical problems experienced in the management of South Africa's groundwater resources. Part 4 contains a review of international trends in groundwater law and management. In Part 5 the research team's recommendations concerning the protection and utilisation of groundwater to be included in a new water code, are set out. Part 6 is a suggested draft Preamble to the chapter on groundwater in a new Water

Report KV 114/98 - Evaluation of Onsite Sanitation from a Socio-Economic perspective

Report to the Water Research Commission by Bernhardt Dunstan & Associates

WRC Report No KV 114/98



Report KV 114/98 - Evaluation of On-site Sanitation from a Socio-Economic perspective. Report to the Water Research Commission by Bernhardt Dunstan & Associates.

Overseas price: US\$ 20 (via surface mail)

This study aims to examine on-site sanitation systems from the perspective of the users - in the belief that such systems should be evaluated from a social perspective which is given equal status to a technical assessment. The hoped-for outcome is that sanitation systems installed in communities will be viable and sustainable with the result that a better quality of life and improved health will benefit all members of the community.

The research documented in the report was undertaken over a twelve month period in the following three areas: Soshanguve TT, an independent development trust development of an informal settlement with the same on-site, low flush system installed on every stand; Ga Mmotla, a peri-urban settlement about 20 km north of Soshanguve in the North West Province with unimproved pit latrines; and Ivory Park, an expanding settlement in Midrand with a variety

of on-site systems, both wet and dry. In each case, the researchers were tasked to evaluate the existing on-site systems from a socio-economic point of view and to focus on the processes that needed to be followed to ensure the introduction of affordable, sustainable sanitation systems to communities. A variety of methods were used by the researchers including random house-to-house interviews using structured questionnaires, focus groups reflecting the different interest groups, one-on-one interviews and discussions with local authorities, technical people and in some cases the manufacturers of the systems.

In all three research areas people said they were dissatisfied with their sanitation systems. People believe they have inferior, second rate systems in comparison with those enjoyed by urban people (i.e. water-borne systems). In their view their systems do not work properly and they cause their users great inconvenience. The least criticism came from the area with rudimentary pit latrines where people seemed to be less politicised in their demands. In the other two areas there was no attempt to relate product to affordability and this reflects the need for a massive education campaign before a service like sanitation can become viable.

Managing water and waste in the NEW MILLENNIUM

The Challenges for Developing Areas

23-26 May 2000 • Eskom Conference Centre, Midrand/Johannesburg, South Africa

call for papers and registration

Submission of papers are requested. Abstracts (a maximum of one page) of proposed presentations must be submitted by 31 August 1999. It is important that the title of the paper, the author's name, organisation, address, telephone, fax and e-mail address appear on the page. E-mail submissions are encouraged, provided that the abstract is either in Windows based Microsoft Word or Corel Word Perfect format.



3



deadline dates

- Receipt of abstract
- Authors advised of acceptance
- Submission of full paper
- 31 August 1999
- 8 November 1999
- 14 February 2000

enquiries and registration

Enquiries for more information should be directed to: Conference Secretariat (Roelien Bakker) • IWA Conference PO Box 6011 • HALFWAY HOUSE 1685 • South Africa

E-mail: conference@wisa.co.za • Telephone: +27 11 805 6368 • Fax: +27 11 315 1258 REGISTER, on-line at: www.wisa.co.za.

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Conference information

Internet details of conferences planned for local and international venues, are now available via the web site of the WRC. These details are gathered from all over the world and form an easy reference source to researchers, academics and consultants who have to budget and plan their activities well ahead.

Where to find the information

All conference details are available under 'Events' (see Figure 1: Water Related Events) on the WRC's web site. Information is ordered according to geographical region (Africa, Asia, Europe, etc.) and also according to date.

For all events, details on date, location, conference theme as well as full contact details are provided. Where available, e-mail addresses of contact persons are also included. Should the conference have its own site on the Internet, the applicable Internet address is also provided.

Abstract deadlines

For anyone planning to submit a paper for presentation at a conference, the deadline for the submission of an abstract of the planned paper is of utmost importance. Where available, the abstract deadlines are also given.

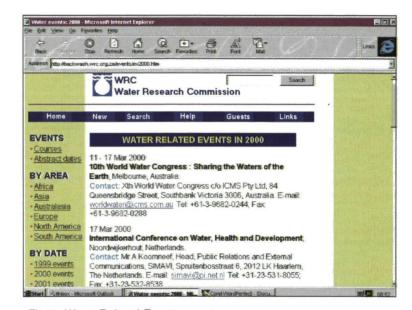


Fig 1: Water Related Events.

Water-related courses

Details on local and international water-related courses, are also available in this section of the web site (see Figure 2: Water Related Courses). Course title, date and location of presentation, together with contact details are provided. A brief description of the course contents, if available, is also provided,.

Invitation to conference planners

Organisers of any water-related conference, symposium, workshop or training course, are welcome to send details of these events for publication on the WRC's web site. Please provide full details of the planned event to:

Francette Myburgh Water Research Commission PO Box 824 0001 PRETORIA

E-mail: fmyburgh@wrc.org.za

Fax: 012 331 2565

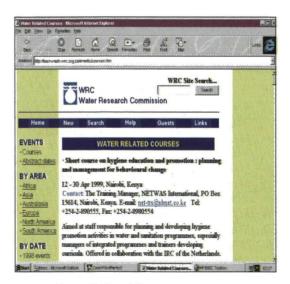


Fig 2: Water Related Courses.

Screening follows world trend

ncreased pressure on South African industries to improve utilisation of resources, especially the recovery of water, as well as the need to reduce effluent flow and loading, has led to the viability and economical use of Rotary Drum Screening in various industries. The South African Paper Industry is one of the industries that have recently started following this world trend.

Autrex Industrial Screening, have already supplied several paper mills with this screening system, in order to increase fibre recovery from their effluent or remove unwanted rubbish. After the removal of rubbish (eg. plastic, bottle tops, polystyrene) at about 2 mm, the effluent flow can be passed through a second stage Rotary Drum Screen with a 0.5 mm aperture. This screen will remove 96% of all solids down to the aperture size plus 50% of all solids down to half the aperture size. This is done by utilising the weir-principal of screening, which requires that all the liquid flow over the liquid distribution weir in the opposite direction to the drum rotation.

The tangential flow of liquid onto the screen face with the resultant shearing action produces this very efficient separation of solids from liquid.

Benefits

There is a number of benefits to using this screening technology. It allows for both maximum recovery of usable fibre and reducing the load on the effluent treatment plant. This in turn reduces the use of chemicals (flocculants), increases the clarifier performance, and reduces loading on the sludge de-watering equipment. There is also a marked improvement to the re-use of water.

Rotary Drum Screening is an evolution of the static hillside or parabolic screen, which generally requires manual cleaning. The rotary screen technology development incorporates inside and outside showers, which are automatically activated, removing the need for manual labour and cleaning-management. Furthermore, rotary drum screens are capable of much higher capacities, com-

pared to the static parabolic or hillside screens. A 1.8 m wide static parabolic screen can handle approximately 2 500 litres of effluent per minute, with a 2 metre head loss through the screen. Whereas a 1.8 m Rotary Drum Screen can handle approximately 5 000 litres of effluent per minute, with a 1 metre head loss through the Screen. Some 12 000 litres/minute can be handled by one large Model 15/40 Rotary Screen Drum. alternatively five 1.8 metre wide Static Screens would be required, with more valves, inlet and outlet pipe work accordingly, and taking up more space aswell.

The Rotary Screens are locally manufactured which make them very affordable, especially considering the payback product recovery and improved effluent plant efficiency.

Rotation

For further information contact:

Mr Bob Barlow Autrex Industrial Screening Tel no: (021) 96 3073

Headbox

Screen Solids

A Rotary

A Rotary Drum Screen.

Optimising wastewater treatment

he Evita® range of oxygen meters from Danfoss consists of sensors able to measure oxygen, ammonia, nitrate and orthophosphate, which are important parameters in the treatment of wastewater. By using information from the sensors, it is possible to optimise the three processes: removal of organic matter, nitrogen and phosphorous.

Organic matter contains carbon, hydrogen and oxygen molecules and acts as a food source for bacteria in a wastewater plant. Using oxygen, the organic matter is changed into carbon dioxide purely to keep the bacteria alive. The content of organic matter in the water is calculated using BOD (Biological Oxygen Demand) by mixing bacteria and oxygen-rich water with a sample of wastewater. After five days in darkness, at a temperature of 20°C, the loss of oxygen is measured and divided by the amount of wastewater (in millimetres), to define the amount of organic matter present in the water.

☐ The removal of nitrogen using bacte-

ria is performed in two steps, with two different bacteria's, by transforming the ammonia into gaseous nitrogen that disappears into the air. The first process, nitrification, requires nitrifying bacteria only grown when sludge reaches a certain age and temperature. When nitrifying bacteria is present, ammonium is transformed into nitrate using oxvgen. Nitrification is followed by the denitrification process where denitrifying bacteria transforms nitrates into free gaseous nitrogen. The denitrifying bacteria removes organic matter from the wastewater when oxygen is present. When oxygen is not present, this particular type of bacteria is able to degrade organic matter using nitrates instead of oxygen. In this way organic matter is transformed into carbon dioxide and nitrate is transformed into free nitrogen removing the nitrogen from the water.

☐ Phosphorous can be removed either chemically or biologically. Chemical removal is a precipitation process where iron salts, aluminium salts or polymers are used to react with phosphate to form larger particles called flocs. The flocs

eventually get so heavy that they are able to precipitate in a settling tank. The flocs are removed from the bottom of the settling tank allowing purification to take place.

Removing phosphorous biologically is a relatively new process and therefore not fully understood. The process works with a special kind of bacteria called Phosphorous Accumulating Organisms (PAO). This bacteria releases phosphorous if there is no oxygen or nitrates present in the wastewater. If there is oxygen and nitrates present in the water, the POA's will take in phosphorous and the uptake is considerably larger than the anaerobic release. The bacteria is eventually removed by the surplus sludge, ridding the water of phosphorous.

Enquiries to:
Trevor Maddison
Instrumentation and Water Valves
Danfoss (Pty) Ltd
PO Box 5022,
RIVONIA 2128
Tel: (011) 803-8390

Fax: (011) 803-8244

Convenient new E.coli test medium available

Illipore has recently introduced m-ColiBlue24 broth which is the first nutritive medium to simultaneously detect total coliforms and *E.coli* in water and beverages using standard membrane filtration equipment. Accurate results are available within 24 hours, as an analyst will be able to identify at least 95 per cent of all *E.coli* on the test medium within 24 hours.

A unique combination of indicators in the medium differentiates *E. coli* from other coliforms. The *E.coli* form blue colonies

while the other coliforms from red colonies. The sum of all the colonies is the total coliforms.

M-ColiBlue 24 contains an enzymatic indicator which is highly selective for E.coli, thereby eliminating the confirmation steps which are required when using conventional media.

The broth also contains special inhibitors that minimise the growth of non-coliform bacteria. m-ColiBlue24 does not contain deoxycholate or bile

acids which inhibit the growth of stressed organisms.

An advantage of m-ColiBlue 24 broth is its immediate readiness for use. It comes prepared and packaged in ampoules, eliminating the need to measure, mix and autoclave dehydrated media. Each ampoule contains enough medium for one test.

Enquiries to: Dr Errol Allcock at Microsep/Millipore. Tel. (011) 444-2280.

SABS approval for taps

apetti bathroom and kitchen tapware has received SABS approval. Produced in Italy, Rapetti taps have been imported into South Africa since 1981.

The company holds the international Standards Organisation (ISO) 9001 Quality Systems Award, in addition to the registered marks of all the leading European standards' authorities. Rapetti is now one of an exclusive few imported tap ranges to be awarded the SABS mark.

A survey conducted last year revealed that there were more than 50 different product tap ranges being imported into South Africa from 27 Different countries. Many of these were considered well below the required standard sought by the SABS.

Unapproved taps are a source of concern to the Department of Water Affairs because of water loss by tap failure. Legislation to control this problem is under investigation.

SA WATERKALENDER

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

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

Address:

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

Legend:

- An SA Water Event arranged for these dates.
- 2nd SA Water Event scheduled for these dates.
- X 3rd SA Water Event scheduled for these dates.

See conferences and symposia pages for events.

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

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

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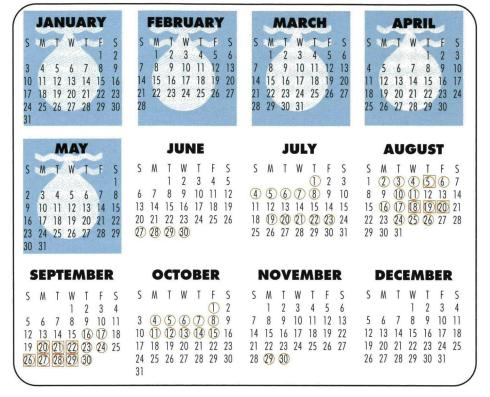
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Gids:

- Een SA Watergeleentheid vir hierdie dae.
- in Tweede SA Watergeleentheid vir dié datums.
- × 'n Derde SA Watergeleentheid vir dié datums.

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

1999



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SOUTHERN AFRICA

1999

SASAQS

27 JUNE - 1 JULY

The 35th conference of the Southern African Society of Aquatic Scientists (SASAQS) with the theme "Research, conservation and management of aquatic resources in Southern Africa" will be held in Swakopmund in Namibia.

Enquiries: Shirley Bethune or Kevin Roberts, Department of Water Affairs, Private Bag 13193, Windhoek, Namibia. Tel: 00264 61 296 +3025 or +3240. Fax: 264 61 208 7160 or 264 61 232861 E-mail: bethunes@ mawrd.gov.na OR robertsk@ mawrd.gov.na

AIEPS '99

JULY 4 - 8

The African international environmental protection symposium incorporating the fourth Southern African anaerobic digestion symposium will he held at the Imperial Hotel in Pietermaritzburg.

Enquiries: Dr Richard A Daneel, Soil and Pollution Research Services CC, Suite 101, Postnet X6, Cascades 3202. Tel: (0331) 962-696. Fax: (0331) 962-696. E-mail: soil&pol@sprs.co.za

SANITATION

JULY 19 - 23

A course on appropriate technologies for low-cost sanitation will be held in Bulawayo, Zimbabwe.

Enquiries: Prof A E Taigbenu, Department of Civil and Water Engineering, National University of Science and Technology, PO Box AC 939 Ascot, Bulawayo, Zimbabwe. Tel: 263-9-229425. Fax: 263-9-76804/66983/229439. E-mail: ae-taigbenu@nust.ac.zw

WATER PURIFICATION

AUGUST 2 - 6

A short course on the operation of small-scale water purification and sewage plants will be held at the Department of Chemical Engineering (Division Water Utilisation), University of Pretoria. Course fee: R3 500 (VAT exclusive). The fee includes

course notes, refreshments and lunches, but excludes accommodation.

Enquiries: Ms E Otto Tel: (012) 420-3566. Fax: (012) 362-5089.

MINE WATER

AUGUST 5

A symposium on new developments in mine water management will be held at the Randfontein Estates Sports Club (WISA Mine Water Technical Division).

Enquiries: Ms Christine Killian. Tel: (011) 726-7027. Fax: (011) 726-6913. E-mail: Phd@phd. co.za

RIVER MANAGEMENT

AUGUST 10 - 11

A conference on integrated management of river ecosystems: an international experience will be held in the Kruger National Park at Skukuza.

Enquiries: Dr Mark Dent, Computing Centre for Water Research, University of Natal, Pietermaritzburg, Private Bag X01, Scottsville 3209. Tel: 0331-260-5177. Fax: 0331-260-6288. E-mail: dent@aqua.ccwr.ac.za

WATER QUALITY

AUGUST 16 - 20

A short course on water quality management will be held at the University of Potchefstroom.

Enquiries: Mrs Dydré Greeff, Section for Training Co-ordination, PU for CHE. Tel: (018) 299-2714 or 299-2715. Fax: (018) 299-2726. E-mail: aokdg@ puknet.puk.ac.za

AFRIWATER '99

AUGUST 18 - 20

The South African water, waste and environmental exhibition will be held at the Gallagher Estate in Midrand, Gauteng.

Enquiries: Avé Delport, TML Reed Exhibitions, PO Box 182, Pinegowrie 2123. Tel: (011) 886-3734. Fax: (011) 781-1270. E-mail: sue.philipson@tmltrade. co.za.

IRRIGATION

AUGUST 24 - 26

The SABI national congress with the theme - Irrigation in the next millennium - will be held in Bloemfontein.

Enquiries: Ms Riana Lombard. Tel: 021-854-8817.

DROUGHTPLANNING

SEPTEMBER 16 - 17 A drought planning workshop will be held at the ARC In Touch Convention Centre in Pretoria (to coincide with the International Conference on Integrated Drought Management).

Enquiries: Adri Laas, Private Bag X79, Pretoria 0001. Fax: (012) 323-1157. E-mail: a-laas@ igkw2.agric.za

DROUGHT MANAGEMENT

SEPTEMBER 20 - 22

An interdisciplinary international conference on integrated drought management - "Lessons for Sub-Saharan Africa" will be held at the CSIR Conference Centre in Pretoria.

Enquiries: Conference Planners, PO Box 82, Irene 0062. Tel: 667-3681. Fax: 667-3680. E-mail: confplan@iafrica.com

SLUDGE HANDLING

SEPTEMBER 20 - 24

A short course on biological and chemical sludge handling and disposal will be held at the Department of Chemical Engineering (Division Water Utilisation), University of Pretoria. Course fee: R3 500 (VAT exclusive). The fee includes course notes, refreshments and lunches, but excludes accommodation

Enquiries: Ms E Otto Tel: (012) 420-3566. Fax: (012) 362-5089.

MEMBRANE TECHNOLOGY

SEPTEMBER 26 - 29

The 3rd WISA membrane technology division workshop with the theme - Membrane developments in waste minimisation, water treatment and the process industry - will be held at the Drakensville Resort.

Enquiries: Dr S Burton, Department of Biochemistry, Rhodes University, PO Box 94, Grahamstown 6140. Tel: (046) 603-8443. Fax: (046) 622-3984. E-mail: chsb@warthog.ru.ac. za

CORROSION

SEPTEMBER 26 - OCTOBER 1
The 14th international corrosion congress with the theme "Cooperation in Corrosion Control" will take place in Cape Town. A trade exhibition will also be held for the duration of the congress. Enquiries: The Secretary, The Corrosion Institute of Southern Africa, PO Box 966, Kelvin 2054. Tel: (011)802-5145. Fax: (011) 8043484. E-mail: norust@future-jhb.co.za

ENVIRONMENTAL MANAGEMENT

OCTOBER 4 - 8

A short course on appropriate technologies for environmental management will be held in Bulawayo, Zimbabwe.

Enquiries: Prof A E Taigbenu, Department of Civil and Water Engineering, National University of Science and Technology, PO Box AC 939 Ascot, Bulawayo, Zimbabwe. Tel: 263-9-229425. Fax: 263-9-76804/66983/229439. E-mail: ae-taigbenu@nust.ac.zw

WATER & WASTE

OCTOBER 11 - 15

The 11th International Training Network for Water and Waste Management (ITN Africa) conference will be held in Kadoma, Zimbabwe.

Enquiries: The Chairman, ITN Conference, PO Box MP 422, Mount Pleasant, Harare, Zimbabwe. Tel: 263-4-735017/26/35. Fax: 263-4-738120. Email: admin@iwsd.icon.co.zw

2000

WATER SUPPLY & SANITATION

FEBRUARY 21 - 25

The 10th UADE/UAWS congress with the theme "Partnerships and sustainable development in the water supply and sanitation sector" will be held in Durban.

Enquiries: UAWS Administrative Secretary, 01 BP 1843 Abidjan, Cote d'Ivoire. Tel: +225 241443. Fax: +225 242629. E-mail: uadewup@africaonline.co.ci

WATER & WASTE

MAY 23 - 26

A specialist conference on managing water and waste in the new millennium - the challenges for developing areas - will be held in Midrand. **Call for papers.** Enquiries: Roelien-M Bakker, IWA Conference, PO Box 6011, Halfway House 1685. Tel: (011) 805-6368. Fax: (011) 315-1258. E-mail: conference@wisa.co.za

WISA

MAY 28 - JUNE 1

The Water Institute of Southern Africa (WISA) will hold its biennial conference and exhibition at Sun City.

Enquiries: Roelien-M Bakker, WISA, PO Box 6011, Halfway House 1685. Tel: (011) 805 6368. Fax: (011) 315 1258. E-mail:

conference@wisa.co.za

WATER RESOURCES

JUNE 7-9

The 4th biennial congress of the African division of the International Association of Hydraulic Research (IAHR) on conserving and sharing water resources in a water scarce environment will be held in Windhoek, Namibia.

Enquiries: Congress Secretariat, Ms Marelise Serfontein, PO Box 9870, Windhoek, Namibia. Tel: +264-61-251014/272031/254281. Fax: +264-61-272032/251014. E-mail: namlink@iwwn.com.na

IRRIGATION

OCTOBER 22 - 27

The 6th international micro-irrigation congress together with the 51st IEC meeting of the International Commission on Irrigation and Drainage (ICID) will be held in Cape Town. Call for papers.

Enquiries: The Congress Secretariat, PO Box 36815, Menlo Park 0102. Tel: (012) 344 0390. Fax: (012) 344 5643. E-mail: reservations@parkgables.co.za.

AGROCHEMICALS OCTOBER 25 - 26

A workshop on the control of adverse impacts of fertilizers and agrochemicals will take place in Cape Town, South Africa.

Enquiries: Prof A Mermoud, Institute of Soil and Water Management (IATE), Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland. Tel: +41-21-693-3726. Fax: +41-21-693-3739. E-mail: andre.mermoud@epfl.ch

HYDROGEOLOGY

NOVEMBER 26 - DECEMBER 1 The International Association of Hydrogeologists' (IAH) XXX Congress 2000 with the theme Groundwater: Past achievements and Future challenges will be held at the University of Cape Town. **Call for papers**: send a 200 word abstract in English before 30 July 1999 to the IAH 2000 Conference Secretariat.

Enquiries: Conference Secretariat, IAH 2000, Conferences et al, PO Box 452, Stellenbosch 7599. Tel: (021) 886-4496. Fax: (021) 883-8177. E-mail: deidre@iafrica.com.



OVERSEAS

1999

MINESITE HYDROLOGY JULY 12 - 14

The second national training course on minesite hydrology will be held at the Hyde Park Plaza Hotel in Sydney, Australia.

Enquiries: Trevor Pillar, Development Officer, Centre for Groundwater Studies. Tel: 618-8303-8753. Fax: 618-8303-8730. E-mail: trevor.pillar@adl.clw.csiro.au Website: http://www.clw.csiro.au/CGS

COLLECTION SYSTEMS

AUGUST 1 - 4

A speciality conference on collection system rehabilitation and O & M will be held in Salt Lake City, Utah, USA.

Enquiries: Technical Programs -Collection System '99, Water Environment Federation, 601 Wythe Street, Alexandria, VA, USA 22314-1994.

STOCKHOLM

AUGUST 9 - 12

The 9th Stockholm water symposium with the theme "Urban stability through integrated water-related management" will be held in Stockholm, Sweden.

Enquiries: Symposium Secretariat, SE-106 36 Stockholm, Sweden. Tel: +46 8 7362021. Fax: +46 8 7362022. E-mail: sympos@siwi.org. Internet: www.siwi.org

STORM DRAINAGE

AUGUST 30 - SEPTEMBER 3

The 8th international conference on urban storm drainage will be held in Sydney, Australia.

Enquiries: 8ICUSD conference secretariat, The organising group, Suite 1, 470 Sydney Road, Balgowlah, NSW 2093, Australia. Tel: +61 2 9949 4933. Fax: +61 2 9949 3905. E-mail: orggroup@orggroup.aust.com. Web address: http://www.iawq.org.uk/conferen/8icusd.htm

WEDC

AUGUST 30 - SEPTEMBER 3 The 25th WEDC conference with the theme "Integrated development for water supply and sanitation" will be held in Addis Ababa, Ethiopia.

Enquiries: Professor John

Pickford, WEDC, Loughborough University, LE11 3TU, UK. Tel: (44) 1509 222390. Fax: (44) 1509 211079. E-mail: j.a.pickford@lboro.ac.uk

WASTEWATER TREATMENT

SEPTEMBER 6 - 9

The 8th IAWQ conference on the design, operation and economics of large wastewater treatment plants will be held in Budapest, Hungary.

Enquiries:TRIVENT Conference office, Szamoca 6/b, H-1125, Budapest, Hungary. E-mail: trivent@mail.elender.hu Fax: +36 1 3566240.

HYDROGEOLOGY

SEPTEMBER 6 - 10

The 29th annual congress of the IAH on hydrogeology and land use management will be held in Bratislava, Slovakia.

Enquiries: Marian Fendek, Geological Survey of Slovak Republic, Mlynska dolina 1, 81704 Bratislava, Slovakia. Tel: +421-7-3705355. Fax: +421 -7-371940. E-mail: iahcong@gssr. sk. Web address: http://petra.fns. uniba.sk/IAH99

DRILLING

SEPTEMBER 21 - 22

A conference on horizontal well drilling - the new dimension for water supply - will be held in Baltimore, Maryland, USA. Enquiries: The American Ground Water Trust, 16 Centre Street,

Water Trust, 16 Centre Street, Concord, New Hampshire 03301 USA. Tel: 603-228-5444. Fax: 603-228-6557. E-mail: agwt@aol.com. Website: WWW.agwt. org

WASTE MANAGEMENT

OCTOBER 4 - 8

The seventh international waste management and landfill symposium - Sardinia 99 - will be held in S Margherita di Pula (Cagliari), Sardinia, Italy.

Enquiries: EuroWaste Srl, Via Altinate, 96-35121 Padova (Italy). Tel: +39 049 663860. Fax: +39 049 663960. E-mail: eurowaste@tin.it. Web page: http://www.pengo.it/sardinia99

SEWAGE SLUDGE

OCTOBER 13 - 15

A conference on the disposal and utilisation of sewage sludge - treatment methods and application modalities will be held in Athens, Greece.

Enquiries: Professor Andreas Andreadakis, Organising Committee, Water Resources Department, National Technical University of Athens, 5 Iroon Polytechniou St, 15773 Athens, Greece. E-mail: andre1@central.ntua.gr. Tel: +30 1 772 2897. Fax: +30 1 772 2899. Web address: http://www.iawq.org.uk

2000

NATURAL RESOURCES

FEBRUARY 14 - 18

An international conference on managing natural resources for sustainable agricultural production in the 21st century will be held in New Delhi, India. Call for papers.

Enquiries: Dr AK Singh, Secretary-General, Indian Society of Soil Science, Indian Agricultural Research Institute, New Delhi-110 012, India. Tel: 91-11-5731494. E-mail: icmnr@biciari.ren.nic.in Fax: 91-11-5755529. Internet site: http://www.nic.in/icar/nrm

WATER

MARCH 11 - 17

The 10th world water congress is to be held at the Melbourne Convention Centre, Melbourne, Australia. **Call for papers.**

Enquiries: Lisa McNaught, ICMS Pty Ltd, 84 Queensbridge Street, Southbank, Victoria, Australia 3006. Tel: +61 3 9682 0244. Fax: +61 3 9682 0288. E-mail: worldwater@icms.com.au

ACHEMA 2000

MAY 22 - 27

The 26th exhibition-congress and international meeting on chemical engineering, environmental protection and biotechnology will be held in Frankfurt am Main, Germany.

Enquiries: Dechema. Tel: +49 (0) 697564-261. Fax: +49 (0) 69756 4201. Internet: http://www.woice. de E-mail: woice@dechema.de

IWA

JULY 3 - 7

The first world congress of the new International Water Association (IWA), formed by the merger of the International Association on Water Quality (IAWQ) and the International Water Services Association (IWSA), will be held in Paris, France.

Enquiries: Aghtm-cfrp, 83 Avenue Foch - B.P. 39.16, 75761 Paris - Cedex 16 - France. Tel: +33 (0)1 53701351 or 53. Fax: +33 (0)1 53701340. E-mail: aghtm@aghtm.org

THE WATER INSTITUTE OF **SOUTHERN AFRICA** (WISA)

BIENNIAL CONFERENCE AND EXHIBITION SUN CITY, SOUTH AFRICA 28 May to 1 June 2000



FIRST ANNOUNCEMENT AND CALL FOR PAPERS

Date and Venue

The WISA biennial conference for the year 2000 will be held at Sun City, in the North West Province from 28 May to 1 June 2000. The Conference will commence on the Sunday with a social Meet and Greet, followed by three days of parallel technical sessions, and will conclude with a number of technical visits. A series of keynote and plenary sessions will be scheduled throughout the conference.

Call for Papers

Anyone who is interested in making a presentation at this conference, either orally or by means of a technical poster, who need not necessarily be members of WISA, are invited to submit a short abstract (maximum of one page) of their proposed presentation by 31 July

It is imperative that the title of the paper, the author's name, organisation, address, telephone, fax and e-mail address appears on the same page. Papers will undergo a peer review process, and will be accepted with the understanding that the main author or co-author will personally attend the conference and present the paper. Please note there will be no reduced registration fee for authors or presenters.

Deadline Dates

Receipt of Abstract 31 July 1999 Authors Advised of Acceptance 30 September 1999 Submission of Full Paper 14 January 2000 28 May 2000 Conference Commence

Exhibition

An exhibition - a showcase for all water orientated organisations will be held concurrently with the conference. Exhibitors are assured of ample opportunities to interact with the conference delegates. Since space will be limited, potential exhibitors are encouraged to make a reservation as soon as possible by contacting the conference organiser, Roelien-M Bakker.

All enquiries with regard to the conference should be directed to: Roelien-M Bakker

WISA PO Box 6011 Halfway House 1685

Telephone: (011) 805 6368 Fax: (011) 315 1258 E-mail:

conference@wisa.co.za

WISA 2000 REPLY FORM

Please return by 31 July 1999 to: WISA, PO Box 6011, Halfway House, 1685, or Fax to: (011) 315-1258, or visit our web site and complete on-line at: www.wisa.co.za

By returning this form, you are indicating your interest in the conference without any obligation.

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Initials	Title (Dr/Mr/Ms etc)
First N	ame
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I an	interested in:
	Making an Oral Presentation
	Making a Poster Presentation
in th	ne following session:
	Anaerobic Processes
	Analytical Equipment and Techniques
	Aquatic Ecosystems
	Collection and Reticulation Systems
	Community Water Supply and Sanitation
	Consumer Education
	Customer Services
	Education and Training
	Environmental Aspects
	Groundwater Management
	Health Related Aspects
	Industrial Water and Effluent
	Information Technology
	Legislation
	Management and Institutional Affairs
	Marine Disposal
	Membrane Technology and Applications
	Mine Water Quality Management
	Nutrient Removal
	Potable Water Treatment
	Plant Operation
	Public Participation
	River Basin Management
	Role of Water Scientists
	Sludge Management
	Social Impacts
	Urban Runoff Wastewater Technology
	Wastewater Technology Watercare
	Water Distribution
	Water Quality Management
	er (Please Specify)
	ase find attached 3 copies of a ONE-page abstract of my
	posed presentation.
_	I wish more information on exhibiting at the conference

Sponsored by Brooke Pattrick (Publishers of Water Sewage & Effluent) **Issued January 1999**

International Conference on Integrated Drought Management

- Lessons for Sub-Saharan Africa -

20-22 September 1999 at the CSIR Conference Centre, Pretoria

The main objective of the conference is to understand more fully the factors predisposing people and landscapes to heightened drought vulnerability, to work towards strategies and actions which can reduce drought vulnerability, and move towards sustainable development.

Emphasis will be placed on drought and social equity. The themes will

- Challenges of forecasting for sustaining natural resource management.
- Climate variability: implications for sustainable natural resources management.
- ☐ Building drought resilience for the "at risk ": strategies that reduce vulnerability of fragile ecosystems and communities.
- ☐ Integrating drought considerations into policy: key principles

 The conference should give impetus to regional and international co-operation in drought management, and make sub-Saharan Africa a focus region for the

Who should attend?

The conference is intended to bring together a broad constituency of researchers, academics, practitioners, consultants, developers, policy-makers, planners, community leaders and media who have a common interest in the effective management of drought in all its manifestations.

International Decade for Natural Disaster Reduction 1990 - 2000.

Exhibition

An exhibition will be held alongside the conference . Manufacturer, suppliers, consultants and contractors are invited to apply for a stand. Please mark the applicable section on the enrolment form inserted in this issue of the SA Waterbulletin.

Drought Planning Workshop

An optional pre-conference workshop on Drought Planning will be held 16-17 September 1999 at the Agricultural Research Council (ARC) in Pretoria. The workshop will be led by Dr Don Wilhite, a world expert on drought from the National Drought Mitigation Centre in Lincoln, Nebraska, USA. Topics will include: An overview of drought concepts, contingency planning, vulnerability, drought triggers and indices, information needs, monitoring, and policy issues. Please indicate your interest in the workshop on the draught conference enrolment form.

Registration and Accommodation

Please find the applicable enrolment and accommodation form inserts in this issue of the SA Waterbulletin. Kindly complete and forward the forms to the addresses as indicated on the forms.

Information and enquiries

For full conference details and a programme, please contact:

Conference Secretariat:

Conference Planners

Tel: +27 (0)12 667-3681 Fax: +27 (0)12 667-3680

E-mail: confplan@iafrica.com

or

Conference Chairman:

Hugo Maaren

Tel: (012) 330-034)

Fax: (012) 330-3275

E-mail: hugo@wrc.org.za





