AQUA News

April 1999

IWSA—International Water Services Association: **AISE**—Association Internationale des Services d'Eau

Director to leave WaterAid

After much consideration, Jon Lane has decided to finish his work as Director of WaterAid, the UK's specialist international water and sanitation development charity.

Jon Lane

In this issue...

As Director for five years, Jon has led the charity to the forefront of helping some of the world's poorest communities provide themselves with clean, safe water. To date, WaterAid-funded projects have enabled over five million people to gain access to safe water and hygiene practices.

Jon is planning to leave at the end of June 1999 and WaterAid is currently in the process of recruiting his successor.

Jon said 'I feel privileged to have worked with

WaterAid for 12 years, as a Country Representative, Advisor and latterly Director. I believe strongly in WaterAid's cause and in the organisation itself. Working for WaterAid has been not a job, but a way of life for me'.

French moules fight water pollution

Biological tests are increasingly seen as reliable indicators of water pollution. The French company CIFEC has manufactured equipment that uses ultrasound pulses to measure changes in trout. These appear when a variety of dangerous pollutants are present. The bonus of this is that unlike current equipment, it indicates changes in the trout before the fish actually dies.

French companies Fremer and Micrel have produced the Valvometer, which monitors mussels. The shellfish normally remains open, but closes when the standard of water deteriorates. Eight mussels are attached to a disc-shaped instrument. Readings are transmitted to a computer, and alarms are activated when enough mussels react simultaneously.

ASA and Fluotox have developed a device that measures the fluorescence emitted by algae fixed to a membrane filter. Pollutants would block photosynthesis and cause fluorescence to be increased.

Soldier's water project leaves Bosnians gushing with thanks

A British Territorial Army soldier has masterminded a project to supply water to a war-damaged Bosnian village.

Sergeant Nigel Allen has brought running water to the a village of Boljkovac in central Bosnia, for the first time since shells destroyed the main cistern during fierce fighting in 1993.

'When I first arrived in Bosnia I was given a map and a local area to deal with' Nigel explained. My job was to go out into the villages and liaise with the local people and find out what they needed most.

'In Bolijkov they told me that they were desperate for a drinking water supply. They can only get water for four months of the year and in the summer everyone does their washing and bathing in the local river, and it also doubles up as the drinking water supply. Alternatively, they have to travel three kilometres to another village to get water, then carry it back.

'When I arrived there were four tanks on the mountain side which feed a main concrete tank. During the war the village was badly shelled and it undermined the base of the main tank. Water was pouring out and there was only a couple of inches of water in the bottom instead of about 21 000 gallons.

'The existing tank had been built in 1974 when there were only about 50 houses in the village. The population has doubled since then, so the tank would not supply the village adequately anyway.'

Nigel formulated a plan to rebuild the ailing water tank and applied successfully for funding from the British Department for International Development. He set up talks with the village leaders and organised for residents—most of whom are unemployed—to lend a hand in the labouring work, overseen by a local civil engineering contractor.

Sergeant Nigel Allen with locals, Boljkovac

'We knocked the whole concrete tank down, rebuilt it and fitted a waterproof lining. New pipes connected the houses to the water supply and we finally put the lid back on the tank. It was quite a big job but everyone was enthusiastic and worked really hard, and any problems we had were solved quite quickly.'

Milanovi Osman, a villager who worked closely alongside Nigel during the project said: 'Soon every house in the village will have clean running water. We can't express how grateful we are; our lives have been transformed.'

Nigel has recently returned from his six month tour of duty in Bosnia and has resumed his normal job as a waste management consultant.

Water Regulations Advisory Committee recruits

The Water Regulations Advisory Committee was established in 1996. It advises Ministers on what technical requirements should be incorporated in the water supply (Water Fittings) Regulations to prevent the waste, misuse, contamination and undue consumption of public water supplies from domestic and commercial plumbing installations and fittings.

A major part of the WRAC remit over the next three years will be to monitor the enforcement of the regulations. Prospective members should note the following:

- All members are expert in their particular field and do not represent professional or trade associations.
- They receive no remuneration, although their travelling expenses are reimbursed.
- The majority of members need technical knowledge about plumbing fittings and installations. Members should reflect the viewpoints of designers, installers, manufacturers, water suppliers, householders and other consumers.

The next generation of water leaders

It was Charles Handy who said in *The Age Paradox* 'Preoccupied with the immediacy of their own careers, young people are tempted to think that the second-curve thinking can be left until late, that the present is their priority, the future the priority of those in charge. In fact , it should be the other way around.' This is a fact that is often not recognised or realised by both the younger and the older generations, not only for the water sector but also for all other areas of development as well.

Potential water leaders of the next generation are now conspicuous by their absence in most international decision-making fora dealing with water. The situation probably is not dissimilar in other non-water areas, but the fact still remains that if the future water problems of the world are to be reliably diagnosed, participation of the next generation of water leaders in these processes is absolutely essential. Equally critical is their active involvement in the analyses of the problems and the identification of cost-effective solutions and their subsequent implementation.

No sane individual would disagree with the statement that successful predictions of future developments are always difficult. It is even more difficult for the water sector, since water has direct and indirect impacts on most development processes, and development in other sectors, in turn, similarly affects the water sector. Thus, future solutions would have to be found, not in terms of the unitary management of one single resource like water, but within an overall system of mutual interactions and interrelations between this resource and the development process itself. Furthermore, future water problems are likely to become more and more complex, and because of rapidly changing social, economic, political and environmental conditions, finding successful and implementable solutions would become increasingly more difficult in the coming decades. On the basis of the current identifiable trends, it can be said that the changes in the overall environment within which water development and management would take place during the first two decades of the 21st century are likely to be vastly different to what has been witnessed during the entire 19th and 20th centuries. If this prediction proves to be correct, and there appear to be many reasons as to why this would most likely to be the case, it is absolutely essential that the next generation of water leaders work with the current leaders to anticipate and solve the critical water problems that are likely to surface globally, regionally and locally in the foreseeable future.

Unfortunately, however, the water profession has basically ignored the critical issue of how best to facilitate the effective development of the next generation of water leaders. While inter-generational conflicts of interest may have played some part in the evolution of this neglect, it is likely that this has happened not by design but by the absence of any clear future-orientated thinking by the current generation. In order to rectify this situation, the committee on International Collaboration of the International Water Resources Association, (CIC-IWRA), Third World Centre for the Water Management (TWCWM) Mexico City and the Stockholm International Water Institute (SIWI) are launching a major effort to identify and then mentor the next generation of water leaders from different parts of the world.

The first issue in this process is the identification of young water professionals who are likely to become the next generation of water leaders. Using the available formal and informal networks, a process has already been initiated which will cast a wide net all over the whole world, which could lead to an initial identification of potential individuals who could assure the leadership mantels in the future.

It was the late President John F. Kennedy who noted that the water problems of the world are so complex that the person who solves them should receive not one but two Nobel Prizes, one for science and the other for peace. More than three decades later, President Kennedy's words have become more prophetic than ever. Global water problems are likely to become increasingly complex in the 21st century, and their resolution would require extensive collaboration between the present and the next generation of water leaders. Equally, the next generation of water leaders would have to face water problems that are far more complex and extensive than we have ever had to face. Accordingly the water profession must give consideration as to how best to facilitate the development of the next generation of water leaders. The current effort by the IWRA, TWCWM and SIWI is an important step in this direction.

Africa consultative forum

The first African Consultative Forum for Water Supply and Sanitation, the 'Forum', was held in November 1998 in Abidjan, Côte d'Ivoire. The Forum was organised by the African Working Group of the Water Supply and Sanitation Collaborative Council (WSSCC) and hosted by the Government of the Côte d'Ivoire

The forum was attended by 1460 water supply and sanitation professionals. They included 110 from Water Supply and Sanitation agencies in 33 African countries, 24 from donor and UN agencies, 8 from non-Governmental organisations and collaborative agencies, 6 from professional associations and the private sector. There were 18 women representing 12% of the total participants. The representation from NGOs and the number of women participants was rather low and is a concern for the African Working Group.

Forum purpose and objectives

The purpose of the Forum was to enhance collaboration among water and sanitation sector professionals and external support agencies in Africa, thus fostering African solutions to African problems. There were three specific objectives:

- Agreement on a statement setting out the current water supply and sanitation situation in Africa. **The Africa Statement**;
- Identification of priority actions to address water supply and sanitation issues in Africa at country and regional levels. **The Africa Action Programme**;
- Development of priority programme areas for the Africa Chapter of the Water Supply and Sanitation Collaborative Council (WSSCC). **The African Chapter (WASAI = Water and Sanitation Africa Initiative)**.

The Forum process

The Forum programme was designed to allow wide-ranging discussion on the three intended outputs. It included plenary sessions on Tuesday morning, Wednesday and Friday morning, and parallel group sessions on Tuesday afternoon. In addition, participants were invited to contribute to the discussions through post-boxes which were available in the main conference hall. A *Programme Committee* responded to the outcomes of the sessions and the post-box contributions, and as a result recommendations were introduced into the plenary discussions.

The Africa Statement

In the preamble to the Africa Statement it was declared that 'in Africa today over half of the population is without access to safe drinking water and two-thirds lack a sanitary means of excreta disposal. It is a situation in which the poor are adversely affected to a disproportionate degree.

'Lack of access to these most basic of services necessary to sustain life lies at the root of many of Africa's current health, environmental, social, economic and political problems. Hundreds of thousands of African children die annually from water and sanitation-related diseases.

'Despite significant improvements during the International Drinking Water Supply and Sanitation Decade (1981–1990), progress has now stagnated. More people are today without adequate services in Africa than in 1990.

'In this light, professionals working in the water supply and sanitation sector from all over Africa have come together to seek solutions to their continent's problems. They have undertaken an extensive review of the water supply and sanitation sector throughout the continent with the objective of establishing the extent of the problem, identifying its causes and finding the way forward.

Guiding principles

The Forum discussed the 'Guiding Principles' by which Africa should seek to resolve its water supply problem:

Basic Right—Access to safe and affordable drinking water supply and adequate sanitation is a basic right and therefore a responsibility for all governments, who have signed conventions to take appropriate actions.

Decentralisation of Service Delivery—Government responsibility should devolve from provider of water supply and sanitation services to facilitator and regulator, while ensuring increased resource allocation to the sector. Responsibility for the ownership and management of facilities should be at the lowest appropriate level, through the most effective arrangement.

Demand Responsive Approach—Water Supply and Sanitation service delivery should be based on demand responsive and participatory approaches.

Partnership—Governments need to create an enabling environment to facilitate service delivery with the due involvement of all partners, including the private sector and civil society organisations.

Cost Recovery—Cost recovery should underpin sector investment decisions and actions for sustained service delivery. However, appropriate safety nets should be put in place to protect the poorest of the poor, taking into consideration willingness and ability to pay.

The African Action Programme

To address the huge backlog of unserved African people and to achieve the long term sustainability of services and optimal use of scarce resources, deliberate action and commitment are needed from everyone responsible.

African Chapter: African Commitment and Strategic Concerns

To conclude, members of the WASAI stated that with reallocation at national and international levels, there are enough resources to support water and sanitation interventions. With increased democratic governance, people expect better services, and African professionals should rise to that expectation. African professionals in the water supply and sanitation sector are dedicated to implement the contents of the Statement and that action ought to be taken urgently. They expressed their '*commitment through the establishment of the African Chapter, Water and Sanitation Africa Initiative (WASAI) to coordinate the urgent actions needed to bring the vision to reality*'.

DFID and the Columbian Ministry of Environment work in Partnership linking water and peace

Columbia's new Minister of the Environment, Dr Juan Mayr, met in December with officials from the Department for International Development (DFID) and the Foreign Office to discuss the Integrated Groundwater Management Pilot project.

Many areas in Columbia are dependent upon the supply of water obtained from underground resources.

During the meeting, Dr Mayr said that peace and water were the issues at the top of the Government's agenda. The new Government in Columbia is developing a new Integrated Water Resources Management Strategy and legal framework to develop and exploit its water resources in a sustainable manner well into the next century. The DFID are currently providing technical assistance to key institutions in the first integrated groundwater management pilot project in Columbia. Their objective is to provide the capacity to plan, implement and replicate socially, economically and environmentally acceptable groundwater management.

This multi-disciplinary, inter-institutional project has brought together numerous national, regional and municipal institutions, the private sector, non-governmental organisations and civil society organisations in two pilot areas: San Andres Island and the Cauca Valley. Dr Mayr pledged that his Ministry of the Environment would provide institutional political support so that this pilot project could be replicated throughout Columbia.

Desalination and the environment

We are pleased to announce that a major European desalination conference will be held in Las Palmas, Gran Canaria, Spain, 10–12 November 1999. The theme of this conference follows from the successful event held by the European Desalination Society in Genoa, Italy in November 1996. The conference is being held in conjunction with the Exhibition on Water, Energy and the Environment (CANAGUA 99) organised in Las Palmas.

As the next Millennium approaches, the need to safeguard and improve the environment is becoming ever more important. Desalination techniques are already making major contributions by providing water in arid countries and in purifying drinking and wastewater. This conference aims to present the latest developments in technologies for improving water production and quality, whilst maintaining environmental impacts such as energy consumption and effluent discharges.

The conference is being jointly organised by the European Desalination Society (EDS) and the IWSA, following their successful joint conferences in L'Aquila (1997), and Amsterdam (1998) on membranes and water production. The Water Science and Technology Association is also a sponsor of this conference.

Tambo re-elected President

Professor Norihito Tambo, the IWSA's second Vice President, has been re-elected President of Hokkaido University. Professor Tambo has held this position since 1995 and his re-election will mean a further two years in this prestigious role.

IWEX launches 1999 innovation award

To recognise and reward innovation in the international water industry, Turret RAI plc, organisers of IWEX, the international Water and Effluent Treatment Exhibition, have launched five special awards for its 1999 exhibition, to be known as the 'IWEX Innovations Awards'. Participation will be open to all IWEX exhibitors and companies who are represented by UK agents and distributors exhibiting at IWEX.

New Members

The IWSA is delighted to welcome our newest members:

C. A. Powell, UK

Carol Powell is a consultant metallurgist specialising in nickel-containing alloys. Over the past five years she has been increasingly involved in the use of stainless steels in the water industry. This has included technical support as well as participating in seminars and workshops in Korea, Australia New Zealand, Italy and the USA.

Dr R. Franceys, the Netherlands

Dr R. Franceys, the Associate Professor of Sector and Utility Management of IHE, Delft, is currently undertaking research for DFID (UK) on 'Contracting-out of services for water utilities' and on 'Marketing and service differentiation (marketing) for the poor', both

directed towards the needs of low and middle-income countries. He coordinates the Institutional Development Research Network for the Collaborative Council and is a member of the OFWAT Central Customer Service Committee.

K. Carlson, USA

Mr Carlson is an Assistant Professor in Environmental Engineering at Colorado State University.

Europroject Tecnologías, Spain

Europroject Tecnologías, S.L., provides assistance to financial, technical and commercial strengthening of public and private water and wastewater services. It also provides consulting and engineering services to the water and wastewater management and operation sector.

All-Water Technology Ltd

AWTL is one of the leading water services companies in the UK. It provides engineering consultancy, project management and a comprehensive range of contract series to the water industry, with particular specialisation in leak detection and flow monitoring.

FEATURE ARTICLE

Cryptosporidium Rules!..... OK?

GEOFF STANFIELD (PRINCIPAL SCIENTIST, WRc) AND PAUL GALE (SENIOR MICROBIOLOGIST, WRc)

Background

In May 1998 the Department of the Environment, Transport and the Regions and the Welsh Office published a consultation paper entitled 'Preventing *Cryptosporidium* Getting into Public Drinking water Supplies'. The consultation paper briefly reviewed the problems that this protozoan parasite had posed to the quality of drinking water supplies and proposed an amendment to the Water Supply Regulations which would establish the performance that water companies must achieve with regard to this organism.

The 'policy solution proposed' included the implementation of a standard which required that water entering supply must contain 'less than an average of 1 oocyst in 10 litres of water'. Compliance with the standard would be assessed on the basis of the results obtained from continuous monitoring every day of the year with at least 1000 litres being collected each day. Non-compliance would constitute a new criminal offence. Following the consultation period the Drinking Water Inspectorate (DWI) held a seminar in London in December 1998 to provide further details on the monitoring procedures and requirements for the provision of a chain of evidence for each sample taken.

So far there appears to have been no published comment on the standard. This paper concentrates on the scientific aspects of the proposed regulations rather than examining the more operational aspects of carrying out the monitoring to the standards stipulated in the DWI standard operating procedures.

General comment

The emergence of *Cryptosporidium* as a waterborne pathogen has emphasised the continuing need to ensure that the primary aim of water treatment is to remove microbial agents which are harmful to health. In the past, demonstrating the absence of faecal indicators such as *E. coli* in water works final water was taken as good evidence that water treatment had achieved this goal. Indeed, monitoring for specific pathogens was viewed, for many reasons, as being unworthy and, until publication of *The Water Supply (Water Quality) (Amendment) Regulations 1999* all UK, European and WHO microbiological standards for drinking water had been expressed in terms of faecal indicator bacteria.

The 1999 amendment is innovative in several ways in that it: (a) specifies a standard for a specific pathogen (*Cryptosporidium*); (b) requires that continuous sampling for this pathogen is carried out; (c) stipulates a sampling and analysis protocol which should secure a chain of evidence; and (d) stipulates a maximum admissible concentration well within the theoretical limits of detection of the prescribed method of analysis.

The proposed *Cryptosporidium* regulations are stated to be a treatment rather than a public health standard. This is a reasonable description, since virtually all microbiological standards (including those for coliforms and *E. coli*) for drinking water can be viewed in this way. To establish a public health stand-

ard an association must be demonstrated between the numbers of the causal organism (in this case *Cryptosporidium*) in the water supply and illness in the community served. While waterborne outbreaks of cryptosporidiosis are well-documented in the UK and USA, there is no clear association between oocyst concentrations measured in 'spot samples' taken during an outbreak and the observed illness in the population [1]. Indeed, in some outbreaks, monitoring did not detect oocysts in the supply. Furthermore, outbreaks have not always occurred when oocysts were detected in the water. Indeed in the UK, DWI notifications of oocyst counts up to 286 per 100 L have been detected with no associated illness or outbreak [1]. The lack of epidemiological data on what is the maximum permissible level for a pathogen therefore makes the design of numerical standards based on public health considerations virtually impossible.

Justification for a standard

New standards can only be justified if there is a recognised failing of existing standards (or processes) or evidence of a new microbiological threat to public health. There are several issues to consider when forming views on new standards, including:

1. Is the target organism appropriate?
2. Are the current methods of detection sufficient in terms of specificity, sensitivity, reproducibility and QA for that target organism in drinking water?
3. Is the monitoring protocol (frequency, volume) appropriate?
4. Is the standard achievable with cost-effective best available technology?
5. Will the standard achieve its objectives?
6. Is the standard necessary? Have the data supporting a new standard been interpreted correctly?
7. What are the future implications (better or worse) for the water industry of having or not having a particular standard?

Is the target organism appropriate?

The theory of traditional water microbiology does not support the use of routine monitoring for pathogens, recommending instead the use of organisms which are consistently present in likely sources of contamination in relatively high numbers and which can be detected in low numbers. The additional desirable quality of such indicators is that their survival in water and response to treatment processes closely mimics that of the pathogens of interest. Whilst coliforms and *E. coli* have proved to be valuable indicators, there have always been doubts concerning the comparability of their survival characteristics with those of pathogens such as enteric viruses. *Cryptosporidium* represents the greatest challenge to the use of faecal indicators such as *E. coli*. Oocysts of *Cryptosporidium* have been demonstrated to be much more resistant to the concentrations of oxidants used in water treatment. Additionally, differences in physical characteristics, such as surface charge and size, makes any similarities in removal efficiency by physical treatment processes less probable.

Recognition of the shortcomings of indicators such as *E. coli* has led to a search for alternative means for measuring the removal of *Cryptosporidium* oocysts by water treatment. Of these, particle counting and examination for bacterial spores (*Bacillus* and *Clostridium*) have been studied as surrogates for *Cryptosporidium*.

Whilst spores have shown some promise, analytical problems encountered with this extremely heterogeneous group, and suspicions that they could proliferate within sand and carbon filters, has tempered their use for control purposes. *Clostridia* spores tend not to suffer from some of these disadvantages, but low numbers in source waters can make their use very insensitive without some analytical development.

In the absence of a suitable indicator or surrogate it is difficult to argue that direct monitoring for *Cryptosporidium* is inappropriate.

Are the current methods of detection adequate?

From a scientific point of view this would appear to be the most contentious area of the new regulations. The methods currently described in the Standing Committee of Analysts '*Blue Book*' are known to be inefficient and not reproducible. However the development of methods for *Cryptosporidium* detection is an area of intense research activity.

The method prescribed by the new regulations is to a degree innovative, in that it requires the use of the Filta-max foam filter (Genera technologies). This filter has been shown, in trials carried out for DWI by the Public Health Laboratory Service, to be capable of filtering 1000 litres of water. Similar studies by the

WRc, as part of a European funded programme to optimise methods for the detection of *Cryptosporidium* and *Giardia*, has shown that the Filta-max gives an improved recovery of oocysts.

The DWI method also stipulates the use of an immunomagnetic separation system (Dynal) for secondary concentration of the oocysts. Again, the results obtained by WRc as part of the EU-funded study suggest that this is a useful and reproducible technique. For final detection and counting, DWI have retained the traditional approach of immunofluorescent labelling and microscopy. It is understood that the DWI approach is to use the traditional method of counting in order to allow analysis under the regulations without investment in other equipment. There is the opportunity for alternatives to be approved for use including the promising results that have been achieved, using solid phase cytometric methods such as the Chemunex Chemscan system. Manual counting and scanning requires a great deal of expertise and time, and as such represents a significant proportion of the cost of the analysis. Furthermore, counting is more prone to human error. The provision of some degree of automation of this process could potentially reduce costs and bring benefits in the time taken to obtain results; an important consideration in the microbiological monitoring of drinking water.

The choice of the Filta-max system could be seen as a bold quest for improved recovery, but it must be a matter of some concern to the water companies that their statutory monitoring responsibilities are dependent on one supplier. The stipulation of the Dynal immunomagnetic separation system could be criticised for the same reason, particularly since there are several other IMS systems which seem to offer at least as good performance.

There are numerous ongoing research studies into methods for the detection of *Cryptosporidium* and no doubt the ultimate goals of each of these will be to bring improvements in sensitivity, accuracy, reproducibility and ease and speed of detection. Whilst the DWI does not exclude a revision of its recommended procedure where there is scientifically based justification, experience suggests that this can be a long, difficult and therefore expensive process. Furthermore, the adoption of new methods will require extensive comparisons with the standard method and testing for method equivalence. The DWI has issued draft guidance on valifation of new methods. In addition, now that a standard has been set, a change to a more efficient method of recovery is likely to increase its stringency. It is to be hoped that this will not deter investment, since improved methods of detection not only for *Cryptosporidium* but also for other emerging waterborne pathogens have a major role to play in improving public health protection.

The method prescribed by the DWI is innovative to a credible degree. However, some parts are more prescriptive than others, presumably due to a lack of definitive information on some techniques. It is understood that it was necessary to have a method to allow the regulations to be introduced and that improvements to the method and alternative methods will be encouraged for evaluation.

Is the monitoring protocol (frequency, volume) appropriate?

As mentioned earlier, there is no clear association between the number of oocysts in a water supply and illness during an outbreak [1]. This reflects the huge variation (both spatial and temporal) in oocyst concentrations in treated waters. The variation is due to both variation in the oocyst loadings in the raw waters and the potentially large fluctuations in the removal efficiency of oocysts by drinking water treatment. Computer simulations in risk assessments funded by the DWI and performed at the WRc suggest, although have yet to prove, that during an outbreak the variation may be so large that within the given supply most consumers ingest zero oocysts per day, while a small proportion ingest high doses, approaching the ID_{50} for *Cryptosporidium parvum* of 130 oocysts per day [2].

Monitoring programmes should therefore be designed to detect the rare but all important high count samples. If oocysts came out of the treatment works in a homogeneous stream then spot sampling would be extremely useful and action levels could be designed to warn of the impending outbreak of illness in the population. Thus, a reading of 0 oocysts/1000 L, for example, would be very reassuring and representative of very low numbers across the whole supply. The fact that oocyst break-through occurs in a non-homogeneous manner places less significance on the 0 oocysts/1000 L samples. On the basis of our simulations for oocyst densities in 100 L volumes during a waterborne outbreak, one-third of all 100 L samples recorded 0 oocysts, while a small propor-

tion of samples contained hundreds and even thousands of oocysts. It is these rare but all-important high count samples that potentially cause a public health problem and should be detected by any sampling programme. By using a continuous monitoring programme (instead of single spot samples) the proposed Regulations would be more likely to detect the infrequent passing of high count oocyst 'spikes' into the supply.

Continuous monitoring for *Cryptosporidium* is only feasible because its decay rate in water is extremely slow. Whereas sampling of this type could be advantageous for other parameters such as *E. coli* it is unfeasible due to the decay in numbers which would occur during the sampling period. However, large volume sampling for less robust organisms such as coliforms and *E. coli* has often been recommended by the WRc [3], if not for statutory then operational purposes. The detection of <1 coliform or *E. coli* per 100 mL of water is of little operational value other than to demonstrate compliance. Using sample volumes at the compliance level (i.e. absence in 100 mL) does not forewarn of deterioration in water quality, which may be considerable before it is detected as a positive detection in 100 mL of water. As a consequence, 'occasional' or unexpected failures occur. The taking of larger grab samples, say, up to 100 L, allows failures to be anticipated or remedial action taken before infringement of the standard.

Will the standard achieve its objectives?

The standard was set for regulatory purposes. It is a treatment standard based on the experience that well operated treatment plants will have no difficulty in complying and that there have been no known outbreaks even at concentrations an order of magnitude greater than 1 oocyst in 10 L. The standard should result in improved treatment plant performance and therefore an improved protection of public health. However, the proposed Regulations do not require the complete elimination of oocysts. Risk assessment calculations show that the risk to the population is determined by the total number of oocysts which enter the supply [2].

In terms of a foundation for protecting public health, it could be argued that the proposed *Cryptosporidium* Regulations do not provide a level playing field. According to the proposed Regulations it will not be illegal to deliver 99 oocysts in each and every 1000 L of treated water every day of the year. For a works with an output of 50 ML per day, this would be 1.8×10^9 oocysts per year. Assuming that 1% of treated water is consumed and only 10% of that is actually imbibed unboiled, the net annual loading on the population would be 1.8×10^6 oocysts. Because the ID_{50} for humans is 130 oocysts, this is equivalent to 14 000 ID_{50}s per year. Potentially this hypothetical water supply could infect 7000 people per year without infringing the proposed Regulations. It should be noted that only a proportion of those infected will go on to develop illness.

In contrast, a company which potentially infected 200-fold fewer people per year could be prosecuted under the proposed *Cryptosporidium* Regulations. Again hypothetically, this could occur with a works which supplies 50 ML per day, but with zero oocysts in each and every 1000 L for 365 days of the year, except for one day when the counts rose to 180 oocysts in every 1000 L. The net annual loading on the population is only 70 ID_{50}s (compared to 14 000 ID_{50}s for the more consistently poor supply). In this case, the company has failed on a single sample and could be prosecuted.

Whether continuous monitoring is successful in overcoming the variation in oocyst densities in treated water and protecting public health will be judged by the number of reported situations in which, despite the treatment works complying with the new Regulations, a suspected water-associated outbreak of cryptosporidiosis is observed in the population. In addition, there may be some works which regularly fail the proposed Regulations although no outbreak may ever be observed in the population. Acquired immunity in those communities may play a considerable protective role in preventing outbreaks from supplies with consistently higher oocyst loadings in the treated waters [4].

The proposed Regulations are innovative in that the limit of detection (1 oocyst in 1000 L) is well below the maximum admissible concentrations (1 oocyst in 10 L). This will allow some forewarning of a change in the system that is indicative of an increased microbiological health risk to drinking water consumers. However, this raises the question of what actions should be taken if a significant change is indeed observed in oocyst counts. For example, consider a supply which regularly gave counts of 0 oocysts per 1000 L. What action should be taken if, for several

consecutive days, 50 oocysts/1000 L were recorded? Although the Regulations would not have been breached, this would clearly represents a change. As a prudent and minimum response, the water company would audit the catchments and works to rectify the problem but at what point, if at all, should health professionals be informed?

From the scientific perspective the proposed Regulations would provide epidemiologists with much better data on oocyst exposures to drinking water consumers. It will then be possible to relate those exposures to the observed incidences of cryptosporidiosis in the population. This will provide a quantification of how effective this treatment standard is in protecting public health.

Why now?

To be of value, standards must be achievable through the application of the best possible design and control technology. Do the new Regulations provide useful design criteria for treatment strategies, and if so why are improvements in treatment required now? Has *Cryptosporidium* emerged as a waterborne pathogen because of some gradual change in treatment strategy, such over-reliance on chlorination? Or is it that advances in diagnostic techniques have allowed the identification of illness formally classified as being of unknown aetiology? If the former, the use of a surrogate as an indicator of treatment performance may have been a more cost-effective alternative to a *Cryptosporidium* standard. If the latter, then risks to the community are no greater now than before these diagnostic techniques were developed. In this case the question needs to be addressed of what impact will comply with this treatment standard have on the incidence of illness in the community?

At the time of going to press, *Aqua* understands that while the basic principles of the regulations and the associated sampling and analysis protocols will remain the same, changes will be made to the detail of these regulations and protocols as a result of a consultation exercise.

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Innovative ways of finding water, Kobe, Japan

The United Nations Environment Programme/International Environmental Technology Centre (UNEP/IETC) is holding an International Symposium on Efficient Water Use in Urban Areas—Innovative Ways of Finding Water for cities.

The UNEP/IETC has a mandate to promote the adoption and use of Environmental Sound Technologies (ESTs) from sustainable urban and freshwater management. Given the rapidly increasing populations in cities, the issue of bringing water to those people is of major importance. The Symposium will focus on alternative and innovative ways of giving urban dwellers access to adequate supplies of water to meet their needs.

The Symposium will take place at the WHO Centre for Health and Development, Kobe, Japan on 8–10 June 1999. It will bring together experts, managers and community to consider this issue from the community/consumer perspective. For further information: tel.: +81 6 6915 4567; fax: +81 6 6915 0304; e-mail: jetc@unep.or.jp

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