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Improving America's Waters
Through Membrane Filtration and Desalting

WATER QUALITY solutions

Spring 2010

Desalination Concept

Joint Texas Regional Desalination Concept

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Introduction

Many parts of the United States are facing, or in the future could be facing, water shortages. Texas is a rapidly growing state whose population is projected to double by 2050, to 40 million people. As our population swells, human demands for water will put increasing pressure on our rivers, streams and aquifers. But water is a finite resource, and we must balance human needs with the survival of wildlife and healthy ecosystems. According to the 2002 Texas State Water Plan, if a drought occurs in 2050, almost half (43%) of the municipal water demand in Texas will not be satisfied by current sources. The best response to this situation is a thoughtful, feasible, and long-term plan for acquiring new water supplies and reducing demand (source: Texas Water Development Board, The Future of Desalination in Texas Volume 1, Biennial Report on Seawater Desalination, December 2004 [1]).

As municipal utilities explore alternative sources for fresh water, the desalination processes have grown in popularity. It is essential to coordinate and share information between municipal governments and seek joint regional approaches for the development of new water sources and advanced treatment processes.

Continued improvements in desalination technologies and the associated decrease in costs have made desalination a practical and cost-effective alternative source of water supply in Texas. In 2002, during the first round of water planning, only five regional water planning groups recommended desalination as a water management strategy. This number has since risen to 10 in the current (2006) round of water planning within Texas (source: Texas Water Development Board: Desalination FAQs [2]).

The World Health Organization recommends that the dissolved solids concentration (or salinity) of drinking water should be less than 500 parts per million (milligrams per liter). Less than 3% of the world's water has a salinity low enough for human consumption, and it is estimated that less than one-half of 1% of the world's water is safe for human consumption and is easily accessible (source: Desalination.com, "An Environmental Primer," by Tom Pankratz and John Tonner [3]). Disposal of desalination concentrate in an environmentally acceptable way has often been difficult, and the practicality and cost associated with desalination is directly proportional to the concentration of dissolved solids and the availability of alternative water sources. According to Pankratz and Tonner [3], as concentrations of dissolved solids increase, so does cost associated with desalination. Indeed, in some cases it can be more costly to desalinate brackish groundwater and seawater than to produce conventional fresh water supplies. However, it should be noted that freshwater supplies are limited and therefore they can be developed only up to a limit.

Contemporary pre-treatment and desalination technologies can offer means to recover fresh water resources from seawater, which is abundantly available. Desalination refers to any of several processes that remove excess dissolved solids (salts and other

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President's Message

Steven J. Duranceau,
University of Central Florida

Welcome to another exciting issue of *Solutions*! With each issue of *Solutions*, I take the opportunity to remind us of our Association's core mission: the improvement of our nation's water supplies through the widespread application of membrane technology. AMTA has clearly established itself as our nation's "Authority in Membrane Treatment" and is the only national organization advocating the use of membrane technologies for the improvement of water supplies. Our association continues to play in important role in the daily application of membranes across the Country. Together with our regional affiliates, the Southeast Desalting Association (SEDA), the South Central Membrane Association (SCMA) and the Southwest Membrane Operators Association (SWMOA), we are continually offered new opportunities to prosper in awareness and knowledge.

Please plan to join your fellow AMTA members at our next Technology Transfer Workshop, "Membrane Treatment in the Heart of the Great Smoky Mountains" to be held between May 4 and 10, 2010. This event includes two unique facility tours, the first to the Isom Lail Memorial 8 MGD water treatment plant, and the second to the City of Alcoa's submerged 16 MGD Ultrafiltration water treatment plant. The program includes topics on membrane basics, facility tours, case studies from the Tennessee Valley, and water quality. It will be worth your effort to attend.

Also please do not forget to head to San Diego in July 2010 to meet with your Board of Directors, including myself, from July 12th to 15th at our Annual Conference and Exposition and experience *"Membrane Technology: The Wave of the Future has Arrived!"* which will be held at the Town and Country Resort and Convention Center in San Diego, CA. Your AMTA Board knows that attending workshops and conferences during harsh economic times can sometimes be problematic if not prohibitive. However, the value of participation far outweighs the financial need to conserve valuable resources. AMTA's annual event offers networking advantages unlike other conferences, including interaction with vendors having name and brand recognition.

We have planned a most unique program to include the highly anticipated *"2nd Osmosis Membrane Summit"* that will take place in conjunction with Europe's largest renewable energy company, Statkraft, at our annual event. The *"2nd Osmosis Membrane Summit"* is designed to serve as an international forum for membrane practitioners interested in the exciting new area of pressure retarded osmosis technologies. There is no doubt that the July AMTA-Statkraft conference will be the event that further defines and stimulates membrane use in the next decade (please visit http://www.statkraft.com/ to learn more about this outstanding company). I am confident that the our July 2010 Summit and Annual Conference will provide engineers, designers, regulators, manufacturers, and other interested parties the latest technical information necessary to remain at the forefront of the ever expanding membrane industry which remains in a constant state of flux.

Please enjoy this issue of *Solutions*, AMTA's informative publication that provides our membership important information with each issue that is designed with the intent of reporting on Association activities in addition to offering articles that advance your knowledge regarding the application of membrane technologies for the improvement of our nation's water supplies.

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PUBLICATION SCHEDULE

Winter
Pretreatment

Spring
Water Quality

Summer
New Facilities

Fall
Membrane Residuals

AMTA *Solutions* is published quarterly for the members of AMTA. AMTA *Solutions* is mailed to AMTA members and published on the AMTA website.

From the Editor

By: C. Robert Reiss, PhD, PE

SUBMIT YOUR ARTICLE TODAY!

AMTA *Solutions* continually solicits technical articles for future issues. We are currently collecting articles in a variety of water treatment subject areas such as Pretreatment, Water Quality, New Facilities and Membrane Residuals. Contact AMTA for additional information.

It has been quite a winter, as throughout the United States snowfall and winter temperatures have shattered records, and kept millions of Americans home from work or school. As springtime approaches and the snow banks begin to recede, many parts of the country will see a significant impact to the volume and quality of freshwater sources. What better time for *Solutions* to publish our annual water quality issue?

This issue contains two technical articles which cover different areas in our membrane world. Our first feature discusses a new approach to water shortage issues in the State of Texas. While the article focuses on the increasing water demands of the Lone Star State, the issues and challenges discussed resonate throughout the southern United States, particularly now as spring begins its lazy roll into summer, and dry weather sets in.

In our second feature, we look more closely at the prevention and mitigation of disinfection byproducts in low pressure membrane systems. As low pressure applications continue to grow in popularity, mitigation strategies to meet regulatory standards are becoming more important every day.

In addition to our technical articles, we take a look back to 1974 and the first publication of the National Water Supply Improvement Association. NWSIA eventually gave birth to the AMTA organization, and as we can see from the journal, faced many of the same considerations membrane technology faces today.

We close this issue with a recap of our January Technology Transfer Workshop in San Juan, Puerto Rico. While much of the US was buried in snowfall, some AMTA members were able to escape the winter weather to attend the workshop. The event was a tremendous success and brought together an international group of membrane enthusiasts to share ideas and information.

Finally, I urge you to consider submitting articles for publication and to share your ideas and experiences with us all. Submissions and inquiries can be sent to either me (crreiss@reisseng.com) or Steve Lash (sjlash@reisseng.com). I hope you will enjoy this issue of *Solutions* and look forward to your feedback.

Ben's O&M Tip Corner

By: Ben Mohlenhoff

If you have a tip or a suggestion for a future O&M article, please contact Ben Mohlenhoff
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Single Membrane Element Test and Cleaning Station

In keeping with the theme of this issue I thought I would like to discuss a very important tool that is frequently overlooked when designing a membrane facility. We all agree that maintaining optimum water quality is key to a successful facility. Unfortunately we do not always provide the operators and maintenance staff with all the tools they will need to carry out this task.

Most large membrane facilities are constructed with a CIP system to facilitate cleaning of the membranes. The fact that we invest money to provide a method of cleaning membranes would appear to indicate that the cleaning of membranes at a membrane treatment plant is normal and to be expected.

Unfortunately the CIP system alone is not enough to get the job done effectively in many instances. To be most effective, you need accurate information about the condition of the membranes you wish to clean.

If you have a single membrane element Test/Cleaning Station at your facility you can quickly and easily conduct a performance evaluation of specific membranes from your system as they age or foul. A properly designed T/C Station will also allow you to evaluate the effectiveness of a proposed cleaning regime on a membrane from your system.

It is definitely cost effective to design a cleaning procedure on a small scale before investing in the manpower, down-time and hundreds of pounds of cleaning chemicals needed to do the full scale cleaning of a large membrane unit.

A single membrane element Test/ Cleaning Station is relatively inexpensive. It will only take one successful cleaning for you to realize the significance of this tool.

The better the information you have on the condition of your membranes the better the water quality from your facility can be.

Ben's Design Tip Corner

By: Ben Movahed

If you have a tip or a suggestion for a future design article, please contact Ben Movahed
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Don't Design a Membrane Plant Like a Two-Car Garage

With the average car being 16'x6' and a standard two-car garage of 20'x20', a garage is meant to merely be a storage space for your car, allowing a person to only get in and out of the space, with doors partially open. The approximate 2.5' left between car does not leave much room to do any major maintenance. That is why the mechanics or those pretending to be a "mechanic", pull the car out of the garage to do any major repairs or maintenance.

Unfortunately, I have seen many membrane plants that are designed just like a residential garage with multiple membrane skids that do not have adequate space for regular and major maintenance. I have even seen plants where the window has to be removed to replace RO elements! Here is what you should consider when laying out a membrane plant, unless you are asking the operators to take the membrane skids out of the building to do maintenance on them!

• Ensure adequate space is at both ends of the RO skids for element removal. Remember that we load them at one end and unload them from the other end. A minimum of 6'-7' would be adequate for standard RO/NF elements.

• If you have any instruments, flow meters, valves or anything that requires maintenance on top of the skid, leave 5'-6' so people can crawl up there. Also ensure there is at least a 2'-3' clearance to the bridge crane hook, if there is one. Even if you don't have such devices, leave 4' so they can clean the dust off once in a while. Also, don't forget those suspended light fixtures, HVAC duct work and cables and conduits.

• Leave at least a 5'-6' space between skids so they can get access with a forklift. Even if you think they will not use a fork lift, sometimes they have no other choice.

• Most electrical codes require 2'-3' in front of open panels and electrical cabinets.

• If there is equipment, such as pumps, cartridge filters, etc on the skid, allow adequate room to take them out and squeeze them between skids.

• If the facility has to be ADA compliant (which is unusual for process rooms), make sure you allow the required turning radiuses.

• If there are CIP connections on the skid, allow for turning radiuses of hoses. They could be significant.

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minerals) from water. The public's perception of desalination can mean different things to different people. Most people associate the term "desalination" solely with seawater desalination and are unfamiliar with its application to remove dissolved solids and minerals from subsurface groundwater, to polish or purify non-potable water for potable or beneficial reuse, and to reclaim and reuse domestic wastewater.

Seawater contains high concentration of dissolved salts. Conventional treatment technologies used to remove suspended solids and organic matters will not significantly reduce dissolved solids. Municipal and industrial water entities require that seawater be desalinated prior to potable usage. It may therefore be pertinent to briefly review desalination methodologies now.

Desalination Methodologies

Three types of desalination technologies are most common: (1) membrane separation, (2) electrodialysis, (3) distillation. Each is briefly outlined here.

Membrane separation: Among many desalination technologies, membrane separation is most often used in the United States. Considering the water quality after pretreatment, a multi-stage combination of micro-, ultra-, nano-filtration and/or reverse osmosis may be suitable for subsequently removing residual macro, medium, and small organic molecules and then inorganic cations and anions (dissolved salts). A challenge to membrane technology always is membrane fouling and degradation of membrane by foreign substances or chemicals. Because of this, membrane desalination process will be preceded by a thorough pretreatment to remove most of suspended particulates and foreign substances. The concentrate produced from desalination process will be a fraction of original volume. For seawater desalination, the concentrate can be disposed of in an environmentally acceptable manner.

The membrane process technology has a number of advantages: (1) One can add capacity as needed; (2) it is simple in construction; (3) it is compact; (4) its operation is automated; (5) it entails energy versus chemical; and (6) its costs are decreasing. However, it also has disadvantages: (1) Economies of scale favor larger facilities; (2) recovery entails concentrate disposal; (3) it is difficult to see what is going on; and (4) it is energy intensive.

Electrodialysis: The process is used to transport salt ions from one solution through ion-exchange membranes to another solution under the influence of an applied electric potential difference. On the other hand, Electrodialysis Reversal is a similar process, except that the cation and anion reverse to routinely alternate current flow.

Electrodialysis and Electrodialysis Reversal technology has a number of advantages. (1) It can remove or reduce a host of contaminants from feed water; (2) the process is not as sensitive to pH or hardness levels in feed water; (3) the process is adaptable to various operation parameters; (4) it requires little labor; and (5) the maintenance costs are generally low. However, it also has disadvantages: (1) Treatment costs are directly related to the total dissolved solids concentration in feed water and are not economical for higher total dissolved solids concentrations; (2) in general only ions are removed from a feed solution; and (3) it involves high energy consumption for desalination of concentrated feed solutions.

Distillation: Desalination could also be achieved by thermal, evaporation and distillation approaches. This will be especially attractive if a waste-heat source is available. In areas with abundant sunlight, solar distillation could be considered. Distillation technology has a number of advantages: (1) Distillation offers significant savings in operational and maintenance costs compared with other desalination technologies; (2) in some applications, distillation does not require the addition of chemicals or water softening agents to pretreat feed water; (3) low temperature distillation plants are energy-efficient and cost-effective to operate; (4) many plants are fully automated and require a limited number of personnel to operate; (5) distillation has minimal environmental impacts, although brine disposal must be considered in the plant design; (6) the technology produces high-quality water, in some cases having less than 10 mg/1 of total dissolved solids; and (6) distillation can be combined with other processes, such as using heat energy from an electric-power generation plant. However, distillation also has disadvantages: (1) Some distillation processes are energy-intensive, particularly the large-capacity plants; (2) disposal of brine is a problem in many regions; (3) the distillation process is often very costly; (4) distillation requires a high level of technical knowledge to design and operate; and (5) the technology requires the use of chemical products, such as acids, that need special handling.

Rationale for Desalination

With the world population exceeding six billion and continuing to grow rapidly, there is ever increasing pressure to satisfy the growing municipal, agricultural and industrial water demands of society. Since fresh water resources account for less than three percent of the entire global water budget, it is becoming necessary in many regions of the world to explore seawater desalination to meet future water demands. Closer to home, the population of Texas is expected to double in the next 50 years. The 2002 Texas Water Plan indicates that about 900 cities and water user groups in Texas, representing nearly 38 percent of the state's population, could face water shortages during droughts within the next 50 years unless they reduce demand or develop additional water sources. According to the 2002 Texas Water Plan, supplies from existing water sources in Texas are expected to decrease 19 percent, from 17.8 million acre-feet per year (mafy) in the year 2000 to 14.5 mafy in 2050. While the available supplies are expected to decrease, municipal demand is projected to increase by 67 percent, and manufacturing demand is expected to

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increase by 47 percent over the next 50 years [9].

According to a new report from the National Research Council [4] [5], desalination will likely have a niche in meeting the nation's future water needs, for recent advances in technology have made removal of salt from seawater and groundwater a realistic option for increasing water supplies in some parts of the U.S. A coordinated research effort with steady funding is, however, required to better understand and minimize desalination's environmental impacts -- and find ways to further lower its costs and energy use. "Uncertainties about desalination's environmental impacts are currently a significant barrier to its wider use, and research on these effects -- and ways to lessen them -- should be the top priority," said Amy K. Zander, chair of the committee that wrote the report and professor at Clarkson University, Potsdam, N.Y. "Finding ways to lower costs should also be an objective. A coordinated research effort dedicated to these goals could make desalination a more practical option for some communities facing water shortages." Often environmental issues can be addressed in a field pilot test.

In the United States, most seawater desalination facilities are small and are used for high-valued industrial and commercial needs. This may however be changing, for technology has improved, demands for water have grown, and prices have dropped. As a result, interest in desalination has recently mushroomed, especially in California, where rapidly growing population, inadequate regulation of the water supply/landuse nexus, and ecosystem degradation from existing water supply sources have forced rethinking of water policies and management. In the past five years, public and private entities have put forward more than 20 proposals for large desalination facilities along the California coast [see Table 1.]. If all of the proposed facilities were built, the state's seawater desalination capacity would increase by a factor of 70, and seawater desalination would supply 6% of California's year 2000 urban water demand. Project proponents point to statewide water-supply constraints, the reliability advantages of "drought-proof" supply, the water quality improvements offered by desalinated water, and the benefits of local control. Along with the proposals, however, has come a growing public debate about high economic and energy costs, environmental and social impacts, and consequences for coastal development policies [6].

Table 1.
Proposed Plants in California as of Spring 2006 [6]

Operator	Location	Max Capacity MGD	m3/d
Marin Municipal Water District	San Rafael	10-15	38,000-57,000
East Bay Municipal Utility District/ San Francisco Public Utilities Commission/ Contra Costa Water District/ Santa Clara Valley Water District	Pittsburg/Oakland/ Oceanside	20-80	76,000-300,000
East Bay Municipal Utility District	Crockett	1.5	5,700
Montara Water and Sanitary District	Montara	N/A	N/A
City of Santa Cruz expansion to 4.5 expansion to 17,000	Santa Cruz	2.5, possible	9,500, possible
California American Water Company	Moss Landing	11-12	42,000-45,000
Pajaro-Sunny Mesa/Poseidon	Moss Landing	20-25	76,000-95,000
City of Sand City	Sand City	0.3	1,100
Monterey Peninsula Water Man. District	Sand City	7.5	28,000
Marina Coast Water District	Marina	1.3	4,900
Ocean View Plaza	Cannery Row	0.05	190
Cambria Community Services District/	Cambria	0.4	1,500
Department of the Army			
Arroyo Grande/Grover Beach/	Oceano	1.9	7,100
Oceano Community Services District			
Los Angeles Dept. of Water and Power	Playa Del Rey	12-25	45,000-95,000
West Basin Municipal Water District	El Segundo	20	76,000
Long Beach Water Department	Long Beach	8.9	34,000
Poseidon Resources	Huntington Beach	50	190,000
Municipal Water District of Orange County	Dana Point	25	95,000
San Diego County Water Authority/	Camp Pendleton	50, expanding to 100	190,000, expd to 380,000
Municipal Water District of Orange County Poseidon Resources	Carlsbad	50, possible expansion to 80	190,000, possible expd to 300,000
San Diego County Water Authority	Carlsbad	50, possible expansion to 80	190,000, possible expd to 300,000

Pending Seawater Desalination Construction Cost

The Camp Pendleton Project in California is being considered for continued funding by the directors of the San Diego County Water Authority. The project is expected to be online in 2018 and serve the needs of the army base as well as the municipality of San Diego. This facility is projected to be a Seawater Desalination Plant capable of treating 50 to 150 million gallons per day (189,250 to 567,750 cubic meters per day) of water with a prospective budget of 1.25 to 1.91 billion dollars [7].

The Port Stanvac Project in Australia is estimated to be online in 2012. This is projected to be a Seawater Reverse Osmosis Facility capable of treating 74 million gallons per day (280,000 cubic meters per day) of water with a prospective budget of 1.3 billion dollars [7].

The first phase of the Granadilla, Tenerife Project in Spain is estimated to be online sometime in the future. Projections indicate this will be a Seawater Reverse Osmosis Plant capable of treating 3.7 million gallons per day (14,000 cubic meters per day) of water with a prospective budget of 25 million dollars [7].

Desalination Solutions Widespread in Texas

The gap between diminishing supplies and increasing demands can be met through a combination of strategies: reduce, recycle, reuse, conserve, and efficient use. These strategies can be combined with producing new supplies of water such as desalinated water, or through a combination of both methods. According to the International Desalination Association, the United States is ranked as having the second largest total desalination capacity of any country in the world. This is due to the numerous inland desalination plants that are used to treat brackish surface water and groundwater. In Texas, more than 100 desalination units produce about 40 million gallons per day (mgd). All desalination plants in Texas currently use either brackish surface water or brackish groundwater as their raw water source. Municipal desalination in Texas accounts for 23 mgd while industrial desalination is approximately 17 mgd. Prominent municipal desalination sites in the state using surface water as their raw water source include Sherman (Lake Texoma), Robinson (Brazos River), and Lake Granbury, while Ft. Stockton and Kennedy use brackish groundwater. Reverse Osmosis (RO) desalination systems are currently the most commonly used systems in Texas [see Figures 1 And 2.]. Regardless of the technique employed, desalination offers many benefits and advantages over other conventional forms of water resource development. The most important advantage is that desalination provides a relatively drought-proof water resource. There is no need to build expensive dams or reservoirs nor deal with issues such as land submergence and flooding [9].

Table 2.
Seawater Desalination Contracted Water Cost [8]

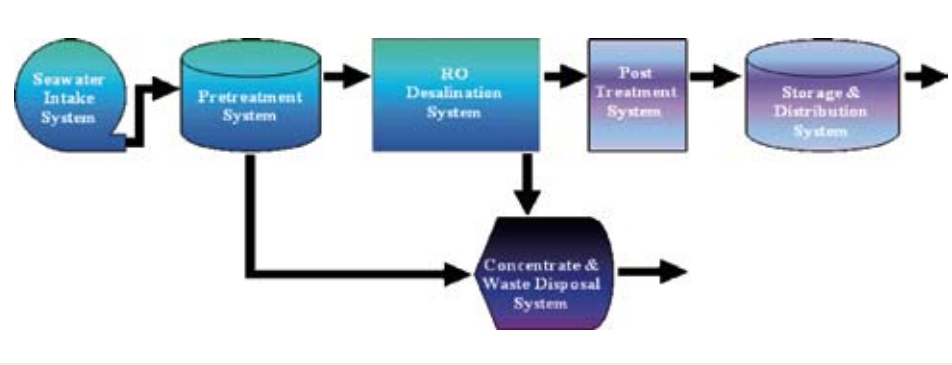
Project	Size (mgd)	$/1000 g	$/acre-ft
Tampa Bay ***	25	2.57	837
Ashkelon, Israel	36	2.00	652
Ashkelon, Israel 2	36	1.89	616
Larnaca, Cyprus	14	2.76	900
Trinidad	30	2.69	877
Shuweihat UAE **	120	2.61	851
Taweelah B, UAE **	63	2.65	864
Taweelah C, UAE	60	2.35	766
Texas *	50	2.10 – 2.30	684 - 750
Southern California*	50	2.41	784

Note: * = estimated, ** = thermal desalination, *** = revised
Transmission Distance and Integration Costs vary for each project
Source: TWDB – The Future of Desalination in Texas Volume II, Page 100

Treatment Approach

Advanced treatment of seawater could be a combination of several of the above mentioned processes, including both physical and chemical processes and biological process. A thorough review and evaluation should be conducted when considering the advantages and drawbacks of each treatment technology for use in treating seawater from the Gulf Coast of Texas. Immense effort will be

Figure 1.
Representation of a typical Reverse Osmosis Seawater Desalination Process



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taken to collect useful information and analyze the results. Based on the facts, a treatment approach should be utilized that incorporates the most suitable technologies for removing dissolved salts. Initially a team should design a laboratory-scale treatment system and operated with actual seawater that will be utilized by the full-scale plant. Each treatment stage should be monitored. The initial treatment results will be used to modify and optimize the design. The compatibility of different treatment technologies should be analyzed.

The initial investment and operation and maintenance cost will be evaluated and compared to the cost from current common seawater desalination practices throughout the world. Social and environmental benefit will be factored into the evaluation.

Joint Texas Regional Concept

Various regions throughout Texas are potentially major contributors to the pending seawater desalination facilities. It will therefore be important to coordinate long range planning efforts with potential cities in need of new water resources. The desalination process is essentially "drought proof" since seawater is an endless supply source.

Cities, such as Pearland, Alvin, Freeport, San Antonio, Austin, Corpus Christi, Brownsville, Houston, and potentially Dallas/Fort Worth should consider desalination of seawater through a joint regional approach for new demands. Cities in west Texas may also be strong candidates as partners in this concept.

Desalination of seawater is a cost effective approach and treated water can be transported via new pipelines to meet these new demands. Projections should be carefully calculated and it will be necessary to develop criteria for advanced treatment facilities. A lead team will be necessary to coordinate data between municipalities and collect forecast for long range planning, design, construction and operation of a Joint Texas Regional Seawater Desalination Facility.

Figure 2.
Representation of Reverse Osmosis Membrane Filtration

According to the Environmental Defense Fund (http://www.edf.org/page.cfm?tagID=66): Environmental flows are the fresh water flows needed in our rivers and streams, and flowing into our bays and estuaries, to support healthy fish and wildlife populations.

Fair and equitable regional water swaps could be considered to help address Texas' diminishing fresh water resources. Surface water could be used upstream, as long as environmental flows [10] were maintained and surface water rights could be sustained downstream.

Upstream communities using more than their allotment of surface water could pay to construct seawater desalination facilities with appropriate infrastructure downstream in strategic locations along the Texas Gulf Coast. The upstream communities would reimburse the downstream communities for any cost associated with the Joint Texas Regional Seawater Desalination facilities that exceeded the cost associated with the downstream communities' conventional

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surface water supplies. This would help assure an equitable water (quantity and cost) swap approach between upstream and downstream communities.

This equitable water swap strategies could be advantageous for consideration between:

- North Central Texas and South East Texas
- South Central Texas and South Texas

Communities must portray a spirit of joint regional partnerships to help alleviate Texas' diminishing fresh water resources and no longer can municipalities seek other communities to be customers for their water utilities. The Regional Seawater Desalination Water Swap Concept truly aligns with the joint partnership intent of the Texas State Water Plan.

There are several benefits of a Joint Texas Regional Seawater Desalination Plant: (1) Flexibility in facility size and source water; (2) minimal reliance on extended delivery systems; (3) the opportunity for local control of water supplies; (4) reduced dependence on inland sources; (5) very high quality potable water; and (6) a reliable more sustainable water source even in times of drought.

It is desirable to consider desalination as a regional or state water supply, because it helps establish economies of scale, is favorable to funding agencies, favorable grant potential, and has potential for additional partners.

Equipments and Laboratory

A laboratory-scale treatment system should be set up and operated in conjunction with sending water samples to an accredited laboratory. The Water Quality Laboratory will be equipped with all necessary instruments and will analyze all of the required water quality parameters for this project.

Conclusion

All valid advanced treatment approaches should be evaluated for the Joint Texas Regional Seawater Desalination Plant. However, conditions seem to favor seawater reverse osmosis treatment at this point in the evaluation.

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Authors

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Prof. V.P. Singh, PhD, DSc, PE, PH, Hon. DWRE, holds the Caroline and W. N. Lehrer Distinguished Chair in Water Engineering., and is also Professor of Biological, and Agricultural Engineering, and Civil and Environmental Engineering at Texas A & M University. He has authored 15 text books, edited 49 reference books and authored 72 book chapters, more than 510 refereed journal articles, and 320 conf. proc. Paper and 70 tech. rep. He is Editor-in-Chief of Water Science and Technology Book Series of Springer, ASCE Journal of Hydrologic Engineering, and Water Science and Engineering. He has received more that 50 national and international awards and numerous honors, including the ASCE's Arid Lands Hydraulic Engineering Award; Distinguished Research Master Award from Louisiana State University; ASCE's Ven Te Chow Award; ASCE's Torrens Award; AIH's Ray K. Linsley Award; AIH's Founders Award; Hon. PhD from University of Basilicata, Italy. He is a fellow ASCE, AWRA, IE, IAH, ISAE and IWRS. He is a member/fellow of 10 international science and engineering academies.

Strategies for Disinfection Byproduct Mitigation in Low-Pressure Membrane Systems

By Robert P. Huehmer, CH2M HILL

The use of low-pressure membrane filtration (microfiltration and ultrafiltration) for the production of potable water has grown rapidly in the past decade. The general acceptance of low-pressure membrane filtration in the industry has resulted in increased innovation in application of the technology. As low-pressure membrane filtration is applied to raw water possessing poorer initial quality, the probability of increased disinfection byproduct (DBP) formation increases. DBP formation is influenced by a number of factors, including disinfectant, disinfectant concentrations, precursor concentrations, temperature and pH. DBP precursors and the formation of DBPs increases as temperature increases. The pH of the water has an impact on the formation of halogenated byproducts with the total trihalomethane (TTHM) formation increasing with increasing pH. Seasonal variations in the concentration of DBP precursors such as humic and fulvic acids also occur in natural waters. The increased natural organic matter (NOM) concentrations in the raw water result in higher chlorine demand to establish a disinfectant residual for pathogen inactivation. The higher chlorine demand results in greater DBP formation. The higher water temperatures present during the summer also contributes to higher DBP concentrations in the summer than during the winter.

The Stage 1 Disinfectants and Disinfection Byproducts Rule (D/DBPR) was developed to reduce chronic health effects as a result of disinfectant residuals and the formation of disinfection byproducts in potable water as a result of disinfection practices. The rule limits the concentration of disinfectant residual and disinfection byproducts allowed in the distribution system. EPA promulgated the Stage 1 D/DBPR in December 1998. This rule is applicable to all community water systems and non-transient non-community water systems that add a disinfectant, and transient non-community water systems that use chlorine dioxide.

The Stage 2 D/DBPR regulates the public health risks associated with DBPs and disinfectant chemicals in drinking water. The rule lowers the only pre-existing Maximum Contaminant Level (MCL); establishes new MCLs, Maximum Contaminant Level Goals (MCLGs), Maximum Residual Disinfectant Levels (MRDLs), and Maximum Residual Disinfectant Level Goals (MRDLGs); and extends MCLs to all system sizes. Table 1 lists the disinfectant MRDLGs and MRDLs for different disinfectants. Table 2 lists the MCLGs and MCLs for regulated DBPs.

Table 1
National Primary Drinking Water Standards for Disinfectants

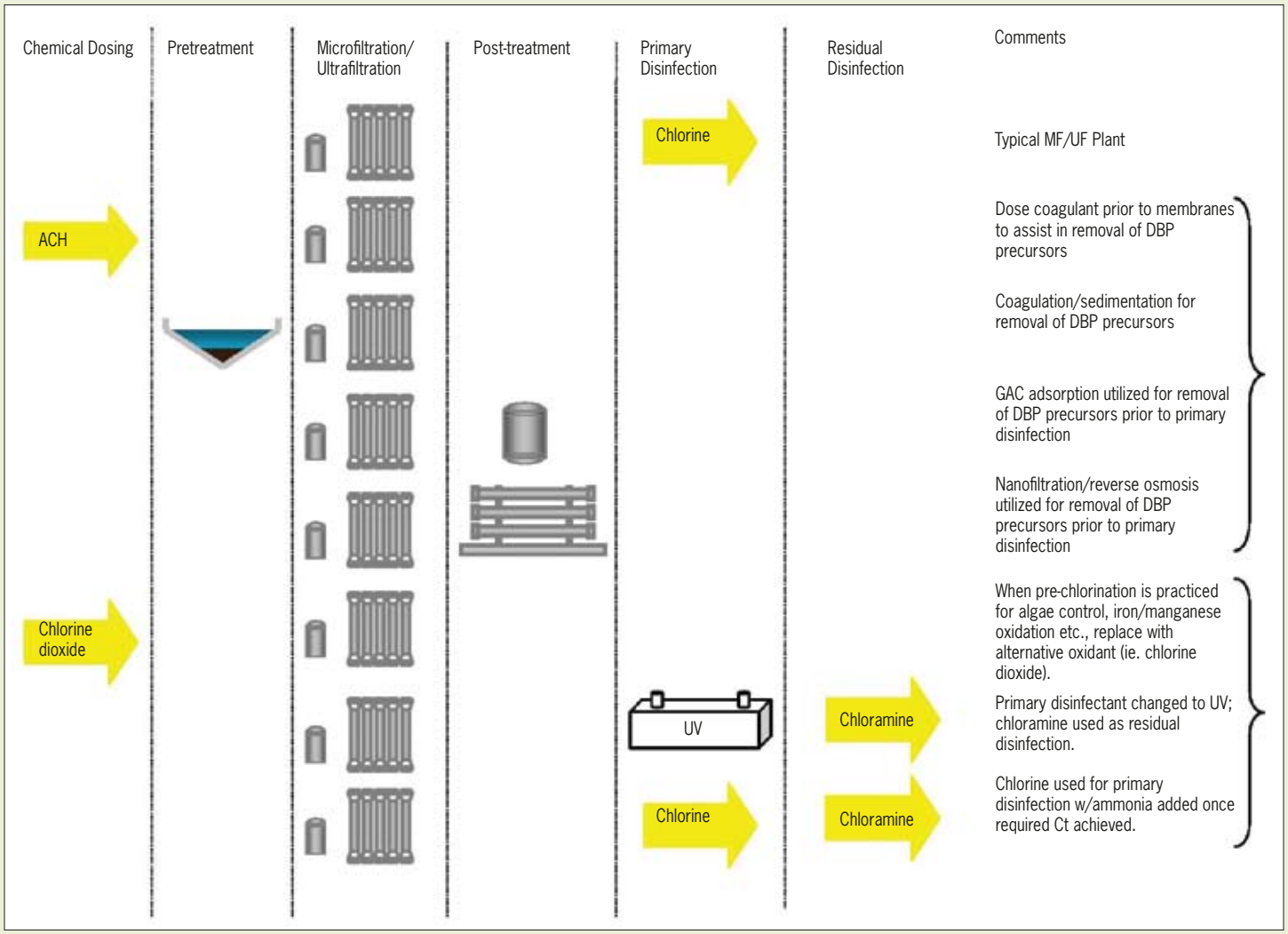
Disinfectant	MRDLG (mg/L)	MEDL (mg/L)
Chlorine	4 (as Cl2)	4 (as Cl2)
Chloramines	4 (as Cl2)	4 (as Cl2)
Chlorine Dioxide	0.8 (as ClO2)	0.8 (as ClO2)

The rule also requires using enhanced coagulation or enhanced softening for conventional filtration systems to remove disinfection byproduct precursors prior to disinfection. Under current EPA definitions, membrane systems are excluded from TOC removal requirements under the Enhanced Coagulation Treatment Technique, as they do not possess a settling step to handle the sludge produced by the enhanced coagulation step. Compliance with the Stage 1 D/DBP rule for membrane systems requires that the MCLs for the regulated disinfectants and contaminants not be exceeded during the required monitoring period.

Table 2
DBPR Standards for DBPs

Disinfection Byproduct	MCLG (mg/L)	MCL (mg/L)
Chloroform	Zero	See TTHM
Dibromochloromethan	0.06	See TTHM
Bromodichloromethane	Zero	See TTHM
Bromoform	Zero	See TTHM
TTHMs	Zero	0.080
Dichloroacetic Acid	Zero	See HAA5
Trichloroacetic Acid	Zero	See HAA5
HAA5	n.a.	0.060
Bromate	Zero	0.010 (s1) 0.05 (S2)
Chlorite	0.8	1.0

Figure 1. Disinfection Byproduct Mitigation Strategies



Low-pressure membrane systems have several advantages to utilities when addressing the mitigation of DBPs. In many states, the disinfection credits assigned to different membrane technologies have a significant impact upon the required C·t for primary disinfection. Several states provide a 4-log inactivation/reduction credit for *Cryptosporidium and Giardia* when low–pressure membrane treatment is applied. Under these conditions, only the C·t necessary for viral inactivation is required – reducing the concentration of chlorine required, and the formation of TTHM and HHA5 in the potable water supply. Additionally, low-pressure membrane filtration is regulated as 'other filtration technology'. As a result, the enhanced coagulation treatment technique – which applies only to conventional filtration technology – does not apply and TOC removal and/or enhanced coagulation is not required as part of the membrane system. Systems regulated under the provisions for 'other filtration technology' must comply with the MRDLs and MCLs listed in Tables 1 and 2. In many cases, it may be possible to meet TTHM and HAA MCLs without NOM removal.

Many technologies and treatment techniques can be used by public water systems to comply with the MCL for TTHMs. Treatment modifications involve moving the chlorination point downstream in the water treatment plant, optimizing the coagulation process to enhance the removal of DBP precursors, and using alternate disinfectants. Moving the chlorination point downstream in the treatment train is very effective in reducing DBP concentrations because DBP precursor concentrations are reduced prior to chlorine addition. Replacing pre-chlorination with an alternate disinfectant that

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Strategies for

produces fewer DBPs is an attractive option for reducing the formation of DBPs. Methods to control the formation of DBPs should focus on:

- Source water selection and control;
- DBP precursor removal; and,
- Disinfection Strategy Selection.

Specific examples of disinfection byproduct mitigation strategies are outlined in Figure 1, and described in the following sections.

SOURCE WATER CONTROL

Source water control strategies involve managing the source water to lower the concentrations of NOM and bromide ion. Source water control strategies may include changing the water source and blending water high in NOM and bromide ion concentrations with high quality water that is low in NOM and bromide ion concentrations. Research has shown that algal growth leads to the production of DBP precursors. Therefore, nutrient and algal management is one method of controlling the DBP formation potential of the source. Typical algal management strategies applied to existing reservoirs have included the application of copper sulfate or the use of surface aerators to provide moving water conditions less likely to promote algal growth. Oxidation of disinfection byproduct precursors, using typical chlorine dioxide or ozone, may also be practiced to reduce the over-all production of DBPs.

DBP PRECURSOR REMOVAL

Raw water can include DBP precursors in both soluble and particulate forms. In conventional treatment, precursors are coagulated, for removal during sedimentation and filtration. The trihalomethane formation potential (THMFP) generally decreases by 15 to 50 percent using conventional coagulation and settling. Moving the chlorination point downstream to control the formation of DBPs is prudent. Systems can lower the DBP formation potential of water prior to disinfection by removing precursors using enhanced coagulation, activated carbon adsorption, or high-pressure membrane filtration (reverse osmosis/ nanofiltration).

Pre-treatment using Coagulation

When feed waters possess high concentrations of algae, turbidity or total organic carbon, the most economical option may be to provide pretreatment to the membrane process. Two typical types of coagulation pretreatment may be implemented, direct filtration and coagulation/ sedimentation. For low turbidity and moderate TOC concentrations (2 – 4 mg/L), chemical injection and direct filtration may provide adequate precursor removal. Suitable mixing time is required to provide good NOM and precursor removal. The application of direct filtration should be applied judiciously; several commercially available membrane configurations possess low tolerance to continuous exposure to high solids concentrations – direct filtration may result in significant fouling of the membranes. Researchers have reported that low doses of aluminum or iron based coagulant have enhanced the hydraulic performance of the membrane system, reducing the fouling rate (Howe *et al.*, 2001).

One researcher reports that the amount of NOM reduction achieved using direct filtration is dependent upon the water supply (Michelsen, 2000). The author performed studies of three separate water sources – the average TOC reduction measured ranged between 20 and 50 percent. For waters possessing high turbidity or TOC, use of clarification/ sedimentation prior to the membranes may be required. The enhancement of hydraulic performance of low-pressure membrane systems is reversed at the high coagulant doses required for coagulation of difficult waters, due to the total solids loading in the system. The use of a separate coagulation/ sedimentation process has several advantages:

- Reduction of organics associated with membrane fouling – enhancing hydraulic performance;
- Reduction of disinfection byproduct precursors prior to the membranes – permitting the use of chlorine prior the membranes – which has also been shown in enhance performance in oxidant resistant membranes;
- Reduction of suspended solids loading to the membranes, resulting in higher operational flux and reduced membrane capital and membrane replacement costs; and,
- A multiple barrier is present – which improves the public safety.

Several large water treatment plants have been designed using conventional coagulation/sedimentation prior to the membrane filters. These include the 12-MGD Logan-Todd Regional Water Treatment Plant in Kentucky and the 40-MGD Otay Water Treatment Plant in California.

Post-Treatment using Granular Activated Carbon Adsorption

An extensive number of pilot studies have been undertaken by one manufacturer exploring the use of Granular Activated Carbon (GAC) to remove disinfection byproducts precursors following low-pressure membrane filtration. Typically, the removal of NOM using low-pressure membrane filtration followed by GAC is

approximately 50% (Michelsen, 2001) Several water treatment plants have been constructed using this treatment strategy. The water treatment plant in Erie, Colorado uses microfiltration to produce potable water. Seasonally, as required, a portion of the filtrate is treated using GAC for the reduction of TOC and DBPs (Norton *et al.*, 2001). A number of other facilities have incorporated ozone/ Biological Activated Carbon filtration as either post-treatment or pre-treatment to the membrane system to address disinfection byproduct precursors. Plants as large as 100-mgd are successfully using this strategy.

Post-Treatment using Nanofiltration/ Reverse Osmosis

Integrated membrane systems are a viable approach for the removal of disinfection byproduct precursors. Nanofiltration and reverse osmosis both possess significant potential is the removal of high levels of color, total organic color and disinfection byproduct precursors. However, in the most common configuration (spiral wound) the membranes are highly susceptible to particulate and biological fouling, requiring advanced pretreatment such as low-pressure membrane filtration.

The Village of Delta, Ohio is exploring the use of an integrated membrane system for the reduction of hardness and disinfection byproduct precursors. A 2,000 hr pilot study was performed; the results have been published previously (Bing *et al.*, 2001). The integrated membrane system consisted of microfiltration and reverse osmosis installed in series. Approximately 50% of the final product water was bypassed around the reverse osmosis unit, and blended with the reverse osmosis permeate. Raw reservoir water TOC measurements ranged from 3.9 mg/L to 5.8 mg/L during the study. The average TOC reduction was 5% with microfiltration, 97% with reverse osmosis, and 50% reduction measured in the blended water. The reverse osmosis permeate possessed average total trihalomethane formation potential (THMFP) and haloacetic acid formation potential (HAAFP) of 2 ppb and 1 ppb respectively.

Figure 2.
Membrane Units installed post-clarifier at a WTP

3 DISINFECTION STRATEGY SELECTION

Chlorine is the predominant disinfectant in use in the United States. It has many advantages, including high efficacy with most pathogens (*cryptosporidium* excluded), low cost and ready supply. Many water treatment plants in the country have multiple application points in a water treatment plant for the addition of chlorine. Chlorine is frequently dosed at the head of the plant to reduce algal growth within the plant, or to assist in the oxidation of manganese in the water. Chlorine addition at the head of the plant should be discouraged – as the practice applies chlorine where the concentration of DBP precursors is highest in the treatment scheme. Where chlorination prior to the clear-well is desired, it should be dosed at the position most downstream as is practical. If DBPs are still an issue, the use of an alternative disinfectant may provide adequate disinfection without resulting in DBP formation. Use of ozone for primary disinfection reduces the concentration of TTHMs produced, but may result in bromate formation. Similarly, the use of chlorine dioxide may result in unacceptable chlorite concentrations. Ultraviolet (UV) light has also been demonstrated as effective primary disinfectant. Since no chlorine products are added, no formation of TTHM or HAA5 will occur during the primary disinfection. The Stage 2 D/DBPs Rule will permit use of UV as a primary disinfectant.

For many applications, chloramines may be the preferred disinfectant for residual or secondary disinfection as they contribute little to the production of DBPs. Adequately controlled, taste and odor issues historically associated with chloramination are not an issue. Chloramines are particularly effective

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Strategies for

where UV is used as the primary disinfectant with water possessing moderate TOC concentrations. It is also very effective where the total residence time in the distribution system is particularly long – resulting in higher chlorine doses than required to achieve the required C.t.

DISINFECTION STRATEGY SELECTION CASE STUDIES

Alternative disinfection strategies may be grouped into several general categories.

- Relocation of existing primary disinfection point;
- Substitution of the existing disinfectant for another; and,
- Use of an alternative residual disinfectant.

Relocation of Disinfection Point

Movement of the point of disinfection to reduce TTHM formation – with the use of free chlorine as a disinfectant, application prior to NOM removal results in DBPs production. Movement of the chlorination point to downstream of the clarification system or filters results in substantial reductions in the DBPs concentrations produced. Low-pressure membrane filtration typically removes between 5% and 20% of NOM present in raw water (Michelsen, 2001/Norton, 2001). Bing *et al.* (2001) found that low-pressure membrane filtration alone reduced the THMFP by 19%.

Substitution of Disinfectants

A study in New Braunfels, Texas explored the use of low doses of chlorine dioxide to mitigate algal growth in a low turbidity, low TOC surface water. Pre-oxidation of chlorine dioxide reduced the disinfection byproducts concentration in the finished water, reduced taste and odor and enhanced the performance of the membrane systems. Low-pressure membrane filtration provides a high-quality single barrier to pathogens. As a result, many plants are currently being

designed to incorporate the installation of the future UV disinfection units. The use of UV will eliminate the use of chlorine for primary disinfection – minimizing the formation of TTHM and HAA. Chloramines may easily be implemented at these plants for residual disinfection in the distribution system

Alternative Residual Disinfectant

Many small municipalities' disinfection practices are determined not by the minimum C.t, but by the minimum residual required in the finished water at the end of a dead-leg. At the Delta Water Treatment Plant, the C.t provided is 3 – 4 times greater than the C.t required (Bing, 2001). The use of alternative disinfectants – particularly chloramines for residual disinfection – may provide considerable reduction in the TTHM and HAA5 concentrations of the finished water. Studies performed by the author at the future 1-MGD Carthage, NC water treatment plant indicated that conversion to chloramines upon achieving the required C.t for disinfection resulted in a 70% reduction in the TTHMs in the finished water.

CONCLUSIONS

The use of low-pressure membrane filtration provides decreased risk acute health effects as a result of pathogens. Low-pressure membrane filtration does not have a major impact on the disinfection byproduct precursor formation potential, with a reduction of between 5% and 19% reported. Proper selection of disinfection byproduct mitigation strategy can permit low-pressure membrane filtration to be applied to all waters, while providing reduced risk of chronic health effects as a result of disinfectants and disinfection byproducts.

EPA has published a number of guidance manuals on managing disinfection byproducts rules. While enhanced coagulation is the preferred method of addressing THMs, pre-oxidation of disinfection byproduct precursors using ozone or chlorine dioxide, substitution of ultraviolet disinfection for primary disinfection and chloramines for residual disinfection are tools at our disposal. For a more complete list, please refer to:

- Alternative Disinfectants and Oxidants Guidance Manual, EPA 815-R-99-014, April 1999
- Disinfection Profiling and Benchmarking Guidance Manual, EPA-815-R-99-013, August 1999
- Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual, EPA-815-R-99-012, May 1999
- M/DBP Simultaneous Compliance Manual, EPA-815-R-99-015, August 1999

These manuals are available at http://www.epa.gov/safewater/mdbp/implement.html. While EPA has not made prescriptive requirements, such as enhanced coagulation and Total Organic Carbon (TOC) removal requirements applicable to membrane filtration, many of the techniques suggested are appropriate for small utilities utilizing membrane filtration. ■

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Membrane Technology Conference, San Antonio, TX, USA

Author:
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CH2M HILL

Message from the Executive Director

Ian C. Watson, P.E.
AMTA Executive Director

Dear AMTA Members:

I recently represented AMTA at the Multi-State Salinity Coalition (MSSC) Summit in Las Vegas. This organization is made up of the following members:

Albuquerque Bernalillo County Water Utility Authority
Central Basin Municipal Water District
City of Phoenix
City of Scottsdale
Coachella Valley Water District
El Paso Water Utilities
Inland Empire Utility Agency
Metropolitan Domestic Water Improvement District
Metropolitan Water District of Southern California
Northern California Salinity Coalition
Salt River Project
San Antonio Water System
Southern California Salinity Coalition
Southern Nevada Water Authority
Tucson Water
West Basin Municipal Water District

MSSC was founded in 2001, and adopted the following mission statement in 2003.

"To meet our Nation's growing need for safe, sustainable, adequate and affordable water supplies, the Multi-State Salinity Coalition (MSSC) promotes advancements in desalination-related technologies, salinity control strategies and associated policies."

This is an organization with a mission similar to AMTA's that primarily serves the southwestern United States, but does have an agenda that could have applicability in other regions of the country.

I am providing this information to our membership to highlight the very serious problem that faces the southwest US, resulting in the formation of MSSC, and the rest of the country. One of the sessions at the Summit dealt with planning for climate change, and the lunchtime keynote speech by Ms. Patricia Mulroy, the general manager of the Southern Nevada Water Authority, also addressed this topic, while noting that Lake Mead was at a dangerously low level. Other sessions dealt with alternative water supply options, international activities, and the Australian experience, which compared the progress made in the national desalting program in that country with the snail-like pace with which the Carlsbad project is proceeding. In six years in Australia, three large plants have gone into operation, and three more are under construction. One theme repeated throughout the two days was the need in the US for a national water policy, and a single responsible entity at the Federal level, a "Department of US Water".

At the end of the day, it is clear that AMTA is an organization, possibly the only organization that focuses directly on the one technology that holds promise for relieving the impending permanent water supply shortfalls in the southwest, and in other parts of the US. It is fitting that our 2010 Annual Conference is to be held in San Diego, California, in July of this year, and even more so because it is preceded by a two day summit planned around the emerging technology of Forward Osmosis, which promises significant reduction in energy requirements for desalination.

In closing I would like to remind all of our members that there is a crisis in public water supply in our future, and that we are practitioners of the one technology that promises some relief. We still have work to do, particularly in the challenge facing inland desalters dealing with concentrate disposal. However, I am confident that solutions will be found, and membrane applications will continue to multiply, from seawater RO to inland brackish water desalting, to fresh water systems using MF/UF. Any one with an interest, a stake, or a position in one of these facilities should be a member of AMTA, together with the organization that employs them. Make sure that your friends and acquaintances get this message, and we go forward as a pro-active, strong, and vital organization. A great start would be to invite all your friends, clients, and acquaintances to come to San Diego in July. It will be a superb conference, and an experience that will help all those looking to the future of water supply in our country.

I look forward to seeing you all in San Diego in July. ■

Regulatory Update

Robert Huehmer, PE
Legislative Affairs & Regulatory Programs Committee Chair

Over the winter holidays, I returned to my home town to visit friends and family. I grew up in a small village, with approximately 1,000 residents, that is much the same as any other small village that I have had the opportunity to visit. And like many of the other villages, they struggle with water quality issues. A history of on-site waste disposal, shallow wells and poorly percolating soil had led to nitrate contamination of the wells. After much study and debate, a community water treatment system was installed in 2006 using a nearby lake as the source. From my childhood, I recalled a slightly eutrophic lake, subject to late summer algal blooms, a green tinge and less than desirable taste and odor. In any location, this represents a treatment challenge.

So it was much to my surprise that I saw a public notice for a meeting to discuss upgrades to the new facility in 2010. Upon doing a little bit of research in the local press and utility, I was informed that the plant was not in compliance with drinking water regulations, with concentrations of Trihalomethanes (THMs) well above the acceptable values, requiring significant changes in practices and system upgrades to be in compliance. Clearly, inadequate bench- and pilot-scale treatability work had been completed as part of the decision making process. And, speaking quite honestly, there is no excuse for 'missing' on these parameters, as significant guidance has been provided to utilities.

I wish that I could say that the events in my childhood community were an isolated occurrence. Regretfully, I can name a large number of small communities I have visited over the past decade that can tell similar tales. So this month, in addition to looking at developments in the regulatory world, I wanted to take a few moments to genuflect on the tools that Environmental Protection Act (EPA) has given us to manage disinfection byproducts.

Disinfection Byproducts Rules. EPA has published a number of guidance manuals on managing disinfection byproducts rules. While enhanced coagulation is the preferred method of addressing THMs, pre-oxidation of disinfection byproduct precursors using ozone or chlorine dioxide, substitution of ultraviolet disinfection for primary disinfection and chloramines for residual disinfection are tools at our disposal. For a more complete list, please refer to:

- Alternative Disinfectants and Oxidants Guidance Manual, EPA 815-R-99-014, April 1999
- Disinfection Profiling and Benchmarking Guidance Manual, EPA-815-R-99-013, August 1999
- Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual, EPA-815-R-99-012, May 1999
- M/DBP Simultaneous Compliance Manual, EPA-815-R-99-015, August 1999

These manuals are available at http://www.epa.gov/safewater/mdbp/implement.html. While EPA has not made prescriptive requirements, such as enhanced coagulation and Total Organic Carbon (TOC) removal requirements applicable to membrane filtration, many of the techniques suggested are appropriate for small utilities utilizing membrane filtration.

EPA Budget for FY2011. President Obama has proposed a budget which would reduce funding for the Drinking Water State Revolving Fund (DWSRF) from $1.387 billion this year to $1.287 billion next year. While this reduction is notable, after the $6 billion infusion into State Revolving funds by FY2010's stimulus package, it is anticipated that it will be perceived as a larger cut than just $100 million. So hopefully utilities needing to address THM levels took appropriate steps in FY2010. ■

Message from Steve Duranceau, PhD, PE, AMTA President:

On behalf of our entire Board of Directors, I would like to welcome you to the premier membrane event in North America. Our 2010 program offers a strong technical program that will provide engineers, designers, regulators, manufacturers and water purveyors the latest technical information necessary for you to remain at the forefront of this ever expanding industry that is continually advancing. AMTA remains the only association with a concentrated focus on membrane technology and as such is best positioned to serve our fast growing industry. I look forward to seeing you in San Diego this year! ■

PLATINUM SPONSORS:

DOOSAN Doosan Hydro Technology

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BEFESA WaterBuild

NRS engineering water solutions

AMTA 2010 CONFERENCE & EXPOSITION - OVERVIEW

Sunday/Monday
July 11th/July 12th

Sunday - Registration Opens at 8:30 am

Sunday: 9:30 am - 5:30 pm
Monday: 9:00 am - 4:30 pm

AMTA/Statkraft
2nd Osmosis Summit
(2 day event)

Monday - Registration Opens at 8:00 am
Monday: 9:00 am - 4:15 pm
Pre-Conference Workshop 1 (PC-1):

AMTA/SWMOA
Operator Training:
Getting Your Membranes Figured Out

Monday:
10:00 am - 3:00 pm
Exhibitor & Poster Set-up

Monday:
4:30 pm - 6:30 pm
Exhibit Hall Open -
Welcome Reception and Social

Tuesday July 13th

Registration Opens at 7:15 am

7:15 am - 8:00 am
Tues. - Moderator/Speaker Breakfast

8:00 am - 10:00 am
Opening Session & Keynote Speakers

10:00 am - 6:30 pm
Exhibit Hall Open
10:00 am - 10:30 am
Refreshment Break - Exhibit Hall

10:30 am - 12:00 pm
Technical Sessions
• Facility Planning & Management
• Growth & Trends in SWRO
• Pretreatment

12:15 pm - 1:45 pm
Lunch in Exhibit Hall

2:00 pm - 4:00 pm
Technical Sessions
•Modern Regulatory Considerations
• Brackish Water RO
• Membrane Bioreactors

4:15 pm - 5:15 pm
Affiliate Recognition &
Operator Challenge

5:30 pm - 6:30 pm
Poster Social & Networking Reception in Exhibit Hall

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AMTA 2010 CONFERENCE & EXPOSITION - OVERVIEW

Wednesday July 14th

Registration Opens at 7:15 am

7:15 am - 8:00 am
Wed. - Moderator/Speaker Breakfast

8:00 am - 10:00 am
Technical Sessions
• Membrane Filtration - Planning Studies & Operations
• Concentrate Management - I
• Membrane Innovations

10:00 am - 12:00 pm
Exhibit Hall Open

10:00 am - 10:30 am
Refreshment Break - Exhibit Hall

10:30 am - 12:00 pm
Technical Sessions
• Integrated Membrane Applications
• International Perspective
• Water Reuse Applications

12:15 pm - 2:15 pm
Awards Luncheon

2:30 pm - 6:30 pm
Exhibit Hall Open

2:30 pm - 4:00 pm
Technical Sessions
• CA Regional Issues
• Advances in Technology
• Utilizing Sustainable Resources

4:45 pm - 5:15 pm
AMTA Annual Membership Meeting
in Exhibit Hall

5:30 pm - 6:30 pm
Poster Social & Networking Reception in Exhibit Hall

Thursday July 15th

Registration Opens at 7:15 am

7:15 am - 8:00 am
Thu. - Moderator/Speaker Breakfast

8:00 am - 10:00 am
Technical Sessions
• Treating Challenging Source Water
• Concentrate Management II
• Research & Student Forum - I

10:00 am - 12:30 pm
Exhibit Hall Open

10:00 am - 10:30 am
Refreshment Break - Exhibit Hall

10:30 am - 12:30 pm
Technical Sessions
• Optimization & Recovery
• Chemistry & Post Treatment
• Research & Student Forum - II

12:30 pm
Technical Program Complete

12:30 pm - 5:00 pm
Exhibitor & Poster - Move Out

1:00 pm - 2:30 pm
AMTA Program Committee Meeting

1:30 pm - 5:00 pm
Olivenhain Municipal Water District - Water Treatement Plant
Facility Tour

Friday July 16th

7:30 am - 2:30 pm
AMTA Board Meeting

Exhibitor List as of March 31

Company	Booth Space #
ACCIONA Agua	400/402
AECOM	302
Aerex Industries, Inc.	118
Afton Pumps, Inc.	503/602
Ahlstrom Filtration, LLC	424
American Membrane Technology Association	A
American Water Chemicals, Inc.	423
American Water Works Association	215
Arkema, Inc.	614
Avista Technologies, Inc.	523/622
Bekaert Progressive Composites	323
BEL Composite America, Inc.	212
Biwater AEWT, Inc.	104
Boerger, LLC	324
Calder, a Flowserve Company	515/517
Carollo Engineers, P.C.	314
DelStar Technologies, Inc.	624
Doosan Hydro Technology, Inc.	201/300
Dow Water & Process Solutions	102
Duhig Stainless, Inc.	623
Enceladus Water Group, LLC.	117/216
Energy Recovery, Inc.	601/603
Enviroquip, a Division of Eimco Water Technologies LLC	120
Florida Aquastore & Utility Construction, Inc.	525
Fluid Equipment Development Company	312
French Creek Software	606
Genesys North America	609
GF Piping Systems	207
Global Water Intelligence	113
H2O Innovation	401/403/500/502
HDR Engineering, Inc.	103/202

Company	Booth Space #
Horizon (Bejing) Environmental Technology Co., Ltd.	213
Hydranautics	509/608
Infilco Degremont, Inc.	422
Inge Water Technologies	325
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BRONZE SPONSORS:

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Sunday-Monday, July 11-12, 2010
THE 2nd OSMOSIS MEMBRANE SUMMIT 2010
An international information hub for researchers and industry

The concept of utilizing the osmotic effect in desalination and power production has received increasing attention over the last several years. Recent university and industry research efforts have been directed toward improving membrane properties that will make it possible to commercialize forward osmosis and pressure retarded osmosis technologies. The number of published scientific papers related to these new osmotic opportunities has increased as there is growing activity in the development of these technologies.

What is the purpose of the summit?

Developing innovative membrane technologies provides a foundation for the creation of new methods to desalinate water at lower cost than current methods offer today and concurrently offer an opportunity to produce a new source of renewable energy. The 2nd Osmosis Membrane Summit will allow attendees to gain new knowledge that will contribute to a better understanding of the challenges and opportunities of forward osmosis. The attendees will also learn about the current status of research and commercialization efforts of these exciting new technologies.

Who should attend?

Planners, regulators, engineers, manufacturers and operators will all gather this July under one roof for one reason: membranes – and only membranes." The summit is designed to benefit those interested in the application of new synthetic membrane processes for water production and renewable energy. Scientists, engineers, planners, regulators, manufacturers, venture capitalists, water purveyors and utilities operations will be able to attend and learn about the latest developments of osmotic membrane technologies. The Summit will serve as an information 'hub' and provide opportunity to explore the further development of membranes, membrane modules, membrane systems and facility integration for forward osmosis and pressure retarded osmosis. Membrane chemistry, module design, system modeling, and process design will be discussed during the two day program.

What will be offered?

The program will be designed to allow for extensive networking opportunities, providing opportunity to participate in an international meeting where key representatives and organizations can come together and discuss the future of membrane applications for the production of safe drinking water supplies while exploring renewable energy options.

For additional information: www.amtaorg.com ■

Message from Stein Erik Stilhagen, Statkraft:

Since the last Osmosis Membrane Summit in October 2008, progress has been accomplished in a number of areas covering the osmotic power process technology. Not only has the world first complete osmotic power system been put into operation, but there are also encouraging developments of new membrane technology all over the world. It is therefore with great pleasure that we invite you to the second Osmosis Membrane Summit, where we will participate in the birth of a new industry. We expect a crowd consisting of membrane developers, manufacturers, utilities, governmental representatives and investors.

The 2nd Osmosis Membrane Summit will be a meeting place for stakeholders in this new business. We will experience a business section giving an overview of the current knowledge of the potential market for forward osmosis in desalination and pressure retarded osmosis in power generation industries. Will these new membrane technologies and applications be attractive in the future market? Participants in the session will gain information on the size and growth expectations of potential markets and niches, potential clients, the challenges of commercial exploitation, the need for public support mechanisms, the market structures and competitive fields as well as the potential value chains and their industrial participants.

In the technology section, an overview of the current knowledge and recent progress in forward osmosis and pressure retarded osmosis will be given. Speakers from all over the world will be presenting their latest results in membrane and system development, as well as the current status of the different applications. The speakers represent the front edge in the field of forward osmosis. See you all in San Diego. ■

THANK YOU 2ND OSMOSIS SUMMIT SUPPORTERS AND SPONSORS:

TORAY Statkraft ERI RECLAMATION *Managing Water in the West*

Monday July 12 / 9:00 - 4:15
AMTA/SWMOA Pre-Conference Workshop 1 (PC-1)
Operator Training: Getting Your Membranes Figured Out

Message from Scott McClelland, P.E., SWMOA President:

The Pre-Conference workshop will provide an opportunity to "Figure Out" membranes in both a class room and hands-on setting. The morning session will include an overview of RO basics, MF/UF basics, Seawater Desalination Pretreatment, RO

Chemistry, and Membrane Cleaning and Autopsy. The afternoon will be held at Sweetwater Authority (SWA)'s R.A.R. Desalination Facility. The facility has been in operation for 10 years and treats saline groundwater with a RO system to drinking water quality. You will learn how SWA has optimized operations, learn about the intricacies of pressure filters, what parameters are critical for proper pump maintenance, pressure vessel probing techniques, and proper performance monitoring. All of these critical elements will be presented at the plant site and presented by local experts who have been involved with the plant for many years. ■

Thursday July 15 / 1:30 - 5:00
Olivenhain Municipal Water District - WTP - Facility Tour

(Ticket Required - price is $25 if registered by June 25th or $45 after, Space is limited to 50)

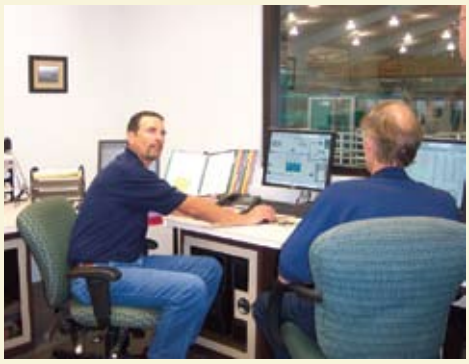
Moderator:
Peter Waldron, Energy Recovery, Inc.

Tour by:
David Smith, Olivenhain Municipal Water District

You will not want to miss out on this membrane facility tour. Here is a brief introduction about the District and facility:

To enhance the reliability of the District's water supply, and to further sustain the increasing demand for a rapidly growing population, the District joined forces with the San Diego County Water Authority to produce what has come to be known as the Olivenhain Water Storage Project (OWSP). The elements of the OWSP include a 24,332-acre-foot reservoir and a 318-foot roller compacted concrete dam, the David C. McCollom Water Treatment Plant (DCMWTP), Pipelines East, a pump station and an electrical substation.

The DCMWTP came online in April 2002 as a 25 MGD immersed membrane water treatment plant. In February 2004, 9 MGD additional capacity was added, making the plant capable of producing up to 34 MGD. This plant, originally the largest of its kind in the U.S.A., utilizes membrane technology that provides more certain removal of waterborne health threats while also benefiting the environment through less chemical usage. The immersed (sometimes referred to as submerged) membrane water treatment process. The District decided upon an UF membrane process for its water treatment plant in order to ensure high-quality water that exceeds regulatory standards. ■



A Look Back to 1974: Our very first newsletter

NATIONAL WATER SUPPLY IMPROVEMENT ASSOCIATION

newsletter

10500 Ellis Avenue, P.O. Box 8300, Fountain Valley, California 92708

MARCH 1974

VOL. 1, NO. 1

BOARD OKAYS BYLAWS, FILES AS CORPORATION UNDER CALIFORNIA LAW

Bylaws under which business affairs of NWSIA will be conducted were adopted by the group's Board of Directors at its January meeting in Washington, clearing the way for incorporation of the association under California law.

The incorporation papers will officially establish Orange County, CA., as legal headquarters of the association. The bylaws also establish the following as objectives of NWSIA:

(Cont'd on Page 3)

Distillation unit at Water Factory 21, near Fountain Valley, CA, is 90% complete, may be on NWSIA meeting tour.

SECOND ANNUAL MEETING SCHEDULED JULY 15-18 AT NEWPORT BEACH HOTEL

The second annual meeting of NWSIA will be held July 15-18 at the Newporter Inn, Newport Beach, CA.

Seventeen technical papers and a panel discussion on control of viruses in municipal water supplies have been scheduled tentatively for five half-day technical sessions, according to Robert E. Bailie, program chairman. The sessions will cover regional planning for salinity control, planning and operation of membrane desalination plants, advanced water resource planning, waste water reclamation and virus control, and thermal desalination plants and large-scale waste water reclamation.

While arrangements still must be firmed up, it is hoped that the Orange County Water District's *Water Factory 21* project might be formally dedicated during the NWSIA meeting. That project is designed to treat sewage from the Orange County Sanitation District and also to desalt seawater. The blended, reclaimed water then is injected into the underground basin to help prevent salt water from intruding into aquifers from which the district draws much of its water supply.

FIRST ISSUE OF JOURNAL TO BE PUBLISHED JULY 1

The JOURNAL OF NWSIA, a semiannual technical publication designed to keep water planners up-to-date on desalination, water reuse, and other technologies for improving water supplies, is expected to make its debut about July 1.

Dr. Nabil El-Ramly, a director of NWSIA and member of the University of Hawaii staff in Honolulu, will edit

(Cont'd on page 2)

A general membership meeting, including reports of all standing committees and election of officers, would conclude the formal business sessions on Thursday morning, July 18. Several field trips, including tours of Orange County District facilities in the Santa Ana area, are planned for the afternoon of the final day.

Hotel reservation forms, airline information, and details of the program should be ready for mailing to all members about 60 days in advance of the mid-July meet.

Editorially speaking ..

With this initial issue of the NEWSLETTER, your association launches a formal program to keep you up-to-date not only on NWSIA affairs but, hopefully, on developments throughout the potable water field.

Like any new publication, we will be feeling our way for a while, trying to establish the format and content which will be of most interest and help to you. Reports on legislation -- pending, passed, or proposed -- will be included from time to time, along with a running report of new developments in desalting technology, new desalting installations, and federal, state, and local water improvement programs.

Naturally we will need, and earnestly solicit, your input. Send your suggestions to the NEWSLETTER editor, Frank R. Zumbro, Public Affairs Dept., Du Pont Company, Wilmington, DE. 19898 or, if you prefer, to the NWSIA office, 10500 Ellis Avenue, P. O. Box 8300, Fountain Valley, CA. 92708.

Frequency of publication? Hopefully the NEWSLETTER will be published monthly ... two, four, or more pages per issue, depending on available material.

FIRST ISSUE OF JOURNAL

(Cont'd from page 1)

the JOURNAL. Mrs. Patricia Burke of the Avco Corporation, Wilmington, MA, will act as managing editor.

Members of NWSIA will receive a copy of the first issue of the JOURNAL as a part of their membership and the magazine will be available to both them and non-members on a subscription basis after the initial issue. Commercial advertising may be solicited in the future to help underwrite costs of the publication.

Noting that the JOURNAL "will be devoted primarily to articles contributing new knowledge and understanding to problems related to the practical aspects and application of desalination, water reuse, and other water supply improvement technologies," Dr. El-Ramly said appropriate papers might include:

Operating experience and cost data of commercial desalination, waste water treatment and other advanced water treatment systems; new concepts in application of desalting or other technologies to enhance the quality of the environment, minimize waste, or increase the efficiency in use of water resources; economic, social and legal impacts of water improvement systems.

LEGISLATIVE OUTLOOK

(Editor's Note: LEGISLATIVE OUTLOOK, we hope, will be a regular feature of your NEWSLETTER, keeping you up-to-date on developments at the federal, regional, and state levels. It is written by William E. Warne, widely-known water resources consultant of Sacramento, CA., who is a charter member and director of NWSIA and serves currently as chairman of its legislative committee.)

The national desalination program has been most useful in developing an industry to improve the quality of community water supplies in the United States, maintains NWSIA, and the federal program must not be abandoned. The Association's position will be placed before Congressional committees and Federal and state agencies at every appropriate opportunity.

W. E. Warne

That, in effect, was the task order issued by NWSIA's Board of Directors to its legislative committee at the January meeting in Washington.

As chairman of the legislative committee, I have checked into the status of the Office of Saline Water and its programs. I also have investigated the status of the U. S. proposal to the government of Mexico for reducing the salt content of the Wellton-Mohawk irrigation drain in Arizona. The latter project would be required to comply

(Cont'd on page 4)

TABULATION COVERS DESALTING PROJECTS FOR POTABLE WATER

What's the status of desalting projects in the national water supply picture?

In an effort to provide at least a skeleton answer to that frequently raised question, the NEWSLETTER will try to maintain a running list of new potable water plant projects. We will list simply the name and location, type of desalination process, size of installation, and system supplier, with an indication of the start-up date and contract price, if available.

As a starter, here are some of the potable water plants installed or contracted for since Jan. 1, 1973.

1) *Laguna del Rey, Coahuila, Mexico* - reverse osmosis, 86,000 gpd (combination potable and process water), Polymetrics, began operation early 1973.

2) *Pine Point, N.W.T., Canada* - reverse osmosis, 320,000 gpd (combination potable and process water), Polymetrics, began operation mid-1973.

3) *Sanibel Island, Florida*- electrodialysis, 1.2MM gpd, Ionics, Inc., began operation October 1973.

4) *Leeds, ND* - reverse osmosis, 100,000 gpd, Permutit, start-up scheduled early 1974.

5) *Hillsdale, IN* - reverse osmosis, 60,000 gpd, Polymetrics, start-up scheduled late 1973.

6) *Pine Island, FL* - reverse osmosis, 550,000 gpd, Envirogenics, start-up slated late 1974, $246,100.

7) *Venice, FL* -reverse osmosis, 1,000,000 gpd, Polymetrics, start-up scheduled late 1974, $385,100.

8) *Card Sound Golf Club, Key Largo, FL* - reverse osmosis, 300,000 gpd, Polymetrics, start-up scheduled late 1974.

9) *New Providence Island, Nassau* - reverse osmosis, 500,000 gpd, Envirogenics, start-up scheduled fall of 1974. ■

BOARD OKAYS BYLAWS

(Cont'd from Page 1)

1. To promote the use of desalination, and other water sciences, and to exchange and spread information concerning the state of the art of desalination, waste water reclamation and other water sciences to enhance the quality of the environment and of city life by:

   a) promoting the conjunctive and efficient use of water;

   b) promoting integration of waters from various sources to supply urban needs;

   c) promoting the enhancement of the urban environment and the protection of the public health through raising the quality of substandard community water supplies;

   d) advocating operations, methods and procedures conducive to aesthetic, recreational, and multiple uses of community water supplies.

   e) minimizing waste and increasing the efficiency of use of urban water supplies;

   f) encouraging regional solutions to water supply, disposal, and management problems.

2. To uphold the public interest in adequate, wholesome, clean and sweet community water supplies, and to identify the real costs of poor quality water. ■

SEVEN COMMITTEES NAMED TO CONDUCT ASSOCIATION WORK

Seven standing committees have been created by NWSIA bylaws to carry on principal activities of the Association under the overall supervision of the Board of Directors.

The committees and their current chairmen are:

Finance - John T. Carr, Texas Water Development Board, Austin, TX.

Bylaws & Constitution - David L. Firor, National Association of Conservation Districts, Athens, GA.

Legislative - William E. Warne, consultant, Sacramento, CA.

Membership - Langdon W. Owen, consulting engineer and NWSIA secretary, Santa Ana, CA.

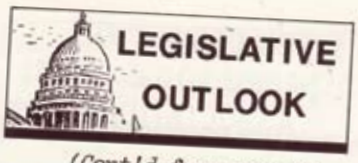
Program - Robert E. Bailie, consulting engineer, Fort Lauderdale, FL.

Technical and Publications - Nabil El-Ramly, University of Hawaii, Honolulu.

Publicity - Donald H. Doud, Du Pont Company, Wilmington, DE. ■

DUES STATUS

All dues paid since NWSIA was formally organized in mid-1973 cover the period through June 30, 1974. Dues received between March 1 and June 30, 1974, will be credited to next year's membership charge. ■



(Cont'd from page 2)

with Minute 242 of the U.S.-Mexico International Boundary and Water Commission (IBWC). It would enable the United States to deliver acceptable irrigation water from the Colorado River to farmers and townspeople in the Mexicali Valley of Baja California in fulfillment of the 1944 Mexican Water Treaty.

$94MM Solution

President Nixon's most recent budget proposed allocating $94,575,000 to the Commission for the purpose of financing, constructing, operating and maintaining the desalting facilities called for by Ambassador Herbert Brownell in his "definitive solution" of the two nations' water quality controversy.

The IBWC monitors waters of the Rio Grande, Colorado and Tijuana rivers in their boundary sections.

Rep. Harold T. (Bizz) Johnson (D-CA), chairman of the Irrigation Subcommittee of the House Interior Committee, has called hearings beginning March 4, 1974, on H.R. 12165, the "Colorado River Basin Salinity Control Act" which he and eleven others introduced. This bill is identical to S.2940 introduced by Senators Fannin and Bible.

These bills apparently originated in negotiations between Interior Department officials and representatives of the seven Colorado River Basin states. They would authorize the Secretary of Interior to undertake all of the work covered by Minute 242, plus additional water quality control projects upstream from Imperial Dam in the United States, as proposed by the Environmental Protection Agency (EPA) pollution conference in Denver in April, 1972.

Interior or State?

A power struggle between the Departments of State and Interior may be in prospect, with the seven basin states lined up solidly behind the Johnson bill. The Office of Management and Budget (OMB) favors the IBWC, apparently because it wants to avoid accepting Federal responsibility to the degree that the basin states have in mind for collateral water supply and quality control measures in the U. S. and upstream from Mexico.

The proposed 100 million gpd desalting plant is both the prize and the bone of contention. It would be the principal element of the solution provided for Mexican water users regardless of which federal agency is given the go-ahead to build the works.

Interior Favored

NWSIA has been invited to appear at the Johnson hearings and will firmly support expeditious construction of the desalting plant. It is NWSIA's belief that the desalting expertise lies in Interior rather than State. Further, NWSIA believes that the water quality problem on the Colorado River is not simply an international problem, and supports efforts to have water quality in the Colorado River approached more comprehensively than it was in the Brownell report.

Meantime, the President's budget also contained bad news for OSW. It recommended only $3 million for OSW in Fiscal Year 75, compared with $3.6 million in FY 74. Carryover funds would give a $4,869,000 desalting program next year. The emphasis next year will be on seawater membrane desalting processes and limited brackish water membrane processes. The Water Factory 21 VTE/MSF desalter at Fountain Valley, CA., would be operated. The OSW staff, under the budget plan, would be reduced to 29 prior to the start of the next fiscal year, and to 22 in FY 75.

NWSIA made strong representations before the appropriations committees last year for augmentation of the budget for FY 74 and was credited with obtaining some relief for OSW, though not enough to prevent drastic reductions in staff and activity levels of the agency. Despite discouraging prospects at this time, NWSIA will continue to fight for better support of the national desalination program.

A 100,000 gallon per day pilot plant for desalting seawater by freeze precipitation -- first of its kind -- has been completed by Avco Systems Division of Wilmington, MA., and shipped to the Office of Saline Water's test facility at Wrightsville Beach, NC. Avco personnel will operate and evaluate the unit under contract with OSW.

News Flash

Global Water Summit 2010: Transforming the World of Water

26/27th April 2010, Paris

This year's Spring conference from Global Water Intelligence (GWI) and the International Desalination Association (IDA) has attracted the highest calibre of speakers and participants from around the world.

Top executives from private water companies, public authorities, environmental organisations and water leaders will present their experiences, ideas and inspiration. Speakers include:

Prof Asit Biswas – Director of the Third World Centre for Water Management

His Excellency Loay al-Musallam - CEO National Water Company of Saudi Arabia

Peter Brabeck-Letmathe – Chairman of Nestlé SA

Tim Brick – Chairman of the Metropolitan Water District of Southern California

Sompodh Sripoom – CEO of Thai Tap Water

His Excellency Ek Sonn Chan – General Director of Phnom Penh Water Supply Authority

Maude Barlow – Chair of the Council of Canadians

Dato' Teo Yen Hua – CEO of SPAN Malaysia

Richard Heckmann – Chairman and CEO of Heckmann Corp.

Dr Cecilia Tortajada – President of the International Water Resources Association and Scientific Director of the International Centre for Water

His Excellency Mohammed Al-Mahrouqi – Chairman of PAEW Oman

Olivia Lum – Group CEO and President, Hyflux Group

The Summit will think radically about the inter-relationship of the world's critical resources – water, food, energy, and money. It aims to bring an end to piecemeal tinkering and to transform the water industry through bold, innovative ideas. The main themes are:

• Finance: what are the new financial models that are galvanising change in the water sector?

• Management: how have water agency leaders revolutionised service while dramatically improving financial sustainability?

• Technology: which technologies are changing the shape of the international water industry?

The impressive line-up of main speakers and panellists will lead the conference through several plenary sessions focussing on broader global issues, such as whether water scarcity even exists and how to turn around mis-management. Smaller sessions will discuss promoting water reuse, diversity in private water operators, and new financial models for water projects. GWI's 'Technology Idol' features a handful of the latest and best innovations - an audience vote will decide the winner. Round table sessions and smaller groups will provide effective arenas for one-to-one interaction and networking opportunities.

The GWI/IDA Water Summit in Paris also hosts the Global Water Awards ceremony for 2010, featuring a keynote speech from **Her Majesty Queen Noor of Jordan** and coveted trophies for the very best water projects, technologies and people from around the world. Nominations have been selected by the Awards Panel and voted for by GWI and WDR readers and IDA members, The ceremony is to be held at the Pavillion d'Armenonville in the Bois de Boulogne on the evening of 26th April.

The Summit will close with **Christopher Gasson's** view of the top ten business propositions for 2010 and a high profile media debate "Should the provision of water be run as a business?"

Further information and online registration can be found at www.watermeetsmoney.com.

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Global Water Intelligence, The Jam Factory, 27 Park End Street, Oxford OX1 1HU, UK ■

NWRI Fellowship Application Deadline - April 1, 2010

Applications for NWRI graduate fellowship funding for the 2010/2011 academic year will be accepted through Thursday, April 1, 2010.

NWRI will offer the following fellowships to graduate students at U.S. universities conducting research in the areas of water resources, treatment, and policy:

• **NWRI Fellowships** (up to $5,000 a year for 1-2 years). Research must pertain to NWRI's mission, which is to create new sources of water through research and technology and to protect the freshwater and marine environments.

• **Ronald B. Linsky Fellowship for Outstanding Water Research** (one fellowship of $10,000 a year for 2 years). Applicants must write an additional 1-page essay detailing their technical capabilities, interest in other fields beside the one they are studying, career goals, and where they hope to take their technical expertise and vision in the future. Funding for this fellowship is provided by private donors through the Ronald B. Linsky Endowment Fund at www.nwri-usa.org/LinskyFellowship.htm.

• **NWRI-AMTA Fellowships for Membrane Technology** (two fellowships

of $10,000 a year for 2 years). Research must pertain to the advancement of membrane technologies in the water, wastewater, or water reuse industries. Funding is provided by the American Membrane Technology Association (AMTA).

• **NWRI-Southern California Salinity Coalition Fellowship** (one fellowship of $10,000 a year for 2 years). Research must address the critical need to remove or reduce salts from water supplies and to preserve water resources in Southern California. This fellowship, which is funded by the Southern California Salinity Coalition, is limited to students at Southern California universities/colleges.

Additional information about the NWRI Fellowship Program, including application procedures, can be found at www.nwri-usa.org/fellowship.htm.

NWRI's Fellowship Program is underwritten by:

• The Joan Irvine Smith & Athalie R. Clarke Foundation.

• NWRI Member Agencies, which include Inland Empire Utilities Agency, Irvine Ranch Water District, Los Angeles Department of Water and Power, Orange County Sanitation District, Orange County Water District, and West Basin Municipal Water District.

• NWRI Corporate Associates, including Black & Veatch, Carollo, CDM, CH2M Hill, Kennedy/Jenks Consultants, Malcolm Pirnie, Inc., MWH, and United Water-Suez.

• NWRI Community Partners, including the American Membrane Technology Association and Southern California Salinity Coalition.

• Private donations through the Ronald B. Linsky Fellowship Endowment Fund at www.nwri-usa.org/LinskyFellowship.htm.

NWRI is grateful for the support provide by these partners. ■

PRESS RELEASE

For Immediate Release March 8, 2010 San Diego, CA

Contact: Stephen Dunham
Office: 760-639-4400

Golf Tournament to Precede AMTA San Diego Conference

The AMTA 2010 Conference & Exposition in San Diego, CA will be preceded by a golf tournament at the Riverwalk Golf Course adjacent to the Town & Country Hotel. This best-ball shotgun style tournament begins with check-in at noon on Sunday July 11th and includes longest drive, straightest drive, and closest to the pin contests. All proceeds from the tournament benefit The Tuition Granted Foundation, a San Diego-based non-profit organization dedicated to raising funds for underprivileged college-bound students.

"This tournament is the perfect opportunity for friends and colleagues in the water treatment industry to come together for a great round of golf at one of San Diego's classic golf courses," says Stephen Dunham of Professional Water Technologies and founder of The Tuition Granted Foundation. "We are excited to bring our industry together for an afternoon of fun while supporting a worthy cause."

Registration for the event ($100/player before June 15) includes a round of golf, box lunch, dinner buffet, goodie bag, and tournament balls. Club rentals ($40/player) are also available upon request. Riverwalk is a Ted Robinson and Ted Robinson Jr. designed course that has hosted a myriad of golf legends during the PGA tour throughout the 50s and 60s. It now features undulating fairways, waterfalls and well-protected bentgrass greens. Water comes into play on 13 of the 27 holes with a spectacular waterfall surrounding the green of the signature hole. The San Diego River is a prominent feature of the layout, contributing to the beauty and challenge of the course.

Hole sponsorship and registration are available online at tuitiongranted.org or call 760-639-4400. 100% of proceeds from this tournament will fund scholarships through The Tuition Granted Foundation, a 501(c)(3) non-profit organization. ■

AMTA Technology Transfer, Puerto Rico

Membrane Treatment in the Caribbean

By: C. Robert Reiss, PhD, PE and Steve J. Lash, E.I.
Reiss Engineering, Inc.

In January of 2010, AMTA members from all over the US and Caribbean gathered in San Juan, Puerto Rico for the first technology transfer workshop of the new decade. True to its title, the workshop included opening remarks from a multi-national panel of keynote speakers. Dr. Steve Duranceau, AMTA's current President and professor at the University of Central Florida, welcomed the attendees and thanked the host committee i for their gracious hospitality. Dr. Duranceau was followed by Ir. Humphrey Gouverneur, President of the Caribbean Desalination Association (CaribDA), Mr. Cyprian Gibson, Caribbean Water and Wastewater Association (CWWA) President, and Mr. Warner Palermo, president of the Puerto Rico Water and Environment Association (PRW&EA). Each offered their own perspective on the applications and potential of membrane technologies applied throughout the Caribbean region.

After the introduction and Key-note speakers, the technical program was underway. The sessions were broken up into three parts, each focusing on a specific area of membrane technology.

The first segment, moderated by Mr. Ian Watson, offered an introduction to membranes and overview of the various applications. Ben Movahed (WATEK Engineering) began the session with two presentations about the basics of low pressure RO, and an introduction to salt rejecting membranes. He was followed by Ashok Duggal (Nalco Co.) offering a perspective on the best practices for implementing RO systems. Carsten Owerdieck (GE Water & Process Technologies) presented an introduction to immersed membrane bioreactors for reuse applications, and Ryan Furukawa (Professional Water Technologies, Inc. (PWT) rounded out the session with a look at RO operations and troubleshooting.

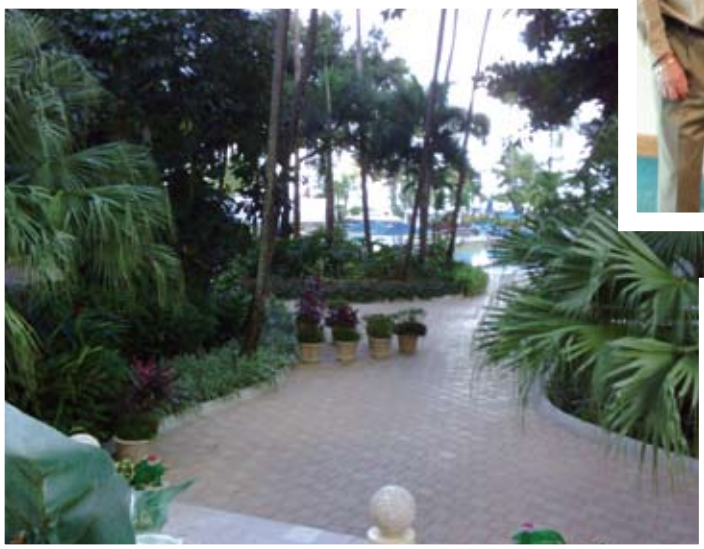
Following a lunch break, the technical sessions continued with a segment focusing on membrane case studies in the Caribbean region moderated by Coley Ali (PWT). The presentations by Albert Ortiz (ETAG Corp.), Dr. Robert Reiss (Reiss Engineering Inc.), Larry Jessup (Veolia), Stephen Lindo (Barbados Water Authority) and Miles Beamguard (Seven Seas Water Corp.) highlighted facilities throughout the Caribbean in which membrane technologies had been implemented. The presentations offered insight into the considerations and conditions unique to the region, and examples of how each challenge had been met through proper design, construction, and operation.

With the technical sessions having ended, day one of the workshop was concluded with a networking reception in the exhibit hall. There, attendees mingled, examined the various posters and displays, and enjoyed authentic Puerto Rican hors d'oeuvres and drinks.

Day two of the workshop opened with the final technical session entitled "Water Quality and Energy Considerations", and moderated by Lynne Gulizia (Toray Membrane USA Inc.). The presentations included discussions of permeate conditioning and handling, water quality considerations, and regional implementation of desalination by Dr. Steve Duranceau (University of Central Florida), Randy Majerle (PWT.), and Chris Hill (Malcolm Pirnie) respectively. The final presentation discussed the operations and objectives of the Caribbean Basin Water Management Programme, during which Mr. Victor Poyotte (CBWMP) gave the attendees insight into the administrative efforts of his program.

The workshop concluded with closing remarks by Dr. Reiss, who reiterated the objectives of the American Membrane Technology Association, and thanked the audience for their time and attendance. Overall the workshop was quite successful, and the short periods of rain throughout the conference did not hinder the spirits or eagerness of the attendees to learn, network, and further develop an understanding of the application of membrane technology in the Caribbean Region.

Please join us for our next technology transfer workshop in Tennessee, "Membrane Treatment in the Heart of the Great Smoky Mountains" between May 4th and 10th. Then in July, be sure to be there for our Annual Conference and Exposition in San Diego, CA, July 12th to the 15th. We look forward to another great Year! ■



Membership Update

Lynne Gulizia / Steve Malloy
Membership Co-Chairs

Since our last newsletter we have welcomed 73 new members!

Poul-Erik Arnvig
Outokumpu Stainless

P. Temple Ballard
Infilco Degremont, Inc.

Craig Bartels Ph.D.
Hydranautics

Walt Beasley
Ohio County Water District

Brad Biagini
N.A. Water Systems, a Veolia Water Solutions & Technology Company

Steve Brooks R.G.
Schlumberger Water Services USA, Inc.

Joseph R. Butler
Operator Training Committee of Ohio

Bob Buxman
National Oilwell Varco

Jami Cerone
HDR Engineering

Rodney Clemente
Energy Recovery, Inc.

Andrew M. Conger
Victaulic Company

Bhasker Dave Ph.D.
Hydranautics

James DeCarolis Jr.
MWH Americas, Inc.

Michael Derr
Afton Pumps, Inc.

Steven Dover
The Island Water Association, Inc.

John D. Dyson
Infilco Degremont, Inc.

Ralph Felix
City of Oceanside

Mike Frost
Startex-Jackson-Wellford-Duncan (SJWD) Water District

Tom M. Galeziewski P.E.
HDR Engineering, Inc.

Mark Graves P.E.
HDR Engineering, Inc.

Jude D. Grounds P.E.
MWH Americas, Inc.

Lyda S. Hakes P.E.
Alameda County Water District

John Hall
Layne Christensen Company

Kristne Hink
MWH Americas, Inc.

David L. Hoffman P.G.
Schlumberger Water Services USA, Inc.

Jason K. Holt
NanOasis Technologies, Inc.

Darrell Horn
Ohio County Water District

Ed A. Jabari P.E.
MWH Americas, Inc.

Kevin L. Kaiser
Hydranautics

Randy Kalisik
Amiad Filtration Systems

Daniel C. Klaybor
Underwriters Laboratories, Inc

Joe Lander
Duraflow, LLC

Tomer Lapidot-Boaz
Amiad Filtration Systems

Mark P. Lee
Site Engineering Consultants

Na Li
Horizon (Bejing) Environmental Technology Co., Ltd.

Ying Ma Ph.D
Pump Engineering, Inc., a Division of Energy Recovery, Inc.

Bill Matheson
Duraflow, LLC

Fred McCreary
City of Marysville

Robert "Bob" R. McVicker P.E.
Mesa Consolidated Water District

Brian C. Meek
Hydranautics

Charles D. Moody Ph.D., P.E.
U.S. Bureau of Reclamation

Veronica Morgante
National Oilwell Varco

John Morrow
NALCO Company

Bassam Saleh Mousa Jaradat
Alawael in Water Technology

Stephen E. Nation

Sam Neilands
New Water Incorporated

George A. Nnanna Ph.D.
Purdue University Calument Water Institute

Dave Oligschlaeger P.E.
Burns & McDonnell, Inc.

John Onkka
Olivenhain Municipal Water District

Daniel Opperman
Dow Water & Process Solutions

Randy Osburn
HDR Engineering, Inc.

Vishal Patel
Synder Filtration

Marshall Plunk
Alan Plummer Associates, Inc.

Stephen G. Polk Sr.
Poole & Kent Company of Florida

Mary Portillo
MWH Americas, Inc.

Patti Radakovich
Pump Engineering, Inc., a Division of Energy Recovery, Inc.

James R. Renner
Victaulic Company

Kathryn Robinson
Myron L Company

Stephanie J. Sansom
MWH Americas, Inc.

Guangda Shi
Conwed Global Netting Solutions

Arun Kumar Srinivasan
CH2M HILL

Tommy Staton
Startex-Jackson-Wellford-Duncan (SJWD) Water District

Michael Stefanic
Toray Membrane USA, Inc.

Harry Storm
Ohio County Water District

Sean Syring
Conwed Global Netting Solutions

Scott R. Terhune
Sanitherm Inc.

Michael Tian
Horizon (Beining) Environmental Techology Co., Ltd.

Jerry Vilander
Mesa Consolidated Water District

Burton Ward
New Water Incorporated

John Whelchel
Florida Aquastore & Utility Construction, Inc.

Joseph Wong
Brown and Caldwell

Angela Yeung
Dow Water & Process Solutions

Pete Zanoni
Burns & McDonnell, Inc.

Message from the Membership Committee

Happy 2010!!!! As the new year gets underway we want to thank all of you who renewed your memberships for 2010. We greatly appreciate your loyalty and continue to strive to earn your membership dollars. At the time of this writing we are expecting to finalize our membership this year at well over 700 members!

Many Division 2 members have opted to take advantage of our new membership structure and include more employees on their membership roster than previously had the opportunity to participate in AMTA events. We're happy this change has provided an additional benefit for you. Thanks for making the transition to the new dues structure so easy!

Please plan to attend the membership meeting during the AMTA Annual Conference in San Diego in July. We want to personally say thank you for your membership, have a little fun, provide some refreshments and reward you with some prizes! Refreshments and prizes are for members only, so if you still have that renewal on your desk, send it in soon.

See you all in San Diego. ■

Christine Owen

2010 Membrane Technology Webinar was held on January 28 at 2 p.m. (EST)

Facilitator: Christine Owen, Tampa Bay Water

The 30,000-sq-ft Tampa Bay Seawater Desalination Plant produces up to 25 million gal of drinking water per day, making it the largest seawater desalination plant in North America. Since March 2007, the plant has desalinated more than 3 billion gal of drinking water from the Tampa Bay.

Christine Owen, water quality assurance officer for Tampa Bay Water, will discuss recent challenges and solutions at the plant.

Owen is responsible for integrating water quality into the regional operation of groundwater, surface water and desalination facilities. She works with member utilities and regulatory agencies to address their distribution water quality needs and issues.

The 2010 Membrane Technology Webinar Series is sponsored by: Koch Membrane Systems

To sponsor an upcoming webinar, please contact Greg Tres at 480.941.0510 x15 or by e-mail at gtres@sgcmail.com.

January 28 Webinar

QUESTION	ANSWER
What is the cost of the desalination facility?	Total cost was $158 M. The cost of the initial facility was $110 M and the remediation was $48 M.
What characteristics of seawater are most difficult to handle in pretreatment?	Coagulation in high salinity and warm water is challenging. Influent water quality can vary (TDS, turbidity and TSS in particular)
Is there any specific reason for adding chlorine prior to coagulation?	Chlorine helps to control biofouling and aids in the coagulation process
What is TSS range of seawater feed?	2 to 47 mg/L
Why are you using both chlorine dioxide and chlorine instead of selecting one?	The results of pilot testing and actual operations have shown that perfomance is improved when both are used.
In hindsight, what studies or tests should have been conducted before pre-treatment designed?	Set-up a functional, integrated pilot operation for a least 18 months.
Chemical costs?	Approximately $320/MG
Sludge production?	Approximately 11050 lbs/MG
Power consumption?	Approximately 14,500 kW-hr/MG
Size of fine screen?	1.5mm traveling screen
Sand filters?	Single pass sand filter (4 foot bed, .85MM sand, 2.28gpm/sq ft, continuous backwash)
DE filters?	Eighteen DE filter vessels with 376 candles each; candles are 6 feet long, 2.5 inches in diameter, 5 micron.
Cartridge filters?	7 cartridge filter vessels; one per train. Each vessel contains 236 cartridges; each is 2.5 inches by 40 inches, 5 micron. Flow through each train is about 5000 GPM.
How frequently do you perform CIP's?	Every 6 - 8 weeks
Why are you concerned with chloride levels in finished water?	Corrosivity of the finished water and secondary MCL of 250 mg/L
Are you using antiscalant?	No
Do you blend feed with permeate water?	No
What is the typical RO feed SDI ?	Range of 2.5 to 3 SDI
Why is second pass production limited?	Original design (DBOOT; Stone and Webster/Poseidon Water Resources)
Is there any monitoring of the water quality at the groundwater discharge points or throughout that receiving aquifer?	No discharge to any aquifer is associated with this plant; colocated with a electric power plant.

John E. Balliew, P.E.

Upcoming Webinar Features Kay Bailey Hutchison Desalination Facility – Register Now

April 28 at 2 p.m. (EST)

Facilitator: John E. Balliew, P.E., vice president of El Paso Water Utilities (EPWU)

Vice president of EPWU, John E. Balliew, P.E., will discuss lessons learned during the past two years of operations.

Balliew has been with EPWU since April 1983. Under the leadership of EPWU President/CEO Edmund G. Archuleta, he is responsible for managing the operation of water, wastewater, reclaimed water service and storm water to the greater El Paso metropolitan area.

A registration fee of $25 will apply to both the live and archived presentations.

Register today at: www.wwdmag.com/membranewebinar2

Upcoming Membrane Technology Webinars
July 29, 2010 • Oct. 28, 2010

Questions & Answers

QUESTION	ANSWER
What type of pumps are used to feed the RO modules?	2 stage horizontal centrifugal
Post treatment question; How do you measure degree of remineralization?	Alkalinity, Total hardness, and pH
Explain more the relation of Bromide to Chlorine residual.	When chloraminated, high bromide permeate does not maintain a stable chloramine residual.
Do you us variable freq drives to run the feed pumps?	Yes
What is the service life of your RO membranes?	Plan on 5 years
Have members of the public commented on the quality of the drinking water?	No
Any plans for future additional desal plants?	Yes
How many pretreatment media cartridges per vessel	There are 286 cartridge filters per vessel. 266 of these cartridge filters are spiral (string) wound. 20 of these filters are Dura Bound and on the outer side of the vessel. All these filters are 5 micron in size. One vessel per train; 7 vessels total.
How often are the pretreatment filter media cartridges replaced?	Every 8 - 10 weeks
RO membrane manufacturer?	Dow Filmtech for 1st Pass. Hydraunatics for 2nd pass.
How do you make the decision on which membrane cartridge to use in your plant?	Recommendation of operater based on pilot work, experience and projections
What do manatees eat?	Sea lettuce; they are herbivores.
What type of pumps are used to feed RO?	2 stage horizontal centrifugal
what is the average TDS of product water	250 to 350 mg/L
Product water TDS, before stabilization?	10 to 20 mg/L
Do you think in the future getting water prefiltered like in a radial well be better choice than direct sea water from a channel, will be advisable to consider?	Under consideration in our long range planning efforts
Are you or the operator evaluating any RO membranes utilizing nanotechnology or other technologies?	Not actively at this time at this site
What RO module diameter are you using now?	8 inches
Basis for membrane selection?	Recommendation of the operator based on pilot, experience and projections
What is the TDS of influent water?	16000 to 34000 ppt

American Membrane Technology Association

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Stuart, FL 34996

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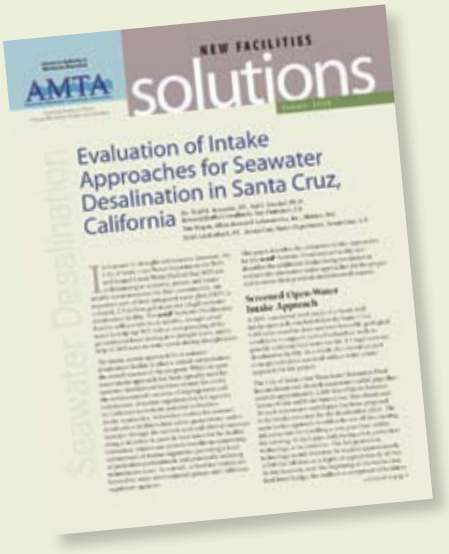

Calendar of Events

2010 Events

April 13, 2010	SWMOA Membrane Plant Operator Training Workshop, San Marcos, CA
April 28, 2010	AMTA/WWD Webinar – Kay Bailey Hutchison Brackish RO, El Paso, TX
May 4-7, 2010	ACWA – Spring Conference, Monterey, CA
May 4-6, 2010	AMTA Technology Transfer Workshop, Knoxville, TN
May 6, 2010	AMTA Board Meeting (3:00 – 9:00 p.m.)
May 17-21, 2010	SEDA MOC School – Pompano Beach, FL
May 18-12, 2010	SCMA Workshop: Pumps, Cleaning & Troubleshooting, Brownsville, TX
June 1-4, 2010	CaribDA 2010 Conference & Expo, Grand Cayman, Cayman Islands
June 6-9, 2010	WEF – Membrane Applications 2010, Anaheim, CA
June 13-16, 2010	SEDA Spring Symposium, Captiva Island, FL
June 20-24, 2010	AWWA Annual Conference & Expo (ACE), Chicago, IL
June 2010	SCMA Workshop: Introduction to Membranes, Abilene, TX
July 2010	SCMA Workshop: Pumps, Granbury, TX
July 11-12, 2010	AMTA/Statkraft – 2nd Osmosis Membrane Summit, San Diego, CA
July 12, 2010	SWMOA – Pre-Conference Workshop, San Diego, CA
July 12-15, 2010	AMTA Annual Conference & Exposition, San Diego, CA
July 16, 2010	AMTA Board Meeting, San Diego, CA (7:30 a.m. – 3:00 p.m.)
July 29, 2010	AMTA/WWD Webinar – Groundwater Replenishment Project, Orange County, CA
Aug. 25, 2010	SCMA Workshop: Cleaning & Troubleshooting, Waxahachie, TX
Sept. 27-29, 2010	SCMA 2010 Annual Conference & Membership Meeting, South Padre Island, TX
Oct. 2-6, 2010	WEFTC 2010 Conference, New Orleans, LA
Oct. 5-8, 2010	CA/NV AWWA – Fall Conference, Sacramento, CA
Oct. 24-26, 2010	SEDA Fall Symposium, St. Augustine, FL
Oct. 28, 2010	AMTA/WWD Webinar – Split Feed Nanofiltration, Town of Jupiter, FL
Nov. 4, 2010	SWMOA Membrane Plant Operator Training Workshop, Pleasanton, CA (Zone 7 Water)
Nov. 9, 2010	AMTA Board Meeting, Portland, OR (3:00 – 9:00 p.m.)
Nov. 9-11, 2010	AMTA Technology Transfer Workshop, Portland, OR
Nov. 30-Dec. 3, 2010	ACWA – Fall Conference, Indian Wells, CA
Dec. 2010	SCMA Workshop: Introduction to Membranes, Houston, TX

Contact the following organizations for more information regarding their listed events:
AMTA – 772-463-0820, admin@amtaorg.com, www.amtaorg.com
AWWA – 303-794-7711, awwamktg@awwa.org, www.awwa.org
CaribDA – 599-9-463-2000, hgouverneur@aqualectra.com, ww.caribda.com
IDA – 978-887-0410, paburke@idadesal.org, www.idadesal.org
SCMA – 512-236-8500, info@scmembrane.org, www.scmembrane.org
SEDA – 772-781-7698, admin@southeastdesalting.com, www.southeastdesalting.com
SWMOA – 888-463-0830, admin@swmoa.org, www.swmoa.org
WEF – 800-666-0206 x2, www.wef.org