WHO Report

Desalination for Safe Water Supply:

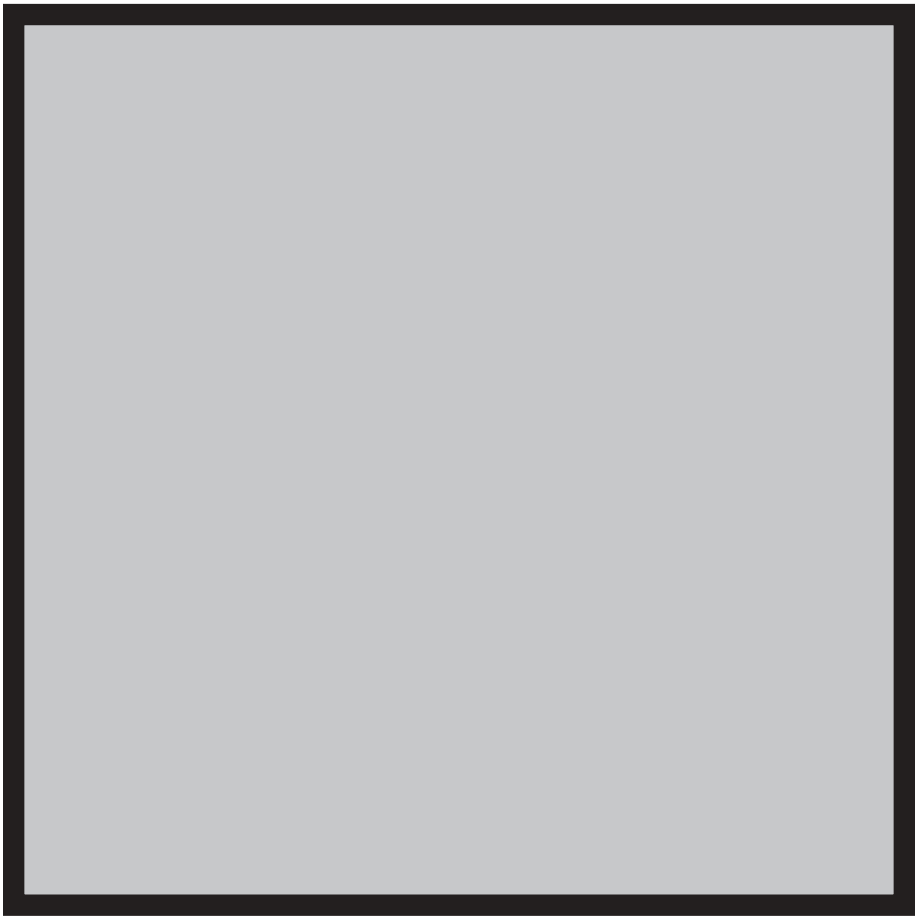
Guidance for the Health and Environmental Aspects

Applicable to Desalination

Geneva 2007

Review by Susan R. Feldman

The final output of the World Health Organization (WHO) Committee on Desalination for Safe Water Supply, led by Dr. Hussein A. Gezairy, WHO Regional Director for the Eastern Mediterranean, was finally released as a report to the public. Dr. Houssain Abouzaid, EMRO Coordinator, Healthy Environments Programme, initiated and managed the desalination guidance development process and Dr. Joseph Cotruvo, USA, acted as technical advisor. Sponsorship of the review document included such agencies as the US EPA's National Risk Management Research Laboratory in Cincinnati, Ohio; American Water Works Association Research Foundation (AwwaRF), Denver, Colo.; the Kuwait Foundation for the Advancement of Science; the Bureau of Reclamation, Denver, Colo. and several other agencies from around the globe. The members of various committees that performed compilation and reviewed the publication sources were hand selected; however, the criteria used to make the committee selection were not revealed.



A comprehensive report

Topics covered in the document include a detailed explanation of desalinated drinking water production and the health and environmental issues associated with the generation of drinking water by various methods included under drinking water production via desalination. The paper also addresses water safety plans, concentrates and residuals management, the chemical aspects of desalinated water, sanitary microbiology pertaining to its production and distribution, monitoring, surveillance and regulation and the environmental impact assessment (EIA) of desalination projects. Included in the report are various flow diagrams that graphically demonstrate the methods described.

The document is a comprehensive treatise on desalination technologies and cites numerous references for its sourcing. If a person is looking for a good comparison of methods by which to produce drinking water and wishes to compare and contrast these methods, this report provides such a service in a readable format.

For the purposes of interest and relevance to the readers of *WC&P*, this reviewer will limit detailed comments to the sections dealing with health and environment. These are the areas with which I take some issue.

The environmental impact of a de-

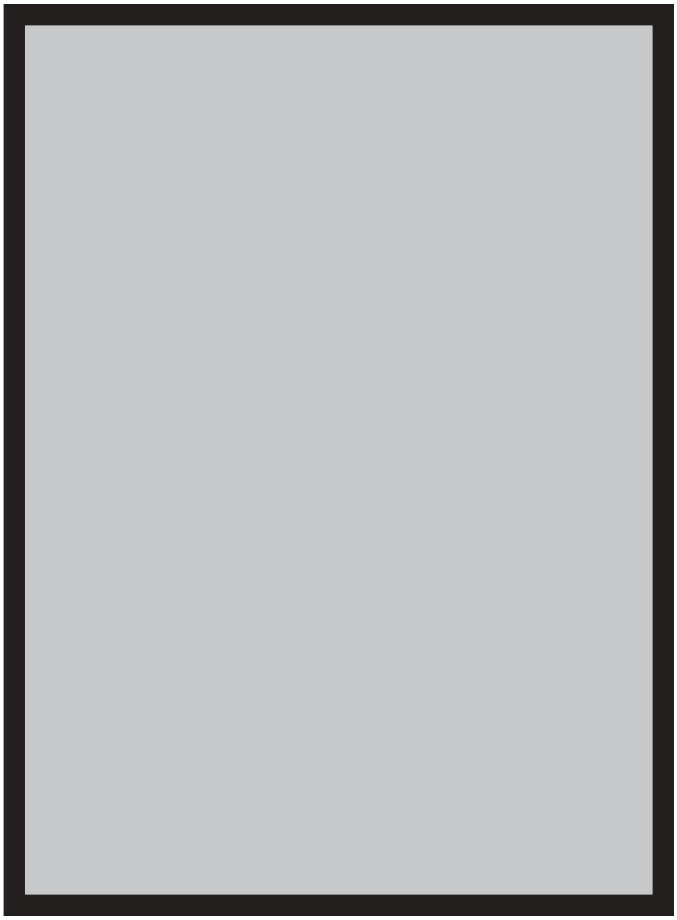
salination plant can be serious if precautions are not taken. Intake water can come from underground sources, lakes, streams or from the ocean. Since there are flora and fauna within these sources, steps are necessary to prevent the uptake of these species by the intake piping. The reasons stated were both practical and environmental. For intake, the process could become clogged with debris of living creatures/plants causing reduced efficiency and contamination. It is specifically at the discharge of waste materials where the environmental issues really come into play. Since the discharge contains high amounts of total dissolved solids (TDS) such as sodium, chloride, calcium, magnesium, iron, boron and other minerals dependent upon the source of the intake stream, release of these high TDS concentrates can affect the habitat of land or sea wildlife around the discharge area. The high TDS water can also create a temperature gradient or even a salinity gradient within the stream source receiving the outflow, especially if the desalination process is thermal desalination. All of these factors can upset the environmental balance, possibly impacting the stability of fish and other living organisms, including bacteria. The report identifies them in detail.

Desalination myths

The document briefly discusses the benefits of evaporation ponds over other methods of effluent discharge because it practices zero-discharge technology, thus having little impact on the environment, especially water-related. Once the water in the evaporation ponds has, in fact, evaporated, what is left can be disposed of in a landfill or sanitary disposal site or even below ground. The report discusses the potential benefit of using the concentrate for various applications, such as de-icing roads, etc. This entirely depends upon the make-up of the source materials. What the report does not mention is that this type of byproduct salt is often contaminated with various metals that most communities wouldn't want on their streets, where it would leave a residue that will end up back in the sewers and water treatment plants of the various communities. The paper even declares that the cost to separate the impurities from the salt or to purify the product makes the entire idea of purification from concentrate absurd from a cost-comparison standpoint. What the researchers probably are not aware of is that such attempts to sell dry concentrate residue have been fairly unsuccessful in the past. In most cases, even *giving away* this byproduct salt was difficult, except to some unsuspecting communities.

These desalination evaporation ponds are usually located in areas of the world where the weather is hot and dry. This creates a logistical problem, because the market for selling the residue as deicing salt is very far away from the production stockpile. So in theory, the idea sounds good…but in practice, it doesn't fly.

On the other issue of health, the WHO report claims to have many articles expounding upon the benefits of nutrients in water being potentially beneficial to the population. At the April 2006 meeting in Baltimore, Md. of the WHO Technical Committee to investigate the impact of calcium and magnesium in water on the health of various populations, the consensus was that there simply was not enough evidence to support the claim of water as a significant source of nutritive levels of these elements in the diet (see *WC&P* June 2006). Certainly, if a population has a relatively poor intake of nutrients in their diet, then the intake of water (presumably desalinated water) fortified with nutrients such as calcium, magnesium and possibly fluoride would provide a significant percentage of all available nutrients in the diet of that par-



ticular population—a matter of math, not science. But if the diet is fairly well-balanced, can one really predict a health benefit from either the lack or the presence of trace amounts of calcium and magnesium in the water? The science currently does not support either theory and it would be necessary to conduct research to answer the question adequately. Certainly, one could imagine that based on the numbers alone, it would appear that the water contribution would be negligible; but what if the water made the nutrients more bio-available? We just don't know and as scientists, we should not guess or jump to conclusions without evidence to support our theories. Nor should we risk the health of a population (possibly even the entire world if the adoption of nutrient-addition to water is seen as a benefit over soft water for drinking) because of poor logic passed off as scientific fact.

Calcium, magnesium and salt

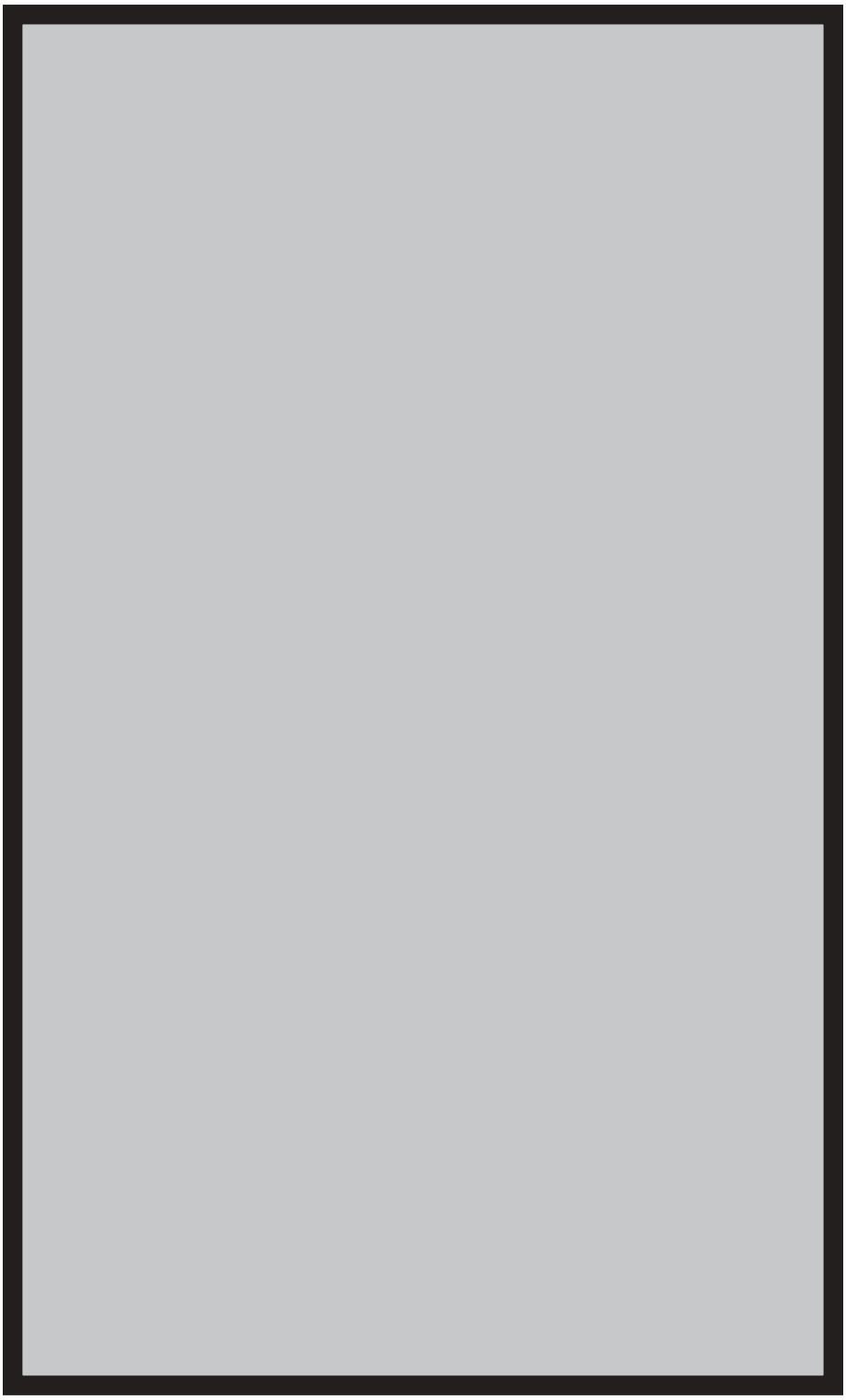
One particular example comes to mind from the report, where WHO states that infants would be subjected to negative consequences of high salt concentrations if source water were mixed with desalinated water in high ratios. Obviously, there are negative impacts from too much of anything, but what about the negative impacts from not enough salt? Several decades ago, there was a very serious outcome in the US to one company's decision to market a 'healthy baby formula' by severely reducing the salt level in their infant formula. The infants who ingested the low-sodium formulation began to exhibit symptoms of brain damage or retardation. The babies were not developing as quickly as their counterparts who were ingesting regular (not very low sodium) infant formula. In most cases, when the babies were taken off the very low-salt formula and given a regular formula with salt, the retardation was reversed (see references). This example should make one question the impact of severely reducing the salt levels in our diet to very low levels, since salt is a necessary nutrient. Yes, salt reduction does assist in lowering blood pressure in certain salt-sensitive populations, but when does salt lowering become dangerous, even to an adult? We don't have definitive answers to these questions, as the research has not been conducted.

In the report, WHO states that iodine fortification of water has been used in Russia as an example of how common the practice of fortifying water with nutrients actually is. I guess WHO is totally unaware of (or wishes to ignore) the vast strides made by the ICCIDD and UNICEF in the fortification of salt (sodium chloride) with iodine all over the world, as they don't mention it. That mode of delivering iodine for the prevention of goiter and mental retardation is the rule, not the exception, throughout the world. Yes, in the US and elsewhere around the globe, fluoridated water has reduced the incidences of dental caries for millions of people. Fluoridation of salt as a means of delivery to the public is also practiced in parts of Mexico, along with iodation.

Searching for a reason as to why the WHO desalination committee continues to promote the addition of calcium and magnesium to desalinated water, I keep coming up with a statement that appears to have no direct effect upon the health of the water users: the calcium or magnesium compounds that are added buffer the water, which provides a less-corrosive environment for the pipes! If the pipes were subjected to corrosion, there could be even worse additives in the water, harmful to those who drink the water. Oh and by the way, the buffering agent is nutritionally beneficial…are we supposed to *buy* this as a reason? We can add the carbonates to adjust the alkalin-

ity and protect the pipes—it is relatively inexpensive *AND* it *might even* be nutritionally beneficial if the people don't have a particularly good diet to start with! One's first inclination is to hope that WHO would not be motivated politically to benefit governments who need to deliver desalinated water and keep their plumbing working well at a low cost! Surely there must be other economical ways to keep the pipes from corroding? Yet perhaps adding alkali salts of calcium and magnesium might actually be beneficial or at least couldn't hurt those who drink the water, because these elements are present in many waters around the world.

Pondering this a bit more, I find myself thinking, "Gosh, this seems like a purely economic solution, possibly with some negative ramifications to the public." Until we have the proof needed to support the theory, I do implore the WHO to refrain from including nutrient fortification as anything but a voluntary suggestion to countries utilizing desalination.



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About the author

Susan R. Feldman, president of Susan Feldman Consulting LLC, has been involved in the salt industry since 1976. She began her salt experience on the bench as Chief Chemist for International Salt Company, which later became Akzo Nobel Salt Company. During her years with this US/Dutch salt company (as Susan R. Gelb), she held the positions of Quality Control and Technical Manager, Quality Assurance Manager, Director of Quality Assurance and Director of Product Technology. In 1997, she transferred to the chemicals division of Akzo Nobel Inc. in Chicago, Ill. as the US Manager of Quality Services, where she served as Chief Change Agent. In 2003, Feldman joined the Salt Institute as Technical Director until May 2006. She currently consults on salt technologies, has performed due diligence of salt manufacturing facilities, obtained environmental permits, dealt with governmental agencies and published treatises on salt history and technologies. Feldman was a Research Assistant for the Atomic Energy Commission in Berkeley, Calif. under the direction of Dr. Melvin Calvin (Nobel Prize winner for carbon pathways of photosynthesis) and James A. Bassham. Feldman has her MA in organic chemistry from the University of Scranton and a BA in chemistry from Douglass College (Rutgers, The State University). She is a member of the Salt Institute, Water Quality Association and the Pacific Water Quality Association, among others. Feldman may be contacted at Feldman Consulting LLC, 410 S. Pitt Street, Alexandria VA 22314; telephone: (703) 706-5841; email: susan@feldmanconsulting.com