WATER REUSE AND DESALINATION: EXPERIENCE AND OPPORTUNITY

September 28-29, 2010
The Cham Palace, Damascus, Syria

TECHNICAL PROGRAM

Levant Desalination Association

NOSSTIA

IDA

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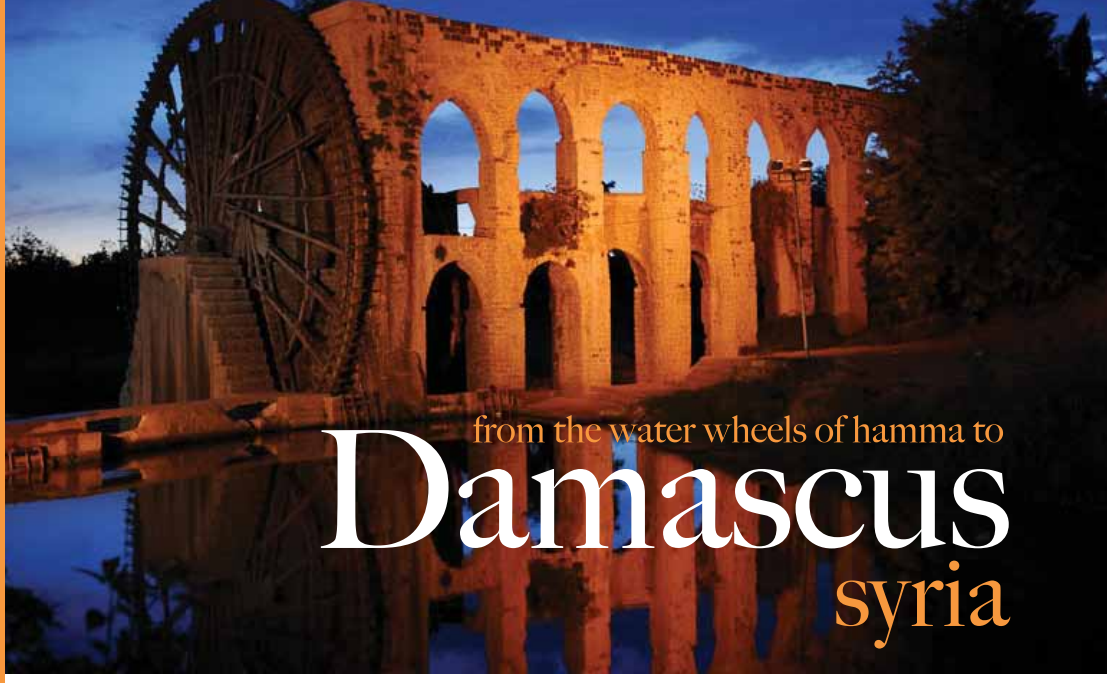

from the water wheels of hamma to

Damascus
syria

water reuse and desalination:
experience and opportunity

A two day event that is organized by the Levant Desalination Association (LDA) and The Network of Syrian Scientists, Technologists and Innovators Abroad (NOSSTIA) with the strategic partnership of International Desalination Association (IDA).

September 28, 29, 2010

The Cham Palace in Damascus, Syria

LDA Sponsorship Acknowledgment:

The Levant Desalination Association (LDA) would like to take this opportunity to thank our Sponsors for their contribution and for making this first conference a success.

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Dear friends and colleagues:
It is my pleasure to welcome you to the first Levant Desalination Association (LDA) Conference entitled, "Water Reuse and Desalination: Experience and Opportunity."

This conference is held under the patronage of the Prime Minister of Syria, H.E. Naji Al Otri, whose association with this event emphasises the importance his government attaches to water problems.

This conference is being organised in partnership with NOSSTIA (Network of Syrian Scientists, Technologists and Innovators Abroad) and with the co-operation of International Desalination Association (IDA). Both partners are committed, with us, to create an outstanding event.

This conference takes place in the ancient city of Damascus, reputedly the oldest continually inhabited city in the world and the city of my birth. This choice is significant, as this once lush green oasis, with its renowned orchards and many rivers, now suffers from acute water distress.

We have invited experts, well known on the world stage, to join regional and local authorities to discuss how problems of the region can be mitigated through the use of integrated water management and water reuse.

Our programme consists of keynote speakers and panel discussions with international and local experts. It is our goal that discussions among these esteemed presenters, with input from conference participants, will create a framework for immediate urgent action.

The aim of this conference with its subsequent events is to create awareness in the region of the magnitude of the problems it faces and act as a catalyst for action. Any sustainable solution will require a partnership between the people of the region with their government to use the latest techniques, encompassing integrated water management, demand management, state-of-the-art technologies and various other tools, to create the conditions for a sustainable future.

We invite all who are interested in solving the water problems of this region to join us in Damascus for this important programme and participate in subsequent events that will build on this foundation for change.

Ghassan Ejjeh
Conference Chairman

PROGRAM SCHEDULE

DAY ONE - TUESDAY, SEPTEMBER 28, 2010

9:00 - 9:45 **WELCOME AND INTRODUCTIONS**

Ghassan Ejjeh, Senior Vice President, BESIX Group - Belgium Chairperson of the Damascus Conference and Director and Past President of International Desalination Association (IDA) 8

Dr. Fouad Abousamra, Deputy Chairperson of The Network of Syrian Scientists, Technologists and Innovators Abroad (NOSSTIA) and UNEP MAP - Greece 9

Imad Makhzoumi, Chief Operating Officer, Future Pipe Industries Group - UAE
President of International Desaliantion Association 10

H. E. Mr. Muhammad Naji Otri, Prime Minister - Syrian Arab Republic

9:45 - 10:45 **KEYNOTE PRESENTATIONS**

9:45 - 10:10 **Singapore's Experience in Ensuring Water Sustainability**
Mr. Wah Yuen Long, Director, Public Utilities Board - Singapore 12

10:10 - 10:35 **The Current Statues of the Waters Resources in Syria**
Dr. Rateb Sayegh and Dr. Bassam Zakar, The Ministry of Irrigation - Syria 14

10:35 - 11:00 **Palestinian Water Sector Challenges and Comprehensive Vision for the Future**
Mr. Rebhi Al Sheikh, Deputy Chairman, Palestinian Water Authority - Palestine 15

11:00 - 11:20 **Coffee Break**

11:20-13:20 **SESSION I: INTEGRATED WATER MANAGEMENT**
Chairperson- Imad Makhzoumi and Leon Awerbuch

11:20 - 11:40 **Water, The Secret of Life**
Dr. Osmane Aidi, Chairman, Osmane Mounif Aidi Foundation for Culture, Communication and Development 17

11:40 - 12:00 **Management of Water Reuse Issues and Lessons Learned from the Mediterranean**
Dr. Fouad Abousamra, NOSSTIA Deputy Chairperson, NOSSTIA & UNEP MAP - Greece 19

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13:30 - 13:50 **Today's Desalination and Future Direction**
Dr. Corrado Sommariva, Managing Director, ILF Consulting Engineer, Director of IDA - UAE 66

13:50 - 14:10 **Global Water Shortages: Membrane Nanotechnology for Water Resources Development**
Professor Nidal Hilal, Director of Centre for Water Advanced Technologies and Environmental Research, Swansea University - United Kingdom 68

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Mr. Leon Awerbuch, President, Leading Edge Technologies, Ltd., Past President of IDA- USA 71

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Dr. Mohammad Al-Fouzan, President, ACWA Power Sasakura - Saudi Arabia 77

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Mr. Saad Elkhadem, Managing Director, Future Pipe Industries - UAE 79

15:10 - 15:50 **Aramco Experience in Desalination Technology**
Mr. Sagar M. Al-Anazi, Project Engineer, Saudi Aramco Company - Saudi Arabia 81

15:50 - 16:10 **Coffee Break**

16:10 - 17:30 **PANEL AND ROUNDTABLE SUMMARY**
Moderator-Leon Awerbuch
Dr. Fouad Abousamra, NOSSTIA & UNEP MAP - Greece
H.E. Dr. Kamal Al Sheikha, Deputy Minister for Housing and Construction-Syria
Mr. Ghassan Ejjeh, BESIX Group - Belgium
Mr. Fady Juez,Metito Overseas, Ltd. - UAE
Dr. Rateb Sayegh, The Ministry of Irrigation, Syria

WELCOME AND INTRODUCTIONS

Ghassan Ejjeh

Senior Vice President - BESIX Group - Belgium
Director of Six Construct UAE and BESIX SANOTEC SA
Director of Ajman Private Sewage Company
Past President and Director of IDA

Mr. Ghassan Ejjeh is one of the most recognized experts in the Desalination and Water Reuse Industry. His qualifications and many years of industrial experience led to his recognition and worldwide election to be a President of the International Desalination Association (IDA). He served also as Treasurer and Chairman of Election and Membership committee. His distinguished service for IDA is recognized by his peers with continuous election to the Board of Directors on which he serves as a member of Executive Operation Committee and a Member of the Environmental Task Force.

A civil engineering graduate from UMIST (Manchester University) with post graduate work on Marine structures, Mr. Ejjeh has completed several managerial and financial courses throughout his career Ghassan Ejjeh has been instrumental in the expansion of the BESIX Group's activities in the Middle East. He has over forty years experience in the construction and water industries, He currently holds the position of Group Senior Vice President and Director of Six Construct UAE, BESIX SANOTEC SA and Ajman Sewage company.

Mr. Ejjeh's 40 years experience in the Middle East both technical and commercial allowed him to lead and develop many large scale power desalination projects. He is a vocal champion for Waster Wate Reuse.

Mr. Ejjeh is a well known speaker at conferences, forums and seminars. He was a Chairman of the World Congress on Desalination and Water Reuse in Bahrain. He made on the subject over 100 presentations at such events.

Mr. Ejjeh has also provided consultation and advice to many leading corporation particularly in the Middle East and GCC countries. He is on the Boards of numerous organization and companies. He is very well acquainted with the customs and rules and regulations of the Middle East. Through his experience he is very familiar with the Water and Power Utilities of the Region and commands great personal respect with the leaders of the Governments as well as the Industry.

Dr. Fouad Abousamra
NOSSTIA Deputy Chairperson - UNEP MAP – Greece

Fouad Abousamra has been with UNEP MAP since 1999 as MEDPOL Programme manager responsible for follow up activities the implementation of legal instruments related to management of water ,chemicals, urban and industrial management as well as preparation of policy oriented assessments. Born in Syria, Fouad Abousamra read for the BSc in Applied Chemistry, at the University of Damascus, a Doctorat in Applied Organic Chemistry Process as well as a Diploma on water Pollution Issues in the University of Louis Pasteur, France and Doctorate ès-sciences in Natural Sciences(water sector) at the University of Paris VI. Before his appointment with UNEP MAP he worked as an advisor to the Ministry of Environment of Syria and served as Head of the Environmental Studies Department at the Higher Institute of Applied Sciences and Technology (HIAST) as well as Head of the Environmental Research laboratory at the Scientific Studies and Research Center of Damascus, Syria.

Imad Makhzoumi
Chief Operating Officer - Future Pipe Industries Group - UAE

During the past decade, he has participated in many international and regional committees responsible for the development for safe use of Fiberglass non-corrosive pipe systems in high temperatures and pressures within desalination plants.

He has been an IDA member for the last 14 years and has served as a director for the last 8 years as well as Second Vice President and chairman of the membership and elections committee.

His educational background includes a Diploma from McGill University (Montreal, Canada), and a Bachelors degree in Civil Engineering and Water Resources Management from the University of Southern California (Los Angeles).

His vision is to enhance the regional and international recognition of IDA's important role in desalination technology and water re-use. He also would like to promote IDA as the authority for various industry participants to interact, share knowledge and technology and enhance IDA's services.

KEYNOTE PRESENTATIONS

Wah Yuen Long

Director, Water Reclamation (Plants) Department - PUB - Singapore

EDUCATIONAL BACKGROUND

Mr Wah graduated from the University of Singapore in 1977 with a degree in Civil Engineering and then obtained his Master's Degree in Industrial and Systems Engineering from the University of Southern California in 1984.

PROFESSIONAL EXPERIENCE

Mr Wah joined the then Sewerage Department of the Ministry of the Environment in June 1977 as an Engineer. Over the next few years Mr Wah worked in the planning and design of the industrial water system and in the operation and maintenance of various municipal wastewater treatment plants. In 1979 he commissioned and then managed the Bedok Water Reclamation Plant.

Subsequently he continued to be involved in the operation and maintenance of wastewater treatment plants followed by planning and design and construction supervision of wastewater projects. Notable projects are the covering and odour control of 4 wastewater treatment plants and their expansion using compact designs. From 1995, he was involved in the conceptualization, detailed planning, design and construction of the S$3.65 billion Deep Tunnel Sewerage System, particularly the 800,000 cubic metres per day Changi Water Reclamation Plant and Outfall. Since July 2004 he has been the Director of Water Reclamation (Plants) Departmen managing all the municipal wastewater treatment plants in Singapore. His current duties include overseeing the operation and maintenance of the plants, commissioning the Changi Water Reclamation Plant and decommissioning 2 of the older plants, driving the effort to certify the plants operators, retrofitting an existing plant with a 65,000 cubic metres per day membrane bioreactor plant, spearheading research and development and energy efficiency efforts in wastewater and sludge treatment and supporting the PUB Consultants in their projects overseas

ADDITIONAL INFORMATION

SELECTED PUBLICATIONS MOST CLOSELY RELATED TO THE PROPOSAL

IWA publication in 2008 - Biological Nitrogen Removal Activated Sludge Process in Warm Climates by Cao Ye Shi, Wah Yuen Long, Ang Chee Meng and Kandiah S. Raajeevan

SINGAPORE'S EXPERIENCE IN ENSURING WATER SUSTAINABILITY

Wah Yuen Long
Director, Water Reclamation (Plants) Department- PUB -Singapore
REF# IDA_DM2010-Long

ABSTRACT
Singapore, a small but highly urbanised and industrialised country, is water scarce in spite of it being situated in the equatorial belt and receiving its fair share of rainfall. Traditionally, Singapore's water resources come mainly from 2 sources: i) imported water from its neighbour the State of Johor, Malaysia; and ii) water from its local but limited water catchments. However, even with half of its land area designated as water catchments, Singapore is not able provide for all its water needs. There is a need to look for innovative ways to increase its water resources to meet growing water demand. To this end, Singapore developed its "Four National Taps" strategy to ensure water sustainability. Of the 4 taps, 3 are essentially primary sources derived from water catchments or the sea i.e. local catchments; imported water; and desalination. The 4th tap is a secondary source from the successful recycling of used water from primary sources. Water re-use allows the multiplication of water resource by using the water more than once. High-grade reclaimed water, termed NEWater, is produced by passing secondary treated effluent through dual membrane process. NEWater is safe for consumption due to its high qualtiy but is largely used to supplement nondomestic water needs. The use of membrane bioreactor technology produces industrial quality water for industry use thereby cutting down the reliance on potable water. Effective public education and communications played an important part in convincing all that NEWater is safe for use. The public communications reached out to the populace, stakeholders and industries. Singapore's Four National Taps strategy to ensure water sustainability is possible only through the efficacious application of innovation and technology, water demand management, water conservation efforts, proper land use planning, particularly in creating more water catchment areas, and public communications.

THE CURRENT STATUES OF THE WATERS RESOURCES IN SYRIA

Dr. Rateb Sayegh and Dr. Bassam Zakar
The Ministry of Irrigation - Syria

Author's material not available at time of print.

Rebhi Al Sheikh
Deputy Chairman – Palestinian Water Authority - Palestine

Mr. Al Sheikh possesses both academic experience as a lecturer for 11 years in the Faculty of Engineering; Birzeit University, West Bank and a practical professional experience of 15 years in projects management and construction, in addition to Institutional Management. He represented PWA in many international and regional conferences and meetings and has built a strong and wide liaison and coordination network with the local and International Governmental and Non governmental organizations. Mr. Al Sheikh has published a number of articles and papers related to the water sector management including desalination works.

He holds a Masters Degree in Energy Related Studies from Liverpool University, England.

PALESTINIAN WATER SECTOR CHALLENGES AND COMPREHENSIVE VISION FOR THE FUTURE

Mr. Rebhi Al Sheikh
Deputy Chairman, Palestinian Water Authority - Palestine

Author's material not available at time of print.

SESSION I: INTEGRATED WATER MANAGEMENT

Chairperson – Imad Makhzoumi and Leon Awerbuch

Eng. Dr. Osmane AÏDI

Chairman – Osmane Mounif Aidi Foundation for Culture, Communication and Development – Europe
Chairman – many Engineering, Contracting, Industrial, Commercial, Water and Touristic companies, including CHAM Palaces & CHAMTOUR – different countries

EDUCATIONAL BACKGROUND

Graduation in 1952 from Polytechnics Institute of Grenoble, France, specialist in water techniques, irrigation, dams and drainage. State Diploma, Ph. D of Hydraulics Sciences from the Academy of Paris (December 1955).

PROFESSIONAL EXPERIENCE

He came back to Syria in January 1956 and is from that date exerting his activities in the Middle East and Europe in his specialty and in all other engineering and studies matters, and economic fields in addition to the press as he was in the sixties President of the "Ousbou Arabi" the well known pan-Arab publication, during its zenith.

Among the contracting achievements, he erected in 1958 the first of the Syrian dams in addition to the Figeh drink water project in Damascus, the Lattakia drink water (Sinn Projects 1962), in addition to having been since 1962 professor of Hydraulics Engineering Science in both Aleppo and Damascus Universities.

In the early seventies he gave interest to the hotels industry and tourism as he constructed some hotels to the benefit of the Ministry of Tourism and was in 1977 Chairman of the first share holding company following a special law, 15 years after the nationalization in Syria, a company which was the first structure of CHAM Palaces & Hotels and CHAMTOUR, yet without neglecting his basic specialty in all what concerns the water problems.

ADDITIONAL INFORMATION

Eng. Dr. Aidi was awarded many distinctions from eight Arab and Foreign Countries including the United Nations. He praises in particular the Syrian Merit Distinction, Excellence Grade, which President Hafez Al-Assad awarded him in 1972 as he was the only person from the private sector to be granted that distinction. To mention also the French "Legion d'Honneur" distinctions in their different grades and from different French eras i.e. both the rightist and leftist, the first one having been awarded by President Charles de Gaulle and the last one the distinction with the "Commandor" Grade being the highest one that France awards to a person belonging to the private sector.

He founded the " Osmane Munif Aïdi for the Heritage, Culture and Science " then "Osmane Munif Aïdi for Culture, Communication and Development ", an NGO foundation accredited by the United Nations through a press release No. NGO/528-PI/1556 dated 6/1/2004.

The only title he is keen on adopting since 1950 until now is "Engineer Doctor Osmane Aïdi ".

WATER, THE SECRET OF LIFE

Dr. Osmane Aidi
Chairman, Osmane Mounif Aidi Foundation for Culture, Communication and Development

Author's material not available at time of print.

Dr. Fouad Abousamra
NOSSTIA Deputy Chairperson – UNEP MAP – Greece

Fouad Abousamra has been with UNEP MAP since 1999 as MEDPOL Programme manager responsible for follow up activities the implementation of legal instruments related to management of water ,chemicals, urban and industrial management as well as preparation of policy oriented assessments. Born in Syria, Fouad Abousamra read for the BSc in Applied Chemistry, at the University of Damascus, a Doctorat in Applied Organic Chemistry Process as well as a Diploma on water Pollution Issues in the University of Louis Pasteur, France and Doctorate ès-sciences in Natural Sciences(water sector) at the University of Paris VI. Before his appointment with UNEP MAP he worked as an advisor to the Ministry of Environment of Syria and served as Head of the Environmental Studies Department at the Higher Institute of Applied Sciences and Technology (HIAST) as well as Head of the Environmental Research laboratory at the Scientific Studies and Research Center of Damascus, Syria.

MANAGEMENT OF WATER REUSE ISSUES AND LESSONS LEARNED FROM THE MEDITERRANEAN

Dr. Fouad Abousamra
NOSSTIA Deputy Chairperson – UNEP MAP – Greece
REF# IDA_DM2010-Abousamra

ABSTRACT
Mobilising non-conventional water resources can provide adequate solutions where projected levels of water savings prove hard to achieve. In many countries, the reuse of water is already applied. However, an unofficial and uncontrolled use of insufficiently treated or even totally untreated wastewater is taking place in some cases, for both irrigation and domestic uses, resulting in unknown risks to users and the environment. Legal and policy frameworks are often missing to stimulate projects development and private sector investments to catch up with rapidly growing demand and emerging needs.

Lessons learned from the Mediterranean region and some global experiences have effectively contributed to pinpoint the major legal, institutional and technical issues that might be considered at national level to make water reuse policy a national success story. In several cases, when they are not properly tackled, the quality of the services which are expected out of the water reused policy are not met.

The paper aims at providing a guiding picture with orientations and recommendations on the major issues that would bring a national water reuse policy within reach.

The existence of a political will is to be boldly pledged to ensure policy consistency with the overall national sectoral development plans and support public-private partnership in support to the national water reuse policy . The integration of the policy in the overall national integrated water resources management has a significant impact on its success. The regulatory and institutional frame works to adjust the institutional, economic and financial aspects that may be complemented by standards, directives and guidelines would improve substantially water policy effectiveness and reliability.

Public acceptance and perception is becoming one of the major limiting factors for the success of water reuse policy . The level of the participation and cooperation of stakeholders and media during the design, implementation and exploitation and in the overall decision making process of a water reuse project is one of the success indicators.

Water reuse projects are normally designed to provide a constant single water quality level. This is an important element of the agreement between reused water promoters and users. Their satisfaction would be granted by ensuring the reliability of the quality and quantity of water provided.

Technology is one of the pillars of the production of water to be reused. Normally water is produced after the application of treatment process which entails several techniques to make certain the quality of water. Strong relationship exists between technology and quality of water.

Protection of public health is one of the key issues in water reuse. Any water reuse project involves risks to the public health which should be prevented from its outset. Risk assessment could be evaluated using several up-to date methodologies. Willingness to finance water reuse project requires the availability of funds which call for a convenient pricing policy, tariff reforms, provision of loans and grants. Given scarce public and private resources, it is imperative that money be well spent and effectively coordinated.

Mahmoud Al-Sibai
Syria

HIGHER EDUCATION
B.Sc in Civil Engineering, Al-Baath University at 1985.

M.Sc. in Irrigation Engineering from the University of Newcastle upon Tyne, UK, at 1992.

Ph.D. in Engineering from the University of Newcastle upon Tyne, UK, at 1996

SCIENTIFIC POSITIONS
Associate Professor of water resources at Al-Baath University.
Member of the Higher Board for Scientific affairs, Al-Baath University from 2008 - 2010.

Director of development and quality assurance, Al-Baath University 2008-2009

Head of Integrated Water Resources Management Program, Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) from 2003-2007.

Consultant, Water resources department, ACSAD
Acting Dean, Higher Institute for Water Management, Syria, since 2009

ADDITIONAL INFORMATION
Expertise:
Integrated Water Resources Management
Mathematical modeling of groundwater flow
Quality Assurance in Higher Education

THE IMPACT OF THE CLIMATE CHANGE ON WATER RESOURCE CASE STUDIES FROM SYRIA

Dr. Mohammad Al-Sibai
The Ministry of Higher Education - Syria

Author's material not available at time of print.

Mohammed Rabia Ahmed
Director General - Palestinian Water Authority - Palestine

EDUCATIONAL BACKGROUND
M. Eng., Technology and Resources Management in the Tropics and Subtropics, 1996. Cologne University, Germany

B.Sc., Mechanical Engineering, 1989. University of Gar Younis, Benghazi - Libya

PROFESSIONAL EXPERIENCE
2008 to present: Director General of Palestinian Water Authority, Gaza Strip

1998-2008: Director of Water Control Department, Palestinian Water Authority.

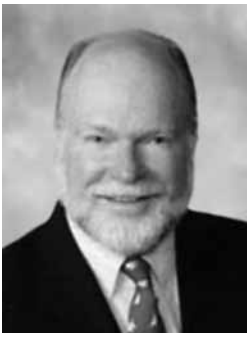
1997- 1998: Consultant for Solid Waste Management Project in Gaza Strip, Funded by GTZ-Germany.

1992-1994: Assistant Water Engineer, Environmental Health Program, UNRWA-Gaza

SUSTAINABILITY OF WATER RESOURCES MANAGEMENT IN GAZA STRIP, PALESTINE

Eng. Mohammed Ahmed
Director General - Palestinian Water Authority – Gaza
REF# IDA_DM2010-Ahmed

ABSTRACT
The Gaza Strip is located on the extreme edge of the shallow coastal aquifer that borders the eastern Mediterranean Sea. There is little rainfall and no reliable riparian flow; hence water supply for Gaza residents is limited to that available from the part of the coastal aquifer. The exploitation of the coastal aquifer has resulted in continuous lowering of regional water levels and the worsening of water quality. The greatest threats to existing water supplies are seawater intrusions and up coning of deep brine fossil water. There are serious water quality problems in the Gaza Strip's Aquifer. The population of the Gaza Strip will grow to over two million by 2020, and the demands for water will far exceed the sustainable capacity of the aquifer. Continuous urban and industrial growth will place additional stress on the aquifer system, unless appropriate integrated planning and management actions are instituted immediately. It is evident that drastic action must be taken quickly to support its people in the future. This paper presents overall guidelines for the management through year 2020, with associated investment requirements for infrastructure facilities to meet all goals and objectives. It has been estimated that a capital investment program of about US$1.5 billion is needed to finance the implementation of such plan. It has been concluded that seawater desalination as well as brackish water desalination are the main components of the domestic water management plan that will have overall beneficial impacts on the socioeconomic aspects in addition to protecting people lives in Gaza.



Thomas M. Missimer

Water Resources Sector Leader -Schlumberger Water Services -USA

EDUCATIONAL BACKGROUND

Dr. Missimer has a BA in geology from Franklin & Marshall College, an MS degree in geology from Florida State University, and a PhD in marine geology and geophysics from the University of Miami.

PROFESSIONAL EXPERIENCE

Dr. Missimer is currently the global water resources sector leader for Schlumberger Water Services. He has practiced as a hydrogeologist for 37 years, beginning with the U.S. Geological Survey in 1973. He was a research associate at the University of Miami from 1975 to 1976. He founded three consulting companies, Missimer & Associates, Inc., Missimer International, Inc., and Missimer Groundwater Science, Inc. between 1976 and 2006 and worked for public and private sector clients during that time. His last company was purchased by Schlumberger Water Services in 2006. He has worked on a variety of water resources projects, including water supply development, aquifer storage and recovery, and the development of innovative intake for desalination facilities.

ADDITIONAL INFORMATION

Dr. Missimer is the author of 6 books and over 270 technical publications in journals, guides, books, and technical proceedings. He recently won an international Award of Distinguished Technical Publication from the Society of Technical Communication for the book "Water supply development, aquifer storage, and concentrate disposal for membrane water treatment facilities." In 1991, he won the Best Paper Presentation Award from the International Desalination Association for a presentation made at their congress held in Washington, D.C.

AQUIFER STORAGE AND RECOVERY OF RECLAIMED WATER: THE USE OF UNDERGROUND STORAGE TO FACILITATE WATER CONSERVATION AND REUSE

Thomas M. Missimer* and Robert G. Maliva
Water Resources Sector Leader - Schlumberger Water Services -USA
REF# IDA_DM2010-Missimer

ABSTRACT
Water use is rapidly rising in the Middle East region as population and land use changes occur. It is now extremely important to invoke the integrated management of all water sources, including desalted water, storm water, and reclaimed water from the treatment of domestic (treated sewage effluent) and industrial wastewaters. Since the cost of desalination is quite high, it is economically significant to reuse as much treated sewage effluent (TSE) as possible.

Efficient reuse of TSE commonly requires that some type of storage infrastructure must be constructed so that the water can be used as needed or more efficiently without discharge to tidal waters. Aquifer storage and recovery (ASR) is a proven method of storing TSE underground during peak production periods and recovering it during peak demand periods. The goal should be to reuse all of the TSE for beneficial purposes, such as irrigation of ornamental vegetation, landscape plants, and certain types of fruit trees and crops. There is no current suggestion to use reclaimed water directly for potable supply, although the technologies exist to purify this water to the highest degree.

ASR has been used to store and recovery TSE at many locations around the world. A good example of this concept is the facility at Destin, Florida. Destin is located along the northwest Florida coast and lies on an environmentally sensitive barrier island. Destin has a very active TSE reuse program, but produces too much TSE at specific times of the year. The existing surface reservoirs and percolation ponds have insufficient volume to meet the seasonal storage requirements. Therefore, Destin had the need to either add more percolation ponds or reservoirs or use another method to effectively store the reclaimed water or discharge the water to tidal water. Discharge of TSE into the sensitive marine environment would produce undesirable environmental impacts and would waste a quite valuable resource. Therefore, they initiated an ASR program was initiated to store TSE in a shallow aquifer during peak production periods. There is a legal prohibition against the development of private wells in the shallow aquifer in the City of Destin, so there is no possibility that the reclaimed water ASR system would result in the consumption of the storedwater by humans. The combination of the ASR and wells used for irrigation by the residents produces a very economical irrigation water supply, reduces any potential adverse environmental impacts of a surface discharge, and conserves a valuable resource. Another added benefit is that Destin does not have to develop a new potable water supply to meet irrigation demands taken for the potable water distribution system.

There are many opportunities in all of the Middle Eastern countries to utilize TSE ASR programs similar to the Destin, Florida system. The ASR systems would store the water until needed without evaporative losses that occur in surface reservoirs and the natural filtration of the TSE through the shallow aquifer system would cause additional treatment of the water to make it fully safe for irrigation use. The reuse of TSE would also improve the fundamental economics of seawater desalination by producing a second use of this expensive water. Each country should attempt place all potential sources of water into an integrated plan, wherein the desalted water would be used primarily for potable requirements, reclaimed water (TSE) would be used to irrigation and aquifer recharge to restore depleted groundwater supplies, and stormwater would be captured and artificially injected into shallow aquifers when possible. The goal is to establish the most economically viable and energy-efficient water supply system to meet current and future water supply demands.

WATER MANAGEMENT AND WATER REUSE PROJECTS IN TUNISIA

Ms. Souad Dekhil,
ANPE,Tunis - Tunisia

Author's material not available at time of print.

SESSION II: ADVANCE WATER REUSE TECHNOLOGY AND SOLUTIONS

Chairperson - Dr. Fouad Abousamra and Dr. Corrado Sommariva

THE MASTER PLAN OF THE SEWAGE TREATMENT IN RURAL DAMASCUS

H.E. Dr. Kamal Al Sheikha and Mr. Mahmouad Jaradat
The Ministry of Housing - Syria

Author's material not available at time of print.

Abdelkader GAID

Head of Department - Veolia Water Technical Department - Veolia Environment - France

EDUCATIONAL BACKGROUND

Diploma :
Engineer Process Chemistry
Engineer Environmental Technologies - France
Doctor engineer Process Chemistry - France
Physical Sciences's Doctor : Ecole Nationale Supérieure Chimie- France
Former Professor : University of Algers (1981-1994)
Member of the African Academy of sciences

PROFESSIONAL EXPERIENCE

Activities :
Drinking water treatment
Wastewater treatment
Definition and Calculation of the water and wastewater treatment plant units.
Expertise, Control and validation of projects
Pilot tests with different treatment processes
Development of new drinking water and reuse processes & technologies

ADDITIONAL INFORMATION

Publications :
More 160 papers and conferences about water and wastewater treatment Three books on the environmental technologies 19 patents

WASTEWATER REUSE: WHAT SOLUTIONS FOR WHAT OBJECTIVES?

Kader GAID

Doc es sciences – Veolia Water - France

REF# IDA_DM2010-GAID

ABSTRACT

In many regions of the world, wastewater reuse is increasingly becoming one of the essential components in the water cycle, with wastewater becoming an integral part of the water resources.

Recognised as early as 1992 by various international institutions as one of the schemes to be implemented as part of a sustainable development policy, wastewater reuse has since been expanding rapidly because it offers a lasting alternative water resource. The first consequences of greenhouse gases and of global warming are leading in various regions of the globe to a reduction in water resources worrying enough to incite water resource managers to turn already to this alternative resource. Veolia Water has committed itself for many years to providing assistance in the implementing of a sustainable development policy and to mobilising its researchers and technicians to develop advanced technologies and contribute their know-how in the field of water and its reuse.

This article describes the possibilities for using conventional treatments (filtration – disinfection) and membrane filtration. First used for drinking water production, membrane technology is now widely used for wastewater treatment. Membrane technologies associated according to the following Microfiltration or Ultrafiltration – Reverse Osmosis schemes can deliver water with physicochemical and microbiological qualities in conformity with WHO standards, or local standards which are strongly inspired by US standards or European standards. The benefits of membrane processes in wastewater plants or drinking water production are nowadays well known: membrane processes offer the advantages of eliminating a large number of pollutants in one step, securely retaining micro-organisms by a physical barrier, producing reliable water quality and reducing the use of chemicals. Thus, the ability of membranes to reliably produce the quality of water specified in water reuse has promoted membrane technology for water resource management.

These treatment schemes are often consolidated upstream by pilot tests which contribute to the choice of the most appropriate technical solutions as well as the best suited reagents. This paper presents examples of projects and discusses current and future developments of the technologies depending on the wastewater reuse application.

The aim of this article is to describe a few examples of wastewater reuse based on the numerous projects in which Veolia Water has been involved and the various positive aspects they present both for local authorities and for industrial companies.

Key words: wastewater reuse, filtration, disinfection, microfiltration, reverse osmosis

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Commitment to a Cleaner Environment

Bassem Halabi
Group Business Development Director
Metito Overseas Ltd. - UAE

EDUCATIONAL BACKGROUND

Bassem Halabi completed his primary and secondary education in Lebanon. He then went on to pursue his higher education from the United Kingdom where he graduated with a BSc. Honours degree in Mechanical engineering from the University of Wales.

PROFESSIONAL EXPERIENCE

Bassem Halabi started his career in 1982 with Metito as a graduate engineer. Over the past twenty three years, Mr. Halabi held several positions in the Metito Group, from a contracts engineer to the higher managerial positions of contracts manager, proposals manager, sales manager and Vice President for sales and proposals, until the current position of Group Director for Business Development. The experience gained from working in every area of the company's activities has earned Mr. Halabi a breadth of knowledge in the various fields of the water and wastewater treatment industry.

ADDITIONAL INFORMATION

Bassem Halabi is the author of several papers published in the water treatment industry magazines, and is a Chartered Engineer and a member of the British Institution of Mechanical Engineers. He is also a member of several other professional associations.

ASR : A VIABLE OPTION

Bassem Halabi
Group Business Development Director – Metito Overseas Ltd. – UAE

REF # IDA_DM2010-Halabi

ABSTRACT

Water is an essential element for sustaining life, and history offers us examples of some of the greatest civilizations that existed on the banks of well known rivers throughout the world. Unfortunately, the availability of natural renewable water resources is gradually diminishing against a global increase in the demand for this commodity. The reduction in the available resources can be attributed to two factors: growing populations and mismanagement of water use. Apart from few countries in the world that are blessed with abundant natural water resources, many countries have no option but to enhance their available water sources. Whilst sea water desalination can offer a viable solution for countries that have coast lines like the GCC and North Africa, countries that do not have access to sea water will have no option but to improve their management of existing water resources, and to augment them by increasing the use of treated waste water.

Current water reuse technologies have made it possible to treat waste water to a degree of purity that is suitable for direct human consumption. However, there remains a psychological barrier that prevents people from using this treated water. The need for fresh water in certain countries necessitates breaking down this barrier as there are hardly any other available options. Whilst it may be easier to overcome the psychological barrier in countries like Singapore, the solution may not be as easy in other countries. One option that has proven itself over the past decades is the Aquifer Storage and Recovery System or ASR. ASR is a process whereby treated waste water is reinjected into the aquifer to undergo further natural purification prior to its recovery for final potable reuse.

In this combined scheme, waste water undergoes extensive biological treatment followed by tertiary treatment before ending up with reverse osmosis and disinfection for complete purification. At this stage, water will be suitable for potable uses, but, for one reason or another, may not gain public acceptance. This problem may be overcome by artificial injection of this water into a soil aquifer system. The injection process, in addition to its aesthetic feature, enhances further treatment of the injected water through a natural process within the soil layers.

In addition to breaking the psychological barrier, aquifer recharge has several other advantages:

Offers a secure water supply

- Recharge methods are environmentally attractive, particularly in arid regions
- Recharge can significantly increase the sustainable yield of an aquifer
- Aquifer water can be improved by recharging with high quality injected water
- Most aquifer recharge systems are easy to operate, and the technology is generally well understood
- Closing the loop in the water cycle

Water supplies remain finite whilst water demands are on the increase because of escalating population, urban development, rising per capita consumption and increasing industrialization. Enhanced aquifer recharge with high quality reclaimed water could be a viable option in the search for new potable water sources, and an alternative to the water sustainability crisis in many arid regions. As more advanced technologies become available, potable quality reclaimed water can be made more affordable. Governments and local authorities must work on a program to increase public acceptance of such schemes, and step up attempts to break down the psychological barrier that exists in the waste-to-tap initiative.

Dr. Harvey Winters
Professor- Fairleigh Dickinson University- USA

EDUCATIONAL BACKGROUND
B.S., M.S. Biochemistry, Fairleigh Dickinson Univ., USA
Ph.D. Chemical Biology, Columbia Univ., USA
Post-Doctoral, Columbia Univ., USA

PROFESSIONAL EXPERIENCE
Professor Winters is currently Professor Emeritus at Fairleigh Dickinson University (FDU), Teaneck, New Jersey, USA and has accepted in 2009 a Visiting Professorship at Nanyang Technological University (NTU), Singapore.

Professor Winters has been at FDU since 1970 and was Director of Desalination Technology at FDU from 1980-1988.

ADDITIONAL INFORMATION
Professor Winters is a reviewer for Journal of Membrane Science and IDA journal. He has been a Director of the International Desalination Association (IDA) and has received two prestigious awards from the IDA for most outstanding research papers at 1995 and 2005 IDA Congress for Desalination and Water Re-Use.

Professor Winters' research has focused on biofouling of Reverse Osmosis membranes and his research has been supported by National Science Foundation (NSF), Office of Navy Research (ONR), Middle East Desalination Research Center (MEDRC), and Bureau of Reclamation.

He has over 50 research publications and has been awarded a patent on the use of chloramines to inhibit membrane biofouling in SWRO.

THE MECHANISM OF BIOFILM FORMATION ON REVERSE OSMOSIS (RO) MEMBRANES

Harvey Winters
Professor - Fairleigh Dickinson University - USA

REF# IDA_DM2010-Winters

ABSTRACT

Membrane fouling, especially biofouling, is the greatest impediment to successful membrane water-reuse involving reverse osmosis (RO) membranes. Because many parts of the world, including Syria, have water scarcity problems, water reuse facilities have increased in numbers, but most are operated in an efficient manner due to the biofouling problem. The main indicator of biofouling in water re-use facilities is the flux decline associated with an increase in pressure drop and/ or trans-membrane pressure.

The first step in the biofilm formation on the RO membrane is the rapid adsorption of acidic exopolymeric substances (EPS) present in the feed water after membrane pretreatment (MBR, MF, or UF). These EPS are acidic glycoproteins, acidic polysaccharides, humic-like material or acidic transparent exopolymeric particles (TEP). This process is referred to as "conditioning" and takes several days, but few bacteria will attach until this conditioning takes place.

Biofilm formation is a combination of nutrient and concentration polarization (CP) events. The growth of the biofilm on the membrane surface is controlled by the level of CP through interplay between CP and nutrient concentration at the membrane wall. It has also been proposed that the deposition of the acidic EPS onto the membrane surface depends also on the level of CP.

The biofilm is formed from viable but non-culturable (VBNC) bacteria in the feed water. The VBNC are resistant to chlorine and chloramine disinfection and interact with the EPS at the membrane surface to form a matrix of cells and extracellular slime material which is referred to as the biofilm.

Prof Dr. Gamal Khedr

Head of Water Technologies Centre - Technology Experts Global – Kingdom of Saudi Arabia

EDUCATIONAL BACKGROUND

Doctorat d'Etat és Sciences, University of Strasbourg, France, (1975).

PROFESSIONAL EXPERIENCE

Professor, National Research Centre Cairo, Egypt, since (1985).

- Consultant, Water Desalination/Treatment Ministry of Water & Electricity, Saudi Arabia.
- Vice President for Technical Affairs, Preussag Arabia.
- Head of Water Technologies Centre, Technology Experts Global, Saudi Arabia.

ADDITIONAL INFORMATION

- Member of IDA, EDS, AWWA, SFC.
- Published 49 articles in International Journals.

NANOFILTRATION MEMBRANE FOULING UPON TREATMENT OF INDUSTRIAL AND MUNICIPAL WASTEWATERS

M. Gamal Khedr *

Head of Water Technologies Centre - Technology Experts – Kingdom of Saudi Arabia

REF# IDA_DM2010-Khedr

ABSTRACT

Evaluation of Nanofiltration (NF) in treatment and recycling of industrial or municipal wastewaters (WW) of moderate salinity together with a variety of organic and inorganic fouling contaminants is investigated through laboratory and pilot testing under fouling conditions.

Investigation included the following themes:

1. Rate of membrane fouling as functions of percent recovery.
2. Individual extents of different types of fouling, scaling, organic and organic / biofouling and their contribution to the decline of NF performance. Results revealed a pronounced interference between the mentioned forms of fouling which worsened the decline of performance, complicated the composition of the fouling film, and rendered more difficult the restoration of the initial NF performance upon chemical cleaning of membranes.
3. Results of inspection of membrane surface during advance of fouling by SEM and chemical analysis of fouling deposit by ED X-Ray and FTIR spectroscopy were correlated to the measured, parallel decline of NF permeation and salt rejection.
4. High temperature NF (HTNF) in case of hot WW streams was shown to combine of acceleration of product rate, control of organic fouling, and promotion rejection of high molecular weight organics.

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Results revealed the feasibility of selection of adequate temperature range of HTNF for the optimum product rate and rejection performance.

A tentative mechanism of development of NF membrane fouling upon treatment of WW is suggested as following:

1. **Colloidal Fouling**
   - Through convective entrainment of organic, silt, and colloidal particles and adsorption on membrane surface.
   - Through electrostatic interaction between the surfaces charges of the colloid particles, and/or chemical interaction through,
   - The interaction between the polyvalent cations like iron or aluminum accumulated by membrane rejection in the diffusion layer with the stabilizing charge of colloidal particles.

2. **Primary Scale Deposition**
   Parallel to point no. 1, and particularly in the last stages:
   Deposition of supersaturated of sparingly soluble salts/compounds in view of:
   - Inadequate acid or antiscalent dosage.
   - Exceeded system design parameters: e.g. too high recovery and/or too slow brine flow.

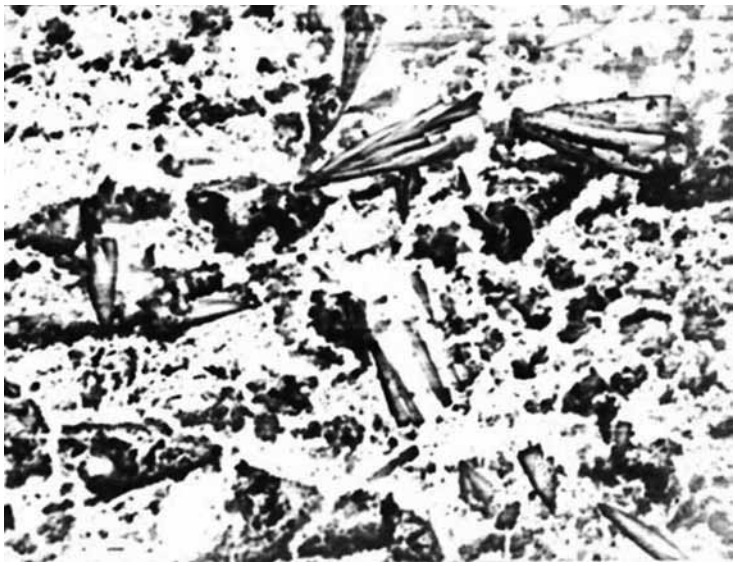
3. **Biofouling**
   a. *Primary Bacterial Adhesion*
      Only a small fraction of bacteria cells (biocolloids) in the feed water adsorbs on the membrane due to electrostatic repulsion between the negative charge on the thin film composite NF membrane and that on the bacteria cells at near neutral pH values. Extent of adsorption is determined by hydrodynamic factors, water composition, suspended matter, and membrane surface characteristics.

   b. *Propagation of Biofilm*
      During an incubation period of about 14 days at ambient temperature of 20 – 30 °C, the adsorbed bacteria progressively covered the membrane surface by their life products, the extracellular polymer substance (EPS), in a layer of several microns thick. The slime gel matrix of the film favors further organic and biofouling through entrapping the organic molecules, colloidal particles, suspended matter and bacteria cells which we considered as (secondary adhesion). This is an example of interaction between the different forms of fouling.

   c. *Fouling Film Denaturation*
      Up to this stage, the adequate chemicals cleaning could remove the fouling film and restore the initial system performance. However, with time the accumulating fouling film underwent progressive change of nature. It became increasingly denser and sticky, more adherent to membrane surface and of lower permeability. Such modification may be attributed to physic- - chemical and/or biological factors.

4. **Secondary Scale Deposition**
   Accumulation of the previous fouling forms lead to the formation of secondary membrane which results in: higher ΔP (feed – permeate) and higher ΔP (feed – brine). The consequently impaired hydrodynamics conditions cause severe concentration polarization with localized scale deposition; the figure shows the film SEM.

   Again this is an example of interaction between the different forms of NF membrane fouling which further complicate the structure and composition of the film and lead to higher decline of performance, and more difficult film removal by cleaning.



Inorganic scale crystal bundles embedded in the organic/biofilm matrix

Conclusion: The main factors that enabled control of fouling are

a. Hindrance of the adsorption of organics and microorganism on membranes surfaces through promoting its hydrophilicity.
b. Selection of membranes of lower surface charge and surface roughness.
c. Periodical backwash of membranes coupled with intermittent choc chlorination.
d. High temperature NF.

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Samir Fayyad
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EDUCATIONAL BACKGROUND
B.Sc. Industrial Engineering, The University of Jordan, 1993

PROFESSIONAL EXPERIENCE
Samir Fayyad is the Vice President, Technical at AES Arabia, a leading water and wastewater treatment company in Riyadh, Saudi Arabia. An experienced professional with more than 15 years practical experience in designing projects and solving problems related to water treatment and reuse both in the private and oil & gas sectors. Clients served including Aramco, Sabic, PDO, JGC, SNC-Lavalin, Snamprogetti, PDO, QP, Total, and many other clients.

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PROPER WATER TREATMENT SOLUTIONS GIVES CONCRETE RESULTS IN CEMENT INDUSTRY

Samir Fayyad
Vice President, Technical – AES Arabia – Saudi Arabia
REF# IDA_DM2010-Fayyad

ABSTRACT
Lafarge has constructed the first private Greenfield cement plant in Aleppo - Syria with a production capacity of 2.75 million tons per annum. The water requirement for the cement plant's power plant is around 5,500 cubic meters per day (CMD) and is supplied from a single deep well groundwater source. The groundwater, which had extremely high Total Dissolved Solids (TDS) and Total Suspended Solids (TSS), had to be conditioned to make it suitable for use as Cooling Tower (CT) makeup and in other processes. Environmental standards and limited water supplies necessitated a solution that would exploit the use of available resources, including treatment of existing process waste streams within the plant.

In response to the client's tough requirements, AES presented a technical solution that maximized overall plant recovery to more than 90% while keeping operational and chemical consumption costs to a minimum. Lime softening followed by high recovery Reverse Osmosis (RO) ensured water conservation, while the design was tailored to allow RO reject water to be utilized within the cement manufacturing process. The plant included a provision to allow for the sludge from the lime softening process to be decanted and returned back to feed, maximizing recovery and making the treatment process a true Zero Liquid Waste solution – a land mark in the region. The plant has been successfully built and commissioned in record time of 4 months.

WATER TREATMENT AND RECYCLING OF THE TANNERIES USING OLIVE MILL WASTE

Dr. Wareef Alyazji
The Ministry of Environment - Syria

Author's material not available at time of print.

Jean-Philippe Croue
Professor in Environmental Engineering – KAUST
Kingdom of Saudi Arabia

Jean-Philippe CROUE (50 yo) is Professor in Environmental Engineering at King Abdullah University of Science and Technology (KAUST) Kingdom of Saudi Arabia since september 2009 –(Division : Chemical and Life Sciences and Engineering). He is conducting is research at the Water Desalination and Reuse Center. He is Adjunct Professor at the University of Curtin – Perth Australia (since 2005). He was previously Professor at the University of Poitiers in France (from 1989 to 2009) and director of the Laboratory of Water Chemistry and Microbiology (laboratory joint to CNRS) when is left the University of Poitiers in 2009. He obtained is MSc in Environmental Engineering at the University of Chambéry – France in 1983 and his PhD (in 1987) and Habilitation (in 1990) in Water Chemistry from University de Poitiers – France. His research activities is pertaining to drinking and reclaimed water treatment focusing on (i) Isolation and characterization of Natural Organic Matter (NOM) and Effluent Organic Matter (EfOM), (ii) NOM properties in the aquatic environment (interactions with contaminants, photoinduced reactions), (iii) Removal of NOM by chemical coagulation and sorption, (iv) Evaluation of disinfection (chlorination, chloramination and ozonation by-products) and (v) Membrane filtration for Desalination and Reuse i.e. characterization of organic foulant of low and high pressure membranes and impact of pre-treatments (dual media filtration, Ultrafiltration/RO, disinfection)

EFFLUENT ORGANIC MATTER: STRUCTURAL CHARACTERIZATION AND FOULING PROPERTIES OF LOW PRESSURE MEMBRANE

Jean-Philippe Croue

Professor in Environmental Engineering – KAUST – Kingdom of Saudi Arabia

REF# IDA_DM2010-Croue

ABSTRACT

The exact role and contribution of biopolymeric materials (extracellular polymeric substances – EPS – and soluble microbial products – SMP) in MBR fouling or UF tertiary treatment fouling still need to be more investigated and understood in order to optimize operational conditions. The proposed research aims to characterize the biopolymer composition of MBR supernatant and effluent organic matter (EfOM) using direct and indirect approaches and identify the main fractions responsible for low pressure membrane fouling.

The first phase of this work was directed to characterize effluent organic matter (EfOM) by combining operationally defined categorization protocols with state-ofthe- art analytical techniques to investigate the bulk of organics with respect to origin, size, structure, and functionality. Samples were collected from waste water effluents (aerobic sludge treatment with long and short contact time) and MBR reactors (pilot scale reactors operating under different sludge wasting regime; full scale plants). After performing direct analyses (DOC, UV, LC-OCD) large volume of samples were subjected to the comprehensive XAD-resin isolation protocol proposed by Leenheer et al. (2000). The isolated fractions were subjected to a large variety of analytical tools including, elemental analysis, FT-IR, ^{13}C-NMR, Delta ^{13}C, pyrolysis and thermochemolysis GC/MS, total aminoacid and aminosugar contents, fluorescence EEM. Results were compared with the data obtained from NOM fractions isolated from natural waters. The DOC profile (LC-OCD analysis) differs with the origin of the wastewater. Bulk EfOM shows higher proportion of hydrophilic colloidal structures (bacterial residues) and nitrogenous organics as compared to bulk NOM. Structural characterization tools pointed out some significant differences in term of biopolymer and molecular composition (humic vs non humics, lipids, sulphurous derivatives).

The second part of the project focuses on the identification of the main fractions of EfOM responsible for the fouling of low pressure membrane (MF or UF). The experiments were conducted with MBR supernatant and pre-filtered wastewater effluent collected from plants performing long term aeration activated sludge process. Two hollow-fiber membranes, PVDF tight MF and PES UF membranes were used as home made mini modules. Short-term fouling tests performed at constant flux were developed consisting of successive filtration steps interspersed by backwashing. Fouling tests were performed before and after physical chemical treatments i.e. PAC, AER, O3 and UV/H2O2. Notice that these treatments were applied with the objective to modify the EfOM matrix. Before filtration all treated waters got their DOC content readjusted to the initial DOC using rotary evaporation. During all membrane filtration tests no significant TOC removal was noticed, however partial

removal of high MW biopolymers occurred. PAC treated effluent exerted strong reversible fouling as compared to the non pre-treatment effluent, observation probably related to remaining <10 µm-AC particles. High MW humic-like structures seems to play a significant irreversible fouling of the PES UF (improved filtration properties after AER). Ozonation and AOP significantly reduced the reverse fouling properties of the biologically treated effluent, results that confirmed the major role of the high MW biopolymers on MF and UF fouling issues.

SESSION III: IMPORTANCE OF PUBLIC PRIVATE PARTNERSHIP

Chairperson – Fady Juez and Mahmoud Anbar

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Nabil Nada
Desal Engineering Manager – ACWA Power International
Saudi Arabia

EDUCATIONAL BACKGROUND

- MSc: Material selection for Desalination Plants and Corrosion. Glasgow University, Scotland 1973
- PhD: Desalination Technology, Glasgow Univ. Scotland
- Bsc: Chemistry & Physics, Shames University 1968

PROFESSIONAL EXPERIENCE

Engineering Department, West Coast, SWCC, as Desalination Expert since 1986.

35 years in the Desalination field including:

- Specification of MSF, RO, MED.,
- Design largest RO Plant and MSF units in KSA
- Commissioning of Desalination Plants.
- Trouble shooting of all types of Desalination Plants.
- Worked in all SWCC 30 Plants which produce more than 900 MGD and 5230 MW.
- Member of IDA since its establishment
- Member of the Board of Directors in 1983-1985
- Member of the Technical Committee for several IDA Conference.
- Chairman of the Scientific Committee for SWCC 4th gained experience Symposium - 2005
- Contributing in the research and development of Desalination Process in R& D in KSA.
- Published more than 20 papers in the following topics:
  - Corrosion of Desalination Plants
  - Material selection for Desalination Plants
  - Desalination Plants economy
  - Design of Desalination Plants
  -Pretreatment of MSF & RO
  - Post-treatment of Desalination Water

CRITICAL CHALLENGES FOR DEVELOPERS OF PPP AND IWPP PROJECTS

Dr. Nabil Nada
Desal Engineering Manager, ACWA Power International - Saudi Arabia

Author's material not available at time of print.

Hans Meulenbroek

Civil Engineer – Metito Berlinwasser – UAE

EDUCATIONAL BACKGROUND

Hans has a Master Degree in Civil Engineering, specialized in Water Economics & Water Treatment, and taught as an assistant at the Institute for Water Quality at the University of Vienna, Austria, and holds a registered license of Mechanical Engineering.

PROFESSIONAL EXPERIENCE

Hans has over 28 years experience in the water industry. Prior to joining Metito Berlinwasser, Hans was a Senior Vice President of Golden State Environmental Group in China, responsible for the asset management of 31 concession projects in the water & waste treatment field and preparing the management for successful Private Placement. His earlier background includes the complete execution of large scale water supply and wastewater plants as project director, as well as the development of new projects throughout China and Asia for Joint Venture and BOT water projects.

CHALLENGE OF EXPERIENCE, TECHNOLOGY AND INNOVATION TO SUCCESS OF PPP

Hans Meulenbroek
General Manager – Metito Berlinwasser – UAE
REF12 IDA_DM2010-Meulenbroek

ABSTRACT
Often the public sector is suffering from high public depths and inefficient public management resulting in the main purposes for Public Private Partnerships (PPP) to attract private capital investment, increase efficiency and use available resources more effectively, as well as to achieve sector reform.

In nearly all cases the private sector participant is a group of entities collected within a special purpose vehicle (SPV), mainly made up of local and/or international building contractors, operators, and lenders, as well as other service providers such as consultants, insurers, each a professional specialist in their field.

Organization of such a group and assuring competitiveness from the market as a private partner cannot be achieved easily by the public partner himself. The consortiums bring with them- specifically for the sector- experience, technology, and innovation to be competitive compared to other private partners.

2009 marks the 10 year anniversary of the public private partnership between the state of Berlin and the private industry, which was assessed by an independent consultant showing that the Berliner Wasserbetriebe as operator of the water supply and sanitation of the City of Berlin has become more efficient and more competitive by the private partner inputs, quality of services could be increased with no reduction of jobs at acceptable tariff levels for the state and the people.

The individual goals are explained and the results shown including self financed investments, ban on job cuts, employee training and development, increased customer service, increase in water quality and sanitation with regard to standards and even to national average, under acceptable tariffs.

Politicians themselves praise the large number of innovations, the development of specific technologies, and the vast amount of experience collected, for which examples are provided.

Anas Ghazi

Attorney at Law, Chairman - Meethak – Lawyers & Consultants - Syria

EDUCATIONAL BACKGROUND

June 2008 - ADR Centre – Dispute Resolution Centre at Hamline University School of Law – the University of Rome "La Sapienza"

2003 – 2004 - University of East London – UK
LLM. International Legal Studies -Graduated with distinction

1990-1995 - Damascus University – Faculty of Law, BA

PROFESSIONAL EXPERIENCE

2008 - present
Chairman - Meethak – Lawyers & Consultants – Syria

2006/ 2007
Chairman - Legality – Lawyers & Consultants, Syria

2001 – 2006
Partner - Awad – Ghazi & Associates, Syria

1998 – 2000
Legal Consultant - Fayad & Associates. UAE

ADDITIONAL INFORMATION

Legal research: "Force Majeure & Hardship" Under the supervision of Dr. Ilyas Hadad, president of Commercial law Dep- Damascus – University
Submitted to Damascus Bar Association 1997.

Comparative Research: on Women Right in Syria in comparison with women's Right in Arab world.
Submitted to University of East London as a Dissertation for LLM Degree.

AN OVERVIEW OF THE LEGAL FRAMEWORK FOR FOREIGN INVESTMENT IN SYRIA

Anas Ghazi, Attorney at Law

Attorney at Law - Chairman – Meethak, Lawyers & Consultants - Syria

REF #IDA_DM2010-Ghazi

ABSTRACT

Among the Middle Eastern countries, Syria has keenly pursued in attracting Foreign Investment (FI). In this respect it has constantly striven to maintain the competitiveness of FI determinants, including the legal infrastructure. Various policy instruments and institutions have been deployed. Today, due to water scarcity in Syria, the foreign investment on water reuse becomes an essential economic need. To counter this phenomenon the Government of Syria has enhanced the utility of the existing determinants and is constantly considering new strategies to attract FI. Accordingly, the FI legal framework has also been enhanced. This presentation examines the legal aspects of FI in Syria on a broad basis and within the context, the emerging legislative policy investment.

Currently, water in Syria is publicly owned, the state has almost absolute authority as regards water resources management, and consequently the water investment in Syria is based on a public-public partnership or private-public partnership contract.

The aim of the presentation is to clarify the legal conditions of water investment, with a special focus on Arbitration which is the most common alternative dispute resolution (ADR) strategy provided for contracts investment in Syria.

Ghassan Ejjeh

Senior Vice President - BESIX Group - Belgium
Director of Six Construct UAE and BESIX SANOTEC SA
Director of Ajman Private Sewage Company
Past President and Director of IDA

Mr. Ghassan Ejjeh is one of the most recognized experts in the Desalination and Water Reuse Industry. His qualifications and many years of industrial experience led to his recognition and worldwide election to be a President of the International Desalination Association (IDA). He served also as Treasurer and Chairman of Election and Membership committee. His distinguished service for IDA is recognized by his peers with continuous election to the Board of Directors on which he serves as a member of Executive Operation Committee and a Member of the Environmental Task Force.

A civil engineering graduate from UMIST (Manchester University) with post graduate work on Marine structures, Mr. Ejjeh has completed several managerial and financial courses throughout his career Ghassan Ejjeh has been instrumental in the expansion of the BESIX Group's activities in the Middle East. He has over forty years experience in the construction and water industries, He currently holds the position of Group Senior Vice President and Director of Six Construct UAE, BESIX SANOTEC SA and Ajman Sewage company.

Mr. Ejjeh's 40 years experience in the Middle East both technical and commercial allowed him to lead and develop many large scale power desalination projects. He is a vocal champion for Waster Wate Reuse.

Mr. Ejjeh is a well known speaker at conferences, forums and seminars. He was a Chairman of the World Congress on Desalination and Water Reuse in Bahrain. He made on the subject over 100 presentations at such events.

Mr. Ejjeh has also provided consultation and advice to many leading corporation particularly in the Middle East and GCC countries. He is on the Boards of numerous organization and companies. He is very well acquainted with the customs and rules and regulations of the Middle East. Through his experience he is very familiar with the Water and Power Utilities of the Region and commands great personal respect with the leaders of the Governments as well as the Industry.

AJMAN, TRAIL BLAZER FOR PRIVATE SECTOR INVOLVEMENT IN WATER - MIDDLE EAST

Mr. Ghassan Ejjeh
Senior Vice President, BESIX Group, Director of IDA- Belgium

Author's material not available at time of print.

Dr. Fouad Abousamra
NOSSTIA Deputy Chairperson – UNEP MAP – Greece

Fouad Abousamra has been with UNEP MAP since 1999 as MEDPOL Programme manager responsible for follow up activities the implementation of legal instruments related to management of water ,chemicals, urban and industrial management as well as preparation of policy oriented assessments. Born in Syria, Fouad Abousamra read for the BSc in Applied Chemistry, at the University of Damascus, a Doctorat in Applied Organic Chemistry Process as well as a Diploma on water Pollution Issues in the University of Louis Pasteur, France and Doctorate ès-sciences in Natural Sciences(water sector) at the University of Paris VI. Before his appointment with UNEP MAP he worked as an advisor to the Ministry of Environment of Syria and served as Head of the Environmental Studies Department at the Higher Institute of Applied Sciences and Technology (HIAST) as well as Head of the Environmental Research laboratory at the Scientific Studies and Research Center of Damascus, Syria.

UNEP/MAP GEF MEDPARTNERSHIP: A NEW PARTNERSHIP FOR THE MEDITERRANEAN

Dr. Fouad Abousamra

NOSSTIA Deputy Chairperson – UNEP/MAP - Greece

REF# IDA_DM2010-Abousamra

ABSTRACT

In the framework of the Mediterranean Action Plan, the countries of the Mediterranean have joined forces with the World Bank, regional and international organizations as well as non governmental organizations (NGOs) to create a Strategic Partnership for the Mediterranean Large Marine Ecosystem - the MedPartnership. This Partnership enables a coordinated and strategic approach to catalyze the policy, legal and institutional reforms, and the investments necessary to reverse the degradation trends affecting this unique large marine ecosystem, including its coastal habitats and biodiversity.

United Nations Environment Programme's Mediterranean Action Plan (UNEP/MAP) is the regional institution that supports and coordinates the implementation of the Barcelona Convention and Protocols adopted by all Mediterranean riparian countries and the European Union to protect the marine and coastal environment.

The MedPartnership is the largest project in history in the Mediterranean, with funding of over 100 million US$ including investments and co-financing, and is the first project to bring together some of the main partners working in the Mediterranean for joint implementation of actions. It is one of the largest projects in the Global Environment Facility (GEF) Large Marine Ecosystem portfolio. With the financial support of the GEF and other partners, including the EU and all participating countries, the project will be implemented in close association with other relevant initiatives, such as EU's Horizon 2020 for the de-pollution of the Mediterranean, the Integrated European Maritime Policy, and the World Bank/GEF Sustainable Mediterranean Program, amongst others. The project also contributes to the sustainable development objectives of the Union for the Mediterranean.

MedPartnership consists of two projects: Regional Project (led by UNEP/MAP), and Investment Fund (led by the World Bank). The Regional Project has 4 components (management of natural resources; reduction of land based pollution; biodiversity conservation and protection; and project management including communication and replication) and 11 sub-components. The Investment Fund has hitherto identified 11 investment projects.

The Project will be carried out in the following GEF eligible countries: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Lebanon, Libya, Morocco, Montenegro, Syria, Tunisia and Turkey. The Palestinian Authority also participates. Its duration is 5 years and will be completed by mid 2014.

The major environmental concerns and 101 hotspots in the Mediterranean were identified in the Transboundary Diagnostic Analysis (TDA). The actions for their remediation were identified and agreed in two Strategic Action Programs (SAPs)

aimed at reducing land-based sources of marine pollution (SAP-MED) and protecting biodiversity and living resources and their habitats (SAP-BIO), adopted by the countries of the Mediterranean.

In order to support the countries in the implementation of the two SAPs, as well as to support the implementation of the new Integrated Coastal Zone Management (ICZM) Protocol to the Barcelona Convention, the Strategic Partnership will address the need for financial resources and investments (led by the World Bank) and the assistance in policy, legislation and institutional reforms, as well as the demonstration and transfer of technical knowledge and best practices (led by UNEP/MAP) to achieve the goal of improving the environmental conditions of the Mediterranean Sea. Executing partners of the project include UNESCO/IHP, FAO, UNIDO, UNEP/MAP's regional activity centers (CP/RAC, SPA/RAC, PAP/RAC and INFO/RAC) and the programme MEDPOL. Non-governmental organizations include GWP-Med, MIO-ECSDE and WWF.

The Strategic Partnership for the Mediterranean will result in some of the following:

- A long term partnership for joint planning and financing in the Mediterranean, facilitating effective and efficient use of resources in addressing countries' priorities for protection of the marine and coastal environment;
- The improvement of environmental conditions in 15% of Hotspots and sensitive areas of national priority;
- More sustainable use of coastal resources through use of Integrated Water Resource Management (IWRM), Integrated Coastal Zone Management (ICZM) and aquifer management;
- The reduction of pollution from land based sources through the demonstration and adoption of environmentally sound technology;
- More sustainable use of fisheries resources through the adoption of an ecosystem based approach to fisheries, and improved protection of critical biodiversity through the management of a coherent network of Marine Protected Areas; and
- The replication and scaling up of investment projects and demonstrations during the 5 year lifespan of the project.

Overall impacts of MedPartnership may be summarized as follows:

- Legal, policy and institutional reforms, on a national and regional level: A minimum of 20 national/sub-regional policies, plans and programmes ; Regional legislations adopted; new tools, techniques and guidelines;
- Demonstration/pilot projects will be implemented resulting in overall decrease in stress reduction to the Mediterranean LME: 32 demonstration projects resulting in a minimum of 15% of the 75 hotspots directly improved;
- Stakeholder participation: NGO Involvement Plan, coordination amongst stakeholders, Country support programme;
- Replication, communication and sustainable financing mechanism: 10% of the demonstration/pilot projects will be replicated during the life-span of the project.

SESSION IV: EXPERIENCE AND FUTURE OF DESALINATION TECHNOLOGY

Chairperson – Dr. Harvey Winters and Ghassan Ejjeh

Dr. Corrado Sommariva
Managing Director Generation Middle East – ILF
Consulting Engineer – UAE

Dr. Sommariva is a consultant of international reputation. He is presently the Managing Director of ILF Consulting Engineers Middle East and the head of the worldwide desalination activities of ILF . Dr Sommariva has experience in both thermal, reverse osmosis and waste water system and served in all the major desalination developments in the Middle East in various roles. Dr. Sommariva has a PHD in Chemical Engineering from Genoa University and a diploma in Management from Leicester University.

Dr Sommariva has been President of the European Desalination Society (EDS) and Vice President of the International Desalination Association (IDA) and Chairman of WHO committee for the establishment of safe drinking water from desalination,

He is presently the Technical Co-Chairman of the IDA World Congress in Dubai and he is an honorary Professor at Genoa and L'Aquila Universities where he holds regular courses on desalination and water re-use related matters.

Dr Sommariva published over 50 papers on desalination leading edge research and economics and published a book on desalination management and economics.

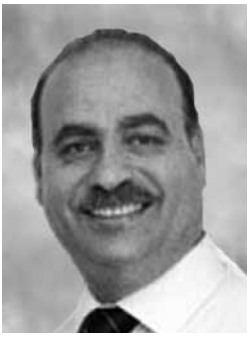
Dr Sommariva joined ILF in 2009 after working 9 years with Mott MacDonald where has been leading the desalination and water treatment group as Managing Director of Generation Middle East.

In his early career Dr Sommariva worked in Ansaldo Energia and Italimpianti in various roles in the Middle East.

TODAY'S DESALINATION AND FUTURE DIRECTION

Dr. Corrado Sommariva
Managing Director, ILF Consulting Engineer, Director of IDA - UAE

Author's material not available at time of print.



Professor Nidal Hilal
Director of Centre for Water Advanced Technologies and Environmental Research (C WATER) - Swansea University - United Kingdom

Professor Nidal Hilal holds a chair in Nano-membranology and Water Technologies and the Director of **Centre for Water Advanced Technologies and Environmental Research (CWATER)** at Swansea University in the United Kingdom. He obtained a PhD in Chemical Engineering from the University of Wales in 1988. In addition to three years of industrial experience, he has worked continuously in academia since graduation in 1981. Over the years, he has made a major contribution becoming an internationally leading expert in the application of atomic force microscopy to chemical and process engineering, particularly in water resources development. His research interests lie broadly in the identification of innovative and cost-effective solutions to real world process engineering problems within the fields of **nano-water, membrane technology, water treatment including desalination, colloid engineering and the nano-engineering applications of atomic force microscopy**. Professor Hilal is now internationally recognized as a world-leader in developing and applying the force measurement capability of AFM to the study of membrane separation and engineering processes at the nanoscale level. In recognition of his outstanding research contribution in the field of Scanning Probe Microscopy and Membrane Science &Technology he was awarded Senior Doctorate (Doctor of Science- DSc) from University of Wales in 2005. The world-leading reputation for research that Professor Hilal has earned in the fields of membrane technology and water treatment have now been formally recognized by the award of the prestigious Kuwait Prize of Applied Science for Water Resources Development for the year 2005. This has been awarded by the Kuwait Foundation for the Advancement of Sciences (KFAS). This prize is one of the highest scientific honours which are awarded in the Middle East for intellectual achievement.

Professor Hilal's research has produced several breakthrough innovations with applicability to water purification and treatment, including the development of novel membranes; the first demonstration to the world that nanofiltration membranes have pores; the smallest AFM colloid probe reported in the literature; the first AFM coated colloid probe technique; the first AFM cell probe technique; the first AFM Calcium Carbonate probe technique to study Desalination; the first direct measurements of the interaction of single live cells with surfaces; the first use of AFM in meso-scale cavitation studies. This work has led to the development of a ground-breaking AFMHSMP technique that combines AFM force-distance measurements with ultra-high speed micrography to study rheology and extensional fluid properties. All these techniques/technologies have widespread applications in process optimisation and the development of novel processes. While of great

importance to process engineering in general, the ability of these techniques to quickly and accurately predict the performance characteristics of novel water filtration membranes can truly be regarded as a breakthrough in water purification technology.

Professor Hilal pioneered the application of atomic force microscopy (AFM) to process engineering problems. These studies have led, for example, to the use of AFM in the development of new membranes with optimised properties for difficult separations. He has recently published a pioneering book on Atomic Force Microscopy and Nano-Process Engineering by Elsevier. He has also published 4 textbooks, 14 book chapters and around 300 articles in the refereed scientific literature. He is a registered European Engineer - Brussels, a Chartered Engineer in the United Kingdom and Fellow of the Institution of Chemical Engineers - London.

GLOBAL WATER SHORTAGES: MEMBRANE NANOTECHNOLOGY FOR WATER RESOURCES DEVELOPMENT

Professor Nidal Hilal

Director of Centre for Water Advanced Technologies and Environmental Research (C WATER) - Swansea University -United Kingdom
REF# IDA_DM2010-Hilal

ABSTRACT

The amount of currently available fresh water on earth is in continuous decline due to rapidly increased consumption as a result of population growth, industrial use and climate change. According to new findings, one in three people are enduring one form or another of water scarcity. Therefore there is an urgent need to address such world water shortages. Membrane technology increasingly proves to be one of the most practical solutions and the application of nanotechnology to membrane separation processes has shown to be extremely valuable to reduce cost and improve efficiency.

The lecture will focus on the global water shortages and will show how the application of nanotechnology and in particular, Atomic Force Microscopy (AFM) to membrane separation processes, can provide us with modern tools that may be applied for further costs reduction of water. Since 1994, the research of Professor Hilal has focused on developing and applying nanotechnology to process engineering, particularly in the fields of water treatment, membrane separation, (bio)colloidal interactions and the measurement of complex fluid properties. A major recent achievement has been the development of the smallest colloid probe reported in the literature, the coated colloid probe technique and the cell probe technique. The presentation will focus on the use of such probes to quantify directly the force of interaction of coated colloid or microbiological cells in a direction normal to the membrane surface, at which the interaction is taking place. The potential of the technique has been demonstrated when such probes are used to assess the rejection of colloids at the entrance to membrane pores, and the adhesive characteristics (fouling) of synthetic membranes. The presentation will also show the recent development of AFM as a nano-viscometer.

Leon Awerbuch
President & Chief Technology Officer - Leading Edge Technologies Ltd. - USA
Past President, International Desalination Association (IDA)
Chairman of IDA Technical Programs

Leon Awerbuch has been involved in the desalination industry for more than 40 years. He joined Bechtel Group in 1972 in R&D followed by increased responsibilities for power and water programs as Bechtel Vice President and Senior Regional Representative for the Middle East. With 35 years carrier with Bechtel he was in charge of desalination programs involved in R&D, design and engineering as well as EPC of desalination and power projects.

As a developer of LET Integrated Upgrading Systems using Nanofiltration membrane softening technology, he was granted numerous patents covering the MED-MSF-RONF Integrated Hybrid Technologies. Mr. Awerbuch was one of the early pioneers in Hybrid Power-Desalination concepts, Desalination Aquifer Storage and Recovery (DASR) and Hybrid MSF-MED. The patented Integrated Hybrid MSF-NF project in Sharjah UAE demonstrated, on commercial basis, a 50% improvement in the capacity of an existing distillation plant, for which the company won the 2007 Global Water Intelligence Award for Innovation. Mr. Awerbuch also won the first prize for Innovation conferred by the Saudi Water and Electricity Forum in 2007.

Mr. Awerbuch holds 28 patents and has published over 90 technical papers. He was Chairman of five IDA World Conferences and was the Co-chairman of the 2009 IDA World Congress on Desalination and Water Reuse in Dubai. He was President and is a Director of the International Desalination Association. He was elected to the Board of NWSIA at the first Conference in Key Largo Florida 1973. He has been a Chairman of IDA's Technical Programs for the past 18 years. As such, he has organized and chaired over 40 conferences, forums, seminars and workshops around the world. These include the recent International Water Forum on Innovation and Integration in Dubai and the Water Leaders Summit in Singapore.

He received a Lifetime Achievement Award from IDA at the 2007 World Congress in Grand Canarias and Life Achievement at the Inaugural Power Generation and Water Solutions Middle East Awards October 2009.

Additionally, Mr. Awerbuch was Chairman of an Evaluation Panel on Nuclear Desalination Program of IAEA in Vienna, reviewer of US Roadmap for Desalination, and a reviewer of a World Bank study on Desalination. He was a technical editor of publications on Desalination culminating in the United Nation Year on Freshwater, and contributed to the Guidebook to Membrane Desalination Technology.

He is a member of the Research Advisory Board of the Middle East Research Center (MEDRC), on Editorial Boards of IDA Desalination Journal, Desalination and Water Reuse Quarterly and Desalination & Water Treatment Science and Engineering Journal.

Mr. Awerbuch received a Master's Degree in Chemical Engineering and Chemistry from Warsaw Technical University. He has also undertaken Graduate Study toward a Ph D. in Chemical Engineering, at Warsaw Technical University and Polytechnic Institute of Brooklyn, New York.

HYBRID DESALINATION SYSTEMS: A SOLUTION TO ENVIRONMENTAL CHALLENGES

Leon Awerbuch
President – Leading Edge Technologies, Ltd. – USA
REF# IDA_DM2010-Awerbuch

ABSTRACT
The hybrid desalting concept is the combination of two or more processes in order to provide better environmental solutions and a lower water cost product than either alone can provide.

Early suggestions for hybrid desalination were based upon eliminating the requirement for a second pass to the RO process so that the higher-salinity RO product could be combined with the better quality product from an MSF plant. This is the simplest application of hybrid desalination.

While various hybrid concepts have been explored, this article focuses on the combination of distillation and membrane processes with power generation. This model offers many additional advantages including the opportunity to better align demand for combined water and power production, reduce energy consumption, and further minimize environmental impacts of power/desalination plants.

Hybrid Systems
Dual purpose power-desalination plants make use of thermal energy extracted or exhausted from power plants in the form of low pressure steam to provide heat input to thermal desalination plants for multistage flash (MSF) or multi-effect (MED) distillation processes. The electrical energy can be also effectively used in electrically-driven desalination processes like Reverse Osmosis (RO) and Vapor Compression Distillation (VCD) processes.

In the simple hybrid MSF+RO desalination power process, a seawater RO plant is combined with either a new or existing dual-purpose MSF power plant. This integrated technology offers several advantages.

A common, considerably smaller seawater intake can be used.
- Product waters from the RO and MSF plants are blended to obtain suitable product water quality.
- Product waters from the RO and MSF plants are blended, therefore allowing higher temperature of distillate.
- A single pass RO process can be used.
- Blending distillation with membrane products reduces strict requirements on boron removal by RO.
- The useful RO membrane life can be extended.
- Excess power production from the desalting complex can be reduced significantly, or power to water ratio can be significantly reduced.

The fully integrated MSF/RO desalination power process, which is particularly suitable for new seawater desalting complexes, takes additional advantage of integration features. These include:

- The feedwater temperature to the RO plant is optimized and controlled by using cooling water from the heat-reject section of the MSF/MED or power plant condenser.
- The low-pressure steam from the MSF/MED plant is used to de-aerate or use deaerated brine as a feedwater to the RO plant to minimize corrosion and reduce residual chlorine.
- Some components of seawater pretreatment process can be integrated.
- One post-treatment system is used for the product water from both plants.
- The brine discharged reject from the RO plant is combined with the brine recycle in the MSF or is used as a feed to MED.
- The hybridization of nanofiltration as softening membrane process for feed of distillation plants MSF and MED could lead to significant improvement in productivity of desalination plants.

In general, the hybrid idea allows part of the distillation plant's heated coolant reject to be de-aerated, using low-pressure steam from the distillation plant to reduce corrosion and residual chlorine, and used as the feed to the SWRO plant. The higher temperature of the feed improves membrane performance (flux, at constant pressure, increases by 1.5–3% for each degree Celsius). This is particularly important during the winter, when seawater temperatures can drop to as low as 15°C. The MSF or MED plant's distillate, at less than 20 ppm TDS, is blended with the SWRO plant's product, making it possible to meet potable water standards for maximum TDS and chloride concentrations with higher SWRO plant product salinity. This, in turn, means that the SWRO plants can be operated at higher conversion ratios, thereby reducing consumption of energy and chemicals and extending membrane useful life.

The use of all or some of the preheated cooling water discharge from a thermal desalination plant as feed to an SWRO plant enables elevating and controlling the SWRO plant's operating temperature at its optimal value or any other higher desired value.

Feed water temperature affects the two main performance characteristics of a membrane: flux and salt rejection. Higher feed water temperatures increase not only flux but also salt passage. For all membranes, water production is a function of temperature, at constant feed pressure. Production will go up with temperature increasing by 1.5% to 3% per degree Celsius for nearly all membranes, thereby enabling reduction of the number of RO membrane modules required for a given permeate capacity. (This, of course, assumes that feed water quality is sufficiently good that the membrane fouling rate will not increase during operation at higher flux.)

The results imply that the energy consumption of RO can be reduced using a simple integration of MSF+RO hybrid arrangement in which the RO plant is fed the preheated seawater rejected from the MSF heat rejection section.

Adding Flexibility to Combined Water/Power Production
In many countries, particularly in the Middle East, peak power demand occurs in summer and then drops dramatically to 30-40%. This creates a situation where over 50% of power generation is idled. In contrast, the demand for desalinated water is almost constant year-round. This inequality of demand between electricity and water can be corrected by diverting excess available electricity to water production incorporating electrically-driven seawater Reverse Osmosis (SWRO) and/or Vapor Compression, combined with low pressure steam-driven technology of MSF or MED.

Since water can be stored, while electricity storage is not practical, another method of making use of idle power capacity is the use of electrically-driven RO or VCD plants in combination with Desalination Aquifer Storage Recovery (DASR) both for averaging the desalination capacity, for strategic and economic fresh ground water storage or improving quality of the basin.

Resource Conservation and Environmental Impacts of Hybrid Systems
Resource conservation and environmental impact are aspects that must be considered when designing hybrid systems. Hybrid RO + distillation systems have great appeal in view of their ability to offer significant savings in fuel cost in comparison with distillation-only. This is especially significant at a time of dramatic concern with global climate conditions and rise in fuel prices in excess of US$ 60 per barrel

It has been demonstrated that coupling reverse osmosis with thermal processes in a hybrid configuration can reduce primary (fuel) energy consumption between 30% - 40% against reference plants (boiler for heat and condensing turbine power plant for electricity). For example, in the base case for a 100 MIGD (455,000 m3/day) MSF-only desalination and 400 MW of electric power generation plant, the fuel consumption is 191 tons/hr and the annual cost requirement will exceed 735 million US$. In comparison, a hybrid 100 MIGD (455,000 m3/day) desalination plant based on 60% thermal and 40% RO will operate at a reduced fuel consumption of only 115 tons/hr and a cost of 443 million US$ per year. The annual fuel cost savings is almost 300 million US$ per year, which will pay back for the total capital expenditure of desalination in less than three years.

In addition, CO2 emissions from a gas-fired combined cycle plant with a corresponding SWRO share are likewise substantially lower than for a conventional cycle, that is a condensing turbine power plant alone with SWRO for water production. Showing a substantial reduction is dissipation of heat from a hybrid plant to the sea as compared with the conventional heat cycle/SWRO configuration. In recent years the consideration of carbon dioxide footprint will have a significant impact in justifying hybrid plants in the Gulf.

Rehabilitation and Upgrading of existing plants
Many of the existing distillation plants approach the design life of 25 years and the owners have to consider life extension with additional upgrading in the capacity and efficiency of the desalination plants. There are new technologies using nanofiltration softening membranes of seawater and integrated upgrading of distillation plants which as result of hybridization permit distillation plants to raise top operating

temperature and increase the design production from existing plants by over 40 %. Such Rehabilitation and Upgrading minimizes the environmental impact as well as produce more critically needed water without building new intake –outfall structures and new power plants.

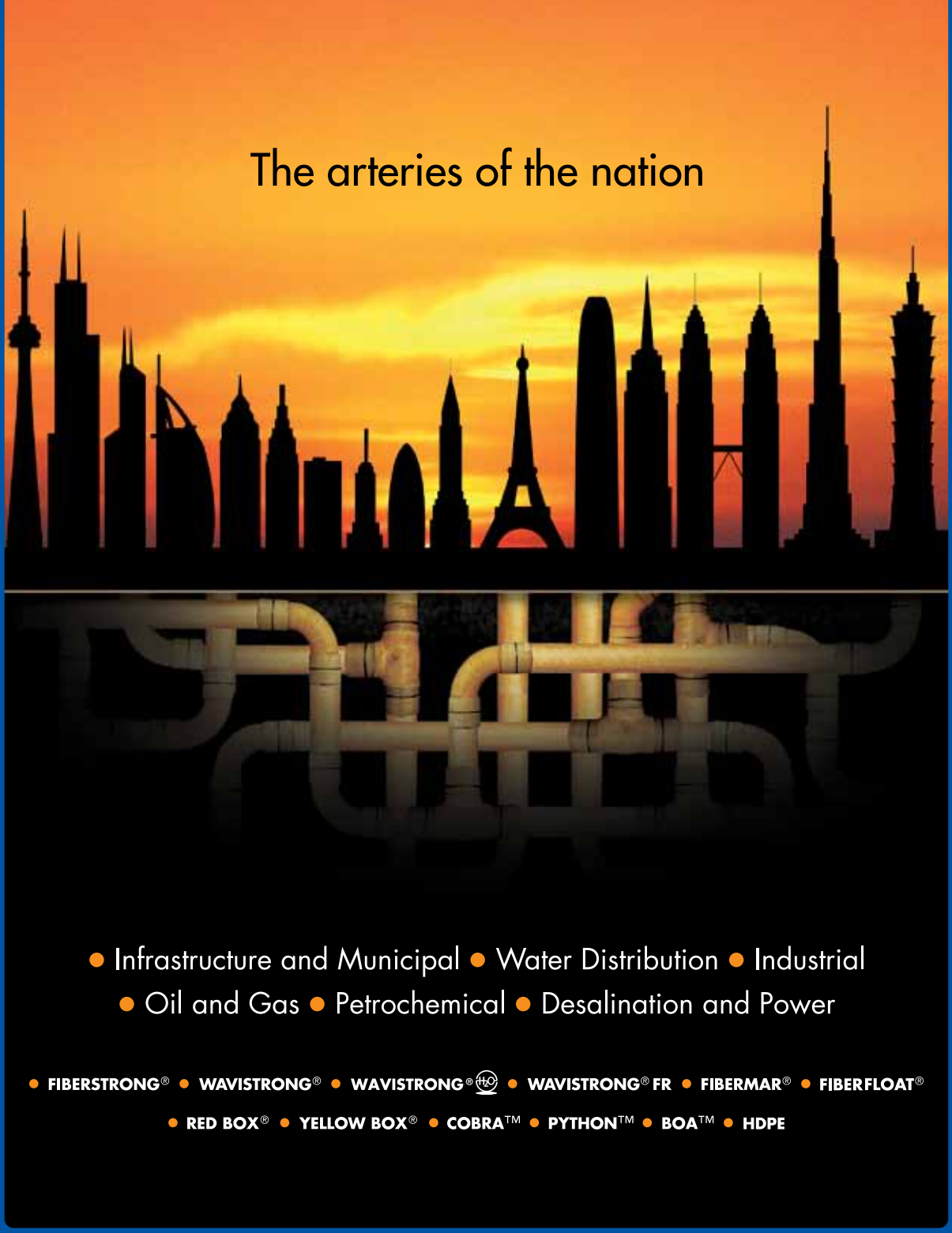
Summary

Hybrid systems combining thermal and membrane desalination processes and technologies within a single plant or in hybrid plant schemes can reduce desalinated water costs; in dual-purpose stations, add flexibility and better match the demand to the combined water and power production; and minimize the environmental impact of power/desalination plants.

IMPORTANCE OF LIFE EXTENSION AND UPGRADING OF EXISTING ASSETS

Dr. Mohammad Al-Fouzan
President, ACWA Power Sasakura - Saudi Arabia

Author's material not available at time of print.



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Saad Elkhadem
Director of Water Division – Future Pipe industries Company - Egypt

Mr. Saad Elkhadem completed his undergraduate and Masters Degrees in Chemical Engineering at Michigan Technological University in the United States. He is a member of the American Chemical Society, the American Water Works Association and a past board member of the International Desalination Association.

During his career, Mr. Elkhadem has held various leadership positions in the industry, including Process Engineer at Dow Corning Corp. and Marketing Manager at SAAC Saudi Arabia.

Mr. Elkhadem joined Future Pipe Industries in 1986 as Vice President of Sales and Marketing. In 1998 he assumed the role of Managing Director of Future Pipe Industries-Egypt until 2004 when he became Regional President for the Americas until his departure from the USA in late 2008.

In April 2010 Mr. Elkhadem was appointed Director of the Water Division for the Future Pipe Industries Group. In this capacity he is responsible for all customer interfaces including sales & marketing, project management, site supervision, technical, engineering, proposals and product development within the Water sector of the Group.

Mr. Elkhadem also serves on the Board of Future Pipe Industries Group as an Executive Director.

EXPERIENCE WITH GRP PIPE IN DESALINATION PLANTS

Eng. Saad H. Elkhadem

Director - Future Pipe Industries Group – U.A.E.

REF# IDA_DM2010-Elkhadem

ABSTRACT

Desalination plants whether MSF, MED or RO invariably use sea water as a feed. Salt water combined with high temperature are particularly aggressive and can cause significant corrosion in traditional materials such as steel/iron or reinforced concrete pipe. In many old installations up to the mid seventies rubber lined steel were considered one of the few materials to survive these environments in desalination plants.

With the use of large diameter Fiberglass reinforced plastic pipe (known as GRP in Europe or FRP in the United States) starting in the mid seventies, this material has gained almost universal acceptance in the desalination industry and is now considered the material of choice in Desal plants or combined Power/Desal plants for cooling water as well.

Experience of this material in the Middle East and in particular in the Arabian Gulf area dates back more than 30 years starting in Saudi Arabia. The Jeddah IV desalination plant in the late 70's and Al Jubail II in 1981 were one of the earliest applications of large diameter above and underground GRP pipe in a desalination plant .

The material has been used in sea water sub sea intake lines, circulating water lines, feed lines, distillate lines and brine return lines. It is unaffected by brine or soft water and can be designed with proper choice of resin systems to withstands temperatures approaching 100 degree C. And unlike plastic pipe, it is essentially unaffected structurally by UV degradation and has been in continuous above ground service for nearly 40 years with no signs of physical deterioration. Advances in production process and machinery now allow GRP to be commercially produced in sizes up to 4000 mm. Such sizes have found ready application in many of the Mega Power and Desalination plants being built such as the Fujairah F2 plant; a plant which produces 2000 MW of electricity and 600,000 M3 / day of water to meet the growing needs of the Emirate of Abu Dhabi and the Northern Emirates of the U.A.E.

The paper deals with the vast experience the Future Pipe group has gained for the last twenty years in the Arabian Gulf and North Africa with this material in Desalination and combined power/Desalination plants and with some of the unique features of this material that must be considered to insure that the long term benefits of GRP pipe are realized.

ARAMCO EXPERIENCE IN DESALINATION TECHNOLOGY

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Project Engineer, Saudi Aramco Company -
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Author's material not available at time of print.

PANEL AND ROUNTABLE SUMMARY

Moderator – Leon Awerbuch

Dr. Fouad Abousamra, NOSSTIA & UNEP MAP - Greece
H.E. Dr. Kamal Al Sheikha, Deputy Minister for Housing and Construction-Syria
Mr. Ghassan Ejjeh, BESIX Group - Belgium
Mr. Samir Fayyad, Vice President - Technical, AES Arabia - Saudi Arabia
Mr. Fady Juez,Metito Overseas, Ltd. - UAE
Dr. Rateb Sayegh, The Ministry of Irrigation, Syria

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