STORMWATER QUALITY: REGULATIONS AND THE LAS VEGAS VALLEY NPDES MUNICIPAL STORMWATER PROGRAM

Angela McKinnon, P.E. - MWH Americas, Inc.

The U.S. Environmental Protection Agency (EPA) considers stormwater runoff to be a significant contributor to pollution of water bodies; thus, the stormwater programs have been created at the federal, state, and local levels, to regulate and manage stormwater discharges. Management of stormwater discharges is conducted though programs, such as National Pollutant Discharge Elimination System (NPDES) permitting, regulated by EPA or other regulatory authority, such as the Nevada Division of Environmental Protection. To comply with these federal and state regulations and to minimize stormwater pollution, municipalities and local agencies have implemented local stormwater programs.

This paper will include a brief overview of federal and State of Nevada stormwater regulations. In addition, the program elements of the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit will be identified and summarizes. Results from the stormwater monitoring program will be included to show stormwater quality analyses for the Las Vegas Valley. Finally, the current status of the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit will be presented, including the identification of the processes that have been implemented to further develop the Las Vegas Valley stormwater program, as a result of the EPA audit in 2005.

CITY OF RENO: ENVIRONMENTAL CONTROL PRETREATMENT PROGRAM IN THE 21ST CENTURY

Author: Ryan Bird (Presenter), Environmental Control Supervisor
Co-author: E. Terri Svetich, P.E., Senior Civil Engineer

With a population of over 211,000, Reno is the largest city in Northern Nevada. The City's Public Works Department has an Environmental Control Section (EC) that permits and inspects approximately 1,500 businesses. In addition, EC provides contract pretreatment services for the unincorporated areas of Washoe County. The City's EC section consists of four officers, one administrative assistant, and one supervisor. This relatively small staff is charged with accommodating an array of functions including pretreatment, industrial storm water, 24-hour, 7 day-a-week spill support services, irrigation allowances, facility plan review and construction inspection, and sewer use function as well as promoting environmental stewardship in the Truckee Meadows.

In 2005, the City's Financial Department upgraded the financial software systems for the entire City. This software change would no longer offer a mechanism for EC to send permit information to the Billing Department. Also, EC's antiquated database, in use since the 1980's, would no longer be serviced by Communication and Technology (C&T) staff. If EC was to accomplish and maintain environmental compliance, EC was going to have to rethink its current business needs or sink! EC chose to rise to the challenge.

In 2006, EC, engineering staff, and C&T staff reviewed all internal and external options for software programs associated with pretreatment management and found only one application which would satisfy both EC and C&T staff criteria. The new software would accommodate consolidation of other computer software functions used, have the ability to interface with the City's new financial system, and be compatible with wireless functions.

In 2007, a software package was decided upon by EC and purchased. Approximately three months after the purchase date, data migration, configuration, training, and operational deployment was achieved.

Today, EC facilitates data storage, permit writing, on-call services, facility inspection, plan review and construction field inspections via wireless laptops. This wireless function enables the EC staff to provide more effective and efficient services than ever before.

THE SCOP PIPELINE AND ENDANGERED SPECIES ACT AND DROUGHT 2008

Presenter - Douglas D. Drury, P.E., PhD, Deputy General Manager, Clark County Water Reclamation District
Author - Lynn H. Orphan, P.E., Regional Water Quality Manager, Clean Water Coalition

The wastewater dischargers of the Las Vegas Valley formed the Clean Water Coalition (CWC) to plan an alternative discharge, and then to build a pipeline for the discharge of highly treated effluent into the Boulder Basin of Lake Mead. The pipeline project entitled Systems Conveyance and Operations Program (SCOP) required permits from both the Bureau of Reclamation (BOR) and the National Park Service (NPS). The Environmental Impact Statement (EIS) for the project included addressing the Endangered Species Act (ESA) because of the designation of Lake Mead and the Las Vegas Wash as endangered species habitat. The United States Fish and Wildlife Service (USF&WS) conducted a Section 7 consultation with both BOR and NPS. The results of the consultation were:

1. CWC to support national research for the Razorback Sucker.

2. CWC to conduct monitoring of endocrine disrupters (EDCs) in Lake Mead.

3. CWC to conduct with SNWA, Clark County Water Reclamation District (CCWRD), USF&WS and United States Geologic Survey (USGS) a research project to determine the multi-generational impact of highly treated sewage effluent on the Fathead Minnow as a surrogate for the Razorback Sucker.

4. To protect the Desert Tortoise during construction of the pipeline along the Las Vegas Wash.

5. Not to construct along the Las Vegas Wash during the nesting season of the Southwest Willow Flycatcher and other migratory waterfowl.

This paper will discuss the multi-generational impact tests on the Fathead Minnow.

TOTAL WATER MANAGEMENT:

GOING GREEN IN THE FACE OF POPULATION GROWTH AND WATER SCARCITY
INTEGRATED SYSTEMS, REGIONAL PLANNING, AND THE ECONOMICS OF WATER RECLAMATION

Trevor T. Hill, P.E. - Global Water[1]

Water management in Arizona and the arid southwestern United States is being influenced by two increasingly synchronous and alarming trends: explosive growth and water scarcity.

The intersection of these factors – a future certainty – will drive water policy to extreme measures. In the absence of action now, those measures will both arrive sooner and be significantly more expensive. Sustainability in the future will depend solely on what action is taken today to preserve and extend the regions limited and increasingly valuable water resources. The purpose of this paper is to outline the limits of water resources in Arizona, and to present solutions to sustainability developed and implemented by Global Water in its fastest growing service areas.

Managing water scarcity in the face of unprecedented growth requires a shift in the way we think about this vital resource. The looming water crisis needs to be met head-on with provider-driven conservation methodologies that reduce reliance on limited ground and surface water supplies. As Arizona's fastest growing private water and wastewater utility owner, Global Water Resources ("Global") is driving the deployment of efficient water resource management to ensure the sustainability – environmental and economic.

Over the course of four years, Global has changed the water delivery paradigm in Arizona. Embracing the certainty of future water scarcity, Global has implemented one of the largest total water management plans in the nation. Formed in partnership with the City of Maricopa, the City of Casa Grande, and the Ak-Chin Indian Community, this plan benefits over 300 square miles – a potential build-out of 500,000 future homes – with water conservation as the number one priority.

Global has invested $150 million in water, wastewater and recycled water infrastructure in Maricopa, including 25 miles of purple pipe to deliver Class A+ recycled water to a multitude of beneficial reuses throughout the region. Starting in 2008, Global, in conjunction with the development community, will begin the deployment of recycled water infrastructure direct to individual lots. This has the potential to further reduce the reliance on non-renewable resources, and to maximize the beneficial re-use of recycled water. In short, total water management means employing the right water for the right purpose.

In order to achieve this level of recycled water deployment, integrated services and public private partnerships are critical. More so, however, will be the public acceptance of recycled water. Global has undertaken unique efforts in educating its consumers and regulators; partnering in research projects on recycled water with the University of Arizona; active membership in the Arizona Water Institute; public outreach with an award-winning advertising campaign designed to inspire confidence in recycled water to replace potable water for non-potable uses; and building a award-winning 25,000 sf operations center to meet LEED certification standards including toilet flushing with recycled water.

Global's combination of infrastructure, cooperation and education are the new model for total water management. Individually none can effect true change in the water situation. When taken collectively however, the goals of true sustainability can be achieved.

WATER PIPELINE CONDITION ASSESSMENT

Holly McNaught - Water/Wastewater EIT, HDR Engineering, Inc,
Mark Russo - Senior Maintenance Engineer, Southern Nevada Water Authority

Buried pipelines often operate in a state of corrosion condition anonymity. Condition assessment provides an illustration of infrastructure condition for monitoring and future asset planning. The Southern Nevada Water Authority (SNWA) retained the services of HDR Engineering, Inc. (HDR) to provide an important condition assessment of about 58,000 linear feet of crucial large diameter potable water pipeline in Las Vegas, Nevada. The pipeline consist of approximately 5,100 linear feet of 96-inch pre-stressed concrete cylinder pipe (PCCP) and the remaining consists of 66-, 72-, and 90-inch cement mortar lined and coated steel pipe (CML&C). The pipeline was constructed during the 1970s with no cathodic protection and only a few test stations have been installed.

The focus of this paper is the application of condition assessment technologies, conducted in strategic phases, to provide a detailed profile of the infrastructure's condition through an examination and evaluation of the supporting soil corrosivity and resistivity as well as the outer steel surface condition and thickness. This paper will describe and compare current and developing inspection technologies including a non-destructive testing technique for obtaining pipe wall thickness data.

Keywords: Pipeline corrosion, non-destructive evaluation, condition assessment, and water.

FINE SCREENING EQUIPMENT – FIRST LINE OF DEFENSE

Author – Gerhard Forstner, President, Huber Technologies, Inc
Presented by - T.R. Gregg, West Region Manager, Huber Technology, Inc

Equipment selection is the most important step in the design of a treatment plant. This is true whether the plant is new or an upgrade. For better or worse the equipment that is installed is there to stay for many years to come. Anyone that has ever operated a treatment facility can quickly tell you horror stories of bad equipment. In many cases it is not the fault of the equipment but rather the equipment not being suited for the application. This scenario is magnified in the headworks of the treatment plant. Nowhere else is equipment called on to do so much. The headworks is the plant's first line of defense. If the equipment in the headworks does not operate properly, then every stage downstream will be affected. When it comes to screening there are a number of different technologies available. It is the responsibility of the plant personal and consulting engineers to fully understand the needs of the facility and to fully understand the different types of screens available to make the best selection. It is no guarantee that what work well for a nearby facility will work for you. This paper will introduce the prominent fine screening technologies available and examine each on a number of important selection criteria.

ENVIROQUIP MBR SYSTEM HELPS OHSU GO PLATINUM

Kimberly Mathis, Senior Regional Applications Manager, Membrane Bioreactors
Enviroquip, a division of Eimco Water Technologies

Enviroquip was the preferred supplier for the MBR system used in the Oregon Health and Science University's River Campus One building that has achieved LEED Platinum status. To date, it is the largest LEED Platinum certified building in the US. The Enviroquip MBR System was selected as the technology-of-choice because of its superior effluent quality, small footprint, ease-of-operation, and cost of ownership.

Among many energy and water conservation programs, the OHSU building recycles 100% of the wastewater generated. It is reused for in-building toilet flushing and landscape irrigation. The OHSU building uses approximately 60% less potable water than a similar conventional building with the help of the Enviroquip MBR System. Effluent not reused is discharged directly to the Lower Willamette River. Discharging the effluent to the river is possible because of the Level IV reuse water produced by the MBR system.

INNOVATIVE TREATMENT ALTERNATIVES FOR SMALL COMMUNITIES

Kirk Peterson, President, SPB Utility Services, Inc.

Rural Nevada communities are struggling with higher construction costs and increased labor needs while providing for the needs of the utility customer. There is an increasing need for new methods of treatment that provide a high level of treatment, as well as reliable operation with minimal operator attention.

Nevada Correctional Facilities

Nevada correctional facilities are a good example of where of high level of treatment can be difficult to attain. Honor camps are minimum security facilities housing about 150 inmates. Many of these facilities provide both water and wastewater treatment and disposal of the treated effluent.

Nitrate contamination of the groundwater from leachfield disposal of the septic tank effluent has in many cases exceeded the allowable limits.

The solution for the Rose Creek Honor Camp (Humboldt County) was the installation of a single basin sequential batch reactor. After a year of operation, we now have data to evaluate the overall effectiveness of the process. (A comparative review with the more standard package system will be included with this presentation.)

City of Tonopah A.I.P.S. (Advanced Integrated Pond System)

The City of Tonopah produced an abbreviated preliminary engineering report which clearly indicated that a conventional pond system or mechanical treatment plant would greatly impact user rates.

One of the largest expenses was for the electrical power requirements and Tonopah P.U.D. was determined to find a process that would reduce or eliminate the cost of electricity. The only viable option was to install an AIPS at the existing plant site; the system has been in service for almost a year. Not all data is available for an accurate assessment at this time, but there is sufficient information to provide an early look at the system performance.

Solids Handling Facilities for Membranes Sludge for the City of North Las Vegas Water Reclamation Facility

Joseph R. Popeck, P.E. - Greenley and Hansen LLC
David Bereskin, P.E. - City of North Las Vegas, NV, Utilities Director
Leslie Long, P.E. - City of North Las Vegas, NV, Technical Services Manager

The Problem

The City North Las Vegas (CNLV) is currently undertaking the design and construction of a completely new 25 mgd Water Reclamation Facility (WRF) that will employ a Membrane Bioreactor activated sludge process. Furthermore, the plant is being designed so that a future expansion, increasing the capacity to 50 mgd, can be accommodated with minimal disruption to operation of the initial 25 mgd WRF.

Historically, it has been reported in the literature, that waste activated sludge (WAS) from Membrane plants have been more difficult and may require higher dosages of polymer to thicken and dewater that WAS from conventional activated sludge plants. Other literature sources claim that thickening and dewatering of sludge from Membrane plants is very similar to conventional plant WAS. Experience of the Design Team with Membrane Plant Sludge and sludge exhibiting similar characteristics tend to confirm the reported difficulties regarding thickening and dewatering of this type of sludge.

Goals and Objectives

The primary goal of the design is that adequate and appropriate equipment is selected and included in the design to assure that the WAS from the new Membrane Bioreactor WRF for the CNLV will be cost effectively thickened and dewatered suitable for disposal at landfill. Provision of polymer feed systems, with adequate capacity and flexibility to permit optimization of polymer dosage to throughput is an essential component of achieving this goal.

Another goal for the project includes provision of odor control so that nuisance odor emissions from the facility are mitigated.

Finally, the facility must be designed to minimize manpower requirements for operation and maintenance and to employ automation to the extent considered practical for a solids handling facility.

Identify the Problem

Since this is a completely new facility, it is not possible to pilot test equipment on the exact membrane sludge to be dewatered. Furthermore, due to the extremely tight schedule for the design and construction, there is no real opportunity to identify and perhaps set up a pilot program at another operating Membrane Bioreactor plant having sludge with projected similar characteristics.

Furthermore, the site for the CNLV WRF is approximately 21 acres, which limits the overall land available for solids handling facilities and was therefore a consideration in the selection of thickening technologies.

These limitations required that the Design Team take into consideration, the opinions presented in the literature, experience form Membrane manufactures, experience of the Design Team on thickening and dewatering of similar sludge and Best Engineering Judgment with regard to the selection of equipment systems and technologies to be incorporated into the design of the Solids Handling Facility for CNLV WRF.

The Solution

The solution developed by the Design Team incorporates the use of Gravity Belt Thickeners (GBT's) for the initial thickening of the Membrane Bioreactor WAS followed by Centrifuge Dewatering to produce a cake suitable for landfill disposal.

The paper will discuss the various options considered for thickening and dewatering, selection of support equipment such as polymer storage and handling equipment, sludge pumps, cake conveyance and truck cake loading facilities.

ADVANCED BIOLOGICAL ODOR CONTROL FOR WASTEWATER TREATMENT PLANTS

Authors: Daryl Letto, Derek Webb

Biological odor control refers to the use of bio-filters, bio-trickling filters, and bio-scrubbers to treat waste air streams and rid them of hazardous and odorous compounds. Since biological means of treating waste air streams has become an accepted technology, there have been many advances in the technology. The limitations of organic bio-filter media and bio-trickling filters are now well understood. Past standard technologies, such as chemical scrubbers, no longer meet the stringent odor removal performance required as urban sprawl and environmental regulations govern what is acceptable. This is particularly important when considering technology to meet the ambient air quality standards and emission requirements.

Consideration of a variety of parameters is required to ensure the system is properly suited to the air that is to be treated. These guiding principles include the source of odors, flow rate, contaminant type and concentration, required performance, proximity of neighbors, and available space, water and utilities. Consideration of these will enable the proper selection of a suitable technology. Novel technologies and approaches to biological odor are required to satisfy the stringent odor performance criteria of WWTPs. The most recent developments include hybrid technologies, next generation medias, and reactor configurations. This paper will discuss in detail the most recent advances in bio-filtration, bio-trickling filtration, and hybrid technologies. In addition, guiding principles for the selection of appropriate advanced biological odor control systems will be discussed. These advances in biological odor control technology will be discussed with reference to various case studies and operating data.

THE SIMULTANEOUS REMOVAL OF ARSENIC AND MANGANESE FROM WATER IN NORTHERN NEVADA

H. C. Liang - Rothberg, Tamburini & Winsor, Inc., Denver, CO
Samuel J. Billin - Rothberg, Tamburini & Winsor, Inc.,
Joseph R. Tamburini - Rothberg, Tamburini & Winsor, Inc.,
Michael J. Petti - Rothberg, Tamburini & Winsor, Inc.,

Arsenic, which occurs naturally in many parts of the earth, is a common groundwater contaminant. Not only is arsenic acutely toxic towards human health at higher concentrations, low level, chronic exposure and ingestion of arsenic is also a major human health concern and can lead to various diseases, including diabetes and cancer. The latest research also shows that arsenic can act as a potent endocrine disrupter and adversely impact hormone functions in humans. These deleterious health effects of arsenic are especially important to Nevada residents due to the rapidly growing population in Nevada, where water usage is projected to increasingly shift from surface to ground water sources as the water usage from surface water sources such as Lake Mead is capped. Because many groundwater sources in Nevada contain arsenic levels higher than the relatively new MCL of 10 ppb for drinking water, there will be growing demand for efficient arsenic removal strategies. These arsenic removal strategies should include technologies and designs that not only ensure compliance with the arsenic MCL but are also cost-effective with regard to both capital and O&M costs as well as being relatively simple to operate and maintain. In this presentation we will highlight a case study in Nevada where we successfully treated influent arsenic levels of up to several hundred ppb of arsenic down to below 10 ppb using existing infrastructure at a water treatment plant. Both bench scale tests and full water treatment plant scale data and analyses will be presented, and the rationale for our examination and refinement of the arsenic removal treatment processes will be discussed. We will also include studies of the water chemistry and the adjustments of both the treatment chemicals used and the treatment procedures, such as the chemical addition points, in this presentation. Finally, we will also report on the simultaneous removal of manganese, a secondary drinking water contaminant, in this case study.

RUNNING A SMALL WWTF FOR RECLAMATION AND REUSE LESSONS FROM FIVE YEARS OF EXPERIENCE AT ROLLING A

Skeet Sellers, Lyon County Utilities Department
William K. Faisst, Brown and Caldwell
Alok Gupta, Brown and Caldwell

Lyon County Utilities Department has operated its Rolling A Wastewater Treatment Facility (WWTF) for over five years, delivering effluent for reuse through recharge to groundwater and golf course irrigation. During that time, staff has run the facility successfully through two major expansions and numerous challenges caused by once rapid residential and commercial development. The permitted capacity is now 1.5 million gallons per day, operated with 40-hour per week staffing.

The WWTF must meet Nevada Administrative Code requirements for Reuse category B since human contact is reasonably expected to occur and onsite recharge basins (RIBs) are very close to groundwater. In addition the facility is a stone's throw from new housing so odor control is of paramount importance.

This presentation will provide a process and operational overview of the WWTF, especially the sequencing batch reactor (SBR) system, discuss challenges faced and overcome during its operations, and make suggestions for key design features and successful operational control. With careful operation, the SBR system can meet 30/30/10 requirements for 5-day biochemical oxygen demand (BOD5), total suspended solids (TSS), and total nitrogen (TN) while holding fecal coliform counts below 2.2. Typical effluent is single digit for BOD5 and TN, below the detection limit for TSS, with phosphorus approaching 1 mg/L. Efficient operation at Rolling A has allowed LCUD to mothball other WWTFs and send all Dayton area raw sewage to Rolling A.

MORE CAPACITY ON THE FLY--THIRD EXPANSION OF THE ROLLING A WWTF SUCCESSFUL CONSTRUCTION MANAGEMENT

Donette Barreto, Lyon County Utilities Department
William K. Faisst, Brown and Caldwell
Rich Mattucci, Brown and Caldwell

Lyon County Utilities Division (LCUD) has expanded its Rolling A Wastewater Treatment Facility (WWTF) three times in the last 6 years. The latest expansion, completed in the spring 2007, increased treatment capacity by almost 400 percent (0.25 million gallons per day—mgd—to more than 1.2 mgd) while adding new processes to improve performance, control odors, and enhance capability for effluent reuse and disposal. Almost $15 million in construction was completed in 15 months with less than 1.2 percent change orders for all causes.

Unlike the approach for many smaller utilities, LCUD chose to manage bidding and construction using its own staff. LCUD's only senior engineer served as the Construction Manager. For this fast track project, close Owner staff participation throughout the construction accelerated decision making and avoided potential delays and claims. Ongoing operations carried through without major disruption. This presentation will discuss the project, especially successes with construction management and decision making. Several interesting challenges will be reviewed.

BNR STARTUP AND OPERATION AT THE CITY OF HENDERSON WRF

Presenter: Howard Analla
Authors: James Okazaki, Adrian Edwards, Howard Analla

The City of Henderson (COH) is upgrading and expanding the WRF from a 24 mgd nitrification process with chemical phosphorus removal to a 32 mgd biological phosphorus removal process with nitrification and denitrification (BNR) plus chemically enhanced supplemental phosphorus removal (SPR). The upgraded facility will be comprised of two 12 mgd and one 8 mgd BNR process trains. The BNR and SPR modifications were constructed in phases to accommodate current process operation and construction sequencing.

In April 2007 the 8 mgd BNR process train was brought on line. A series of startup meetings and planning sessions were conducted to prepare the contractor, design engineer, construction manager, laboratory, and the operations and maintenance for the startup and sustained operation of the new treatment process.

The planning included:

- Verification that the structures and equipment were built as intended
- Development of tracking forms to verify that the instrumentation and control features were ready for startup and operation
- New bench sheets and monthly operating reports were developed
- Operator training was conducted by the equipment vendors to focus on the equipment or process operation
- Process overview and process control training was conducted by the design engineer
- A startup plan was conceived and all vested parties agreed to a final plan prior to startup

The elements listed above allowed for a smooth startup with few glitches; no major show stopping problems were encountered. Startup operating data will be presented to show how the process goals and milestones were achieved and allowed the process to achieve operating limits in less than two weeks. After achieving proper operation the flow was slowly increased to 10 mgd (2 mgd above design flow) to alleviate flow from the existing nitrification process and allow the 12 mgd trains to be converted to the BNR process mode.

In February 2008 the next BNR train was ready for operation and placed into service. Similar startup planning was used to startup the process and in less than one week the process was operating and meeting intended operating limits. Process data and trend charts will be shown to indicate how the operating milestones were met and used to sustain operation.

At the presentation of this paper the final train will be on line and additional operating data will be available for presentation and discussion.

OPERATION EXPERIENCE WITH THE LARGEST AVERAGE DAY FLOW MBR IN THE NORTH AMERICA

Minggang Liu, Grant MacInnis and Jeff Peeters - ZENON Membrane Solutions, GE Water & Process Technologies
Glenda Nichole - Kyrene Water Reclamation Plant, City of Tempe, Arizona

This paper presents 2-years of successful operation experiences of the Kyrene Water Reclamation Plant in Tempe, Arizona, the largest design average day flow MBR plant in operation in North America at present time. This MBR plant was converted and expanded from the existing activated sludge system for ADF of 9.0 mgd. It consists of six (6) biological trains and eight (8) ZeeWeed@ membrane trains, with the MLE process configuration to achieve total nitrogen removal.

Since being commissioned in May, 2006, the Kyrene MBR plant has treated all the influent flow available and consistently achieved permeate NO3-N < 4 mg/L and TN < 5 mg/L, as shown in Table 1. The transmembrane pressure has been sustained at < 2 psi with a NaOCl maintenance clean frequency of twice per week. NaOCl recovery cleaning frequency is less than once per year and citric acid cleaning has not been applied to-date.

The actual influent flow is approximately ½ the design capacity due to the limited sewage supply and thus only a portion of the eight ZeeWeed membrane trains are simultaneously in operation. This paper investigates the options to optimize the operation under the current conditions to reduce operation cost. It also discusses lessons learned related to mechanical design and operation.

Cost analysis is conducted with actual costs in chemical usage, power consumption, O&M expense, and labor and sludge disposal, while life cycle cost is evaluated based on the current and projected operation cost when the plant reaches the design capacity in the future as well as the projected membrane replacement cost. The operation cost and life cycle cost are compared with the previous conventional activated sludge system and other MBR plants at the similar scale.

Table 1: Monthly Average of Permeate Quality Parameters

Month	Influent		Bioreactor	Permeate				
	COD	TSS	MLSS	COD	TSS	TKN	NO3-N	TN-N
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Sep, 2006	488	157	5943	19.1	0.27	0.8	1.56	2.36
Oct, 2006	457	162	6376	17.9	0.27	0.7	1.56	2.26
Nov, 2006	453	185	7929	16.2	0.27	0.9	3.69	4.59
Dec, 2006	543	232	7641	14.2	0.26	0.7	2.43	3.13
Jan, 2007	506	255	5,647	14.5	0.17	1.00	3.02	4.02
Feb, 2007	466	308	5,560	18.2	0.19	0.89	2.99	3.88
Mar, 2007	425	218	3470	16.8	0.20	1.20	3.27	4.47
Apr, 2007	409	234	5110	13.9	0.18	0.97	3.48	4.45
May, 2007	480	275	8301	12.9	0.24	0.81	2.84	3.65
Jun, 2007	463	213	7509	19.6	0.17	0.99	2.90	3.89
Jul, 2007	398	215	7384	17.0	0.17	1.04	3.68	4.72
Aug, 2007	445	255	8406	17.0	0.23	1.03	2.98	4.01
Sep, 2007	397	224	8828	16.0	0.24	1.28	3.17	4.45

WHAT EVERY BOARD MEMBER SHOULD KNOW ABOUT HEALTH, SAFETY AND RISK MANAGEMENT

John Bannen, Senior Client Representative, Workplace Safety Specialists

Calculating the direct cost savings of an effective health and safety program is like trying to get an answer to the questions "How long is a rope?" Board members of water and wastewater districts and utilities are presented with unique opportunities that do not always equate to the private sector or large companies. Implementing or understanding the value of health and safety programs and risk management is one of those unique circumstances. A recent study of over 400 utility boards showed that 56% of the boards had no involvement with health and safety, 33% were unsure of their role, which leaves 11% who were in good standing with their involvement in the organization's health and safety programs.

Board level direction can offer employees strong leadership, demonstrate commitment, and help improve employee health and safety. Appointment of a board member to a specific oversight role in health, safety and risk management within an organization is a benefit that can return measurable benefits. An initial investment into a safety program, employee personal protective equipment or consultation services within the organization historically returns a net of 3 to 1. Effective leadership skills and health or safety knowledge typically must be obtained through training and education of the board member. But by specifically defining goals and expectations of one board member, the entire board, as well as the organization, can benefit from his activities.

In addition to the financial benefits of an established health and safety program, a solid understanding of organizational liability relative to protection of the public interests, assets and company asset versus the company employees' safety is a fundamental difference between risk management and safety programs. While risk management traditionally focuses on the liability side and impact to the public safety, property, etc., safety programs focus on the organization's employees and their actions. It should be easy to see a close relationship between what and employee does at work – working safely while out in the public – and how this can affect the organization on the risk management side.

ANALYSIS OF CENTRATE COMPOSITION AND EVALUATION OF ITS APPLICABILITY AS A NUTRIENT SUPPLEMENT TO IRRIGATION WATER

Eric A. Marchand - UNR Dept. of Civil & Env. Engineering,
Nalleli Herrera - UNR Dept. of Civil & Env. Engineering,
Shai Koussevitzky, UNR Dept. of Biochemistry
Greg Dennis , Stan Shumaker, and Terri Svetich, Public Works Dept., City of Reno

Experimental analyses were carried out to evaluate the chemical composition of centrate originating from Truckee Meadows Water Reclamation Facility (TMWRF, Sparks, NV) and its applicability as a nutrient supplement to reuse water used for irrigation. Centrate is the liquid fraction following centrifugation of anaerobic digester sludge. Regular chemical analyses have been performed on both centrate and reuse water (roughly on a monthly basis) for over six months. Tests have revealed that centrate, with an average pH of 8.0, has a higher total dissolved solids (TDS) concentration than reuse water (about 3.5 times greater). Ammonia and orthophosphate concentrations in centrate were also higher than reuse water at an average of 1,100 mg/L and 210 mg/L, respectively. Elemental analyses of select cations (e.g., sodium, iron, magnesium, and potassium) and potential metals of concern (e.g., aluminum, cadmium, cobalt, and copper) revealed that concentrations in centrate did not exceed published recommended maximum irrigation levels for any constituents. In fact, centrate had a higher concentration of potassium – an important component of fertilizer – compared to TMWRF reuse water. In addition to the chemical analyses, centrate was also subjected to bench-scale chlorination tests to identify the required disinfectant dose required to achieve complete inactivation of bacteria. Total and fecal coliform were used as indicator organisms and were enumerated following chlorination tests. Chlorination tests showed that inactivation of coliform bacteria in undiluted centrate was achieved at a dose of 100 mg/L of chlorine (as NaOCl) after a 30 minute contact time. Changes in the centrate TDS were measured following disinfection and
TDS values were found to increase by less than 10%.

Centrate diluted in TMWRF reuse water was tested for root growth inhibition using two different plant seedling species: Arabidopsis thaliana (a highly sensitive species) and tobacco (a hearty species). Low concentrations of centrate (less than 1% mixed in reuse water) were found to result in germinated Arabidopsis thaliana seedlings with smaller root lengths compared to untreated controls; however, the presence of centrate led to larger cotyledons (first leaves following germination) suggesting that centrate enhanced growth of plant material. In tests with tobacco, centrate concentrations up to 5% in reuse water did not have a significant adverse effect on root growth. Greenhouse growth studies with both alfalfa and golf course turf grass are currently underway to identify the influence of adding centrate to reuse water on plant growth and yield.

THE OSMOTIC MEMBRANE BIOREACTOR: A DUAL BARRIER APPROACH TO POTABLE WATER REUSE

Andrea Achilli, Eric A. Marchand, Amy E. Childress
University of Nevada, Reno - Department of Civil and Environmental Engineering

Tzahi Y. Cath - Colorado School of Mines
Environmental Engineering and Science Division

The paper presents a novel wastewater treatment process known as the osmotic membrane bioreactor (OMBR). The OMBR process is the integration of a wastewater bioreactor with forward osmosis (FO) technology. It utilizes a submerged FO membrane module inside the bioreactor. FO, or simply osmosis, is the transport of water across a selectively permeable membrane from a solution of higher water chemical potential (low osmotic pressure) to a solution of lower water chemical potential (high osmotic pressure). Typically, the FO process results in concentration of the feed stream and dilution of a highly concentrated stream (referred to as the draw solution (DS)).

In the OMBR system, wastewater is fed into a reactor which is continuously aerated to supply oxygen for the biomass and to scour the membrane. Through osmosis, water diffuses from the bioreactor, across a semi-permeable membrane, and into a high salinity DS. The FO membrane acts as a barrier to solute transport and provides high rejection of the contaminants in the wastewater stream. The diluted DS is sent to a desalination process (e.g., reverse osmosis or distillation) which re-concentrates the DS and provides high-quality product water. Thus, in most wastewater treatment applications, FO is not the ultimate process but rather a high-level pretreatment step before an ultimate desalination process. Furthermore, the FO followed by a desalination process treatment scheme represents a dual barrier purification system.

Membrane bioreactor (MBR) technology is an attractive alternative wastewater treatment; the membrane retains solids inside the bioreactor and achieves high nutrient removals and effluent disinfection. Compared to the microfiltration or ultra-filtration process in a conventional MBR, the FO process in the OMBR offers the advantages of much higher rejection (semi-permeable membrane versus microporous membrane) at a lower hydraulic pressure. FO is also likely to have lower fouling propensity than pressure-driven systems.

Preliminary results from experiments conducted with a flat-sheet cellulose triacetate FO membrane and NaCl solution as the DS demonstrated high sustainable water flux and relatively low reverse transport of solutes from the DS into the bioreactor. Membrane fouling was minimal and controlled with osmotic backwashing. The FO membrane was found to reject 98% of organic carbon and 90% of ammonium; the OMBR process was found to remove 99.8% of organic carbon, and 97.7% of ammonium.

THE TREATMENT OF COOLING TOWER BRINES THROUGH NOVEL MEMBRANE PROCESSES

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Water and energy are intertwined; it takes energy to extract, clean, and distribute water. It is also used to produce energy by generating steam that spins turbines and as a cooling medium for processes. This interdependency, coupled with the increasing population in the US, is creating an ever increasing demand on the nation's water resources.

In cooling towers, large portions of the makeup water evaporate; leaving behind a stream concentrated with dissolved and suspended contaminants. These contaminants are originated from the water source or from the air. Most makeup water is being treated before use in cooling towers, but is still limited for use before scaling and fouling occur in the cooling tower. The blowdown water that is produced is contaminated with chemicals. This could have severe environmental implications. Therefore, volume minimization and water reuse in these applications is of great importance.

The current study evaluates a wide range of membrane processes for treatment of cooling water in the geothermal power industry. Two groups of membrane processes are being evaluated. Pressure-driven membrane processes, including ultra-filtration, nanofiltration, and low-pressure reverse osmosis, and membrane contactor processes, including membrane distillation and forward osmosis. A thorough comparison between the technologies aims at providing process selection guidelines. Results from the pressure driven membrane processes have shown that the system is able to operate at low pressures and fluxes are able to be recovered after cleaning processes. Results from membrane distillation have shown that high water recovery can be achieved with blowdown water from power plants. Moreover, the driving force for water production in membrane distillation is the heat (temperature) of the feed solution; and because the blowdown water is already at elevated temperature, no additional energy is required to produce highly purified water for reuse

The current study is sponsored by the National Renewable Energy Laboratory.

COMPARISON STUDY OF METHODS FOR DETERMINING MPN FOR COLIFORMS

Lillie Fleming, Chemist, City of Henderson

The City of Henderson Water Quality Laboratory (COHWQL) supports the wastewater, drinking water, and pre-treatment functions of the Utility Department for the City of Henderson. Multiple-Tube Fermentation Technique for Members of the Coliform Group is the analytical procedure currently used to enumerate coliforms for compliance reporting of fecal coliform density. It takes up to five days to generate results and requires a significant volume of growth media preparation. Enzyme substrate coliform test utilizing a multi-well format for wastewater is a newly approved method for enumerating *E. coli* and total coliforms. This test produces results in 24 hours and does not require any media preparation. A comparison study for determining MPN for Total Coliforms, Fecal Coliforms and *E. coli* using Multiple Tube Fermentation and Enzyme Substrate coliform method with multi-well format will be discussed.

A NOVEL APPROACH TO ENHANCED WATER-RECOVERY FROM REVERSE OSMOSIS BRINES

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Tzahi Y. Cath - Colorado School of Mines, Environmental Science and Engineering

The global demand for fresh water is continuously increasing while water resources are being depleted, contaminated, or adversely affected by drought. Water reclamation and reuse, seawater and brackish water desalination, and water conservation are the main methods currently used in an effort to resolve water scarcity problems. However, some of these methods are energy intensive (e.g., RO), can achieve limited water recovery (e.g., brackish water desalination), or are not yet acceptable for potable reuse (e.g., reclaimed wastewater). Recently, enhanced water recovery in brackish water desalination receives greater attention in inland arid regions due to increased water demand and limited options for brine disposal. Advanced processes such as seeded RO, mechanical evaporation/crystallization, and lime/soda softening are being studied for use in zero liquid discharge (ZLD) and near-zero liquid discharge (near-ZLD) systems.

In a recent study, direct contact membrane distillation (DCMD) and forward osmosis (FO) were investigated as potential membrane separation processes for water recovery enhancement in desalination of brackish water. In DCMD, water only evaporates through the pores of a microporous and hydrophobic membrane, rejecting almost all dissolved solids. Because the driving force for mass transport in DCMD is vapor pressure gradient, the concentration of the feed solution (even at relatively high levels) minimally affects water flux through the membrane. IN FO, concentrated draw solution (DS) is used to create a strong osmotic pressure driving force for transport of water through a semi-permeable membrane from a feed solution into the DS – thereby concentrating the feed and minimizing its volume. Past studies have demonstrated that both DCMD and FO can directly be effectively utilized in treatment of a wide range of highly concentrated feed solutions, including saline water.

In the current study, two brine streams from a brackish water desalination plant (Eastern Municipal Water District, California) at an average total dissolved solid concentration of 7500 mg/L and 17,500 mg/L were further desalinated by vacuum enhanced DCMD (VEDCMD) and by FO. Test results from both processes revealed that water recovery was limited by inorganic scale deposition on the membrane surface. Yet, despite the scaling environment, high water recoveries were achieved. Various cleaning techniques were able to remove the scale layer from the membrane and restore water flux to almost initial levels. FO achieved water recoveries up to 90 percent from the brines and VEDCMD achieved water recoveries up to 81 percent. Addition of a scale inhibitor was effective at maintaining high water flux for extended time; further enhancing water recovery. When considering the combined water recovery of EMWD and the investigated process, close to 97 percent total recovery was achieved.

CITY OF TRACY WETLANDS AND HABITAT ENHANCEMENT PROJECT

Vijay Kumar, P.E. – CH2M Hill

The City of Tracy must expand its wastewater treatment facility to meet the growing needs of our community. The new wastewater treatment facilities are currently being constructed next to the existing plant that will process the increasing flow. Currently, treated wastewater is sent to Old River where further natural treatment occurs. To protect aquatic life in the River, the Regional Water Quality Control Board may require the City of Tracy to cool their treated wastewater. To accomplish this, the City of Tracy is considering creating a cooling wetland system near the treatment facility. The wetland will also incorporate walking paths and interpretive signs for public use. In addition, as a part of the project, the City is in the process of partnering with San Joaquin County Parks to build a new waterfront park in the area.

As a first step, the City is conducting a preliminary study to determine the best methods for cooling and will conduct a pilot study on City owned land. Creating a wetland system is the most environmentally friendly approach to accomplish the effluent discharge. In addition, the City is considering creating much-needed new park areas adjacent to the wetland for families to enjoy.

This presentation summarizes planning and engineering work that has been completed including analysis of various options. An animated video using advanced video editing was prepared to highlight the project features and to explain the benefits of the presentation. Due to its creativity, Tracy Wetlands Video received the 2006 Telly Award. At the end of the presentation, the award winning video will be shown.

DEMONSTRATING THE BENEFITS OF 3D BUILDING INFORMATION MODELING FOR THE CITY OF NORTH LAS VEGAS NEVADA WATER RECLAMATION FACILITY

Presenter: Julian Hoyle, Vice President, CH2M Hill
Authors: Leslie Long, Julian Hoyle, George Crawford, David Bereskin, Ram Janga

The City of North Las Vegas, Nevada is growing rapidly in both population and land area. The City's mission is to provide treatment of wastewater to meet regulatory requirements and to be able to do so in the most cost effective manner. In order to accomplish this, the City is designing and constructing a 25 mgd facility that includes a membrane bioreactor (MBR), solids processing on-site, and a "good neighbor" facility. The design for the membrane bioreactor facility is being completed using 3D Building Information Modeling (BIM) tools in support of a fast paced design with a Construction Manager at Risk delivery approach.

Building Information Modeling

The Building Information Model—or BIM—advances the use of information throughout the facility's lifecycle. Information for the project design is captured from smart 2D drawings, 3D models, and other information (typically data that is manually entered). Thus, the BIM delivery model encompasses three distinguishing features:

- An integrated, multidisciplinary 3D model from which 2D plans and sections can be extracted.
- Information for the facility (the "I" in BIM) captured from intelligent 2D schematics, intelligent 3D models, and other information that is manually entered.
- The capture of information throughout the facility lifecycle process, including design and construction information to be used in facility management.

BIM 3D moves beyond earlier 3D/2D efforts with the following different approaches:

- Facility design is done using 3D models throughout the entire design process.
- All disciplines are modeled in 3D.
- 2D plans and sections are extracted from an integrated, multidisciplinary 3D model.

BIM Benefits in Project Delivery (Conventional and Alternative Delivery)

BIM 3D benefits, apart from the enhanced visualization capability for owners and designers, include favorable design costs, simplified identification of conflicts and interferences among piping, structures and equipment, and assurance that the final drawings are coordinated without conflicts or superseded information. Unlike traditional 2D drawings and the early generation of 3D models, BIM 3D design components are linked to a database with functionality to generate isometrics, bills of materials, and intelligent design tools. BIM takes BIM 3D design further by adding equipment recognition, integrated simulation and analysis, quantity take-offs of building components, multidisciplinary 3D design modeling (by definition), and interference coordination—all integrated with a project database. BIM includes 3D modeling, *but emphasizes collaboration and provides additional information to deliver a more comprehensive facility.*

Conclusion

No one can deny that times have improved through the use of 3D design. Taking a virtual 3D "walkthrough" of a proposed water or wastewater facility helps all involved in the process—be they designers, owners, plant staff, regulatory agencies, or contractors—to see clearly the layout and function of the various aspects of the facility. And using BIM 3D, the benefits continue to progress throughout the lifecycle of the project.

CASHING OUT ON COWS: ANAEROBIC DIGESTION-RECOVERING ENERGY THROUGH TECHNOLOGY

Rudy Kilian, P.E. – Carollo Engineers

Anaerobic digestion is a simple technology that degrades the organic matter present in wastes and produces an energy rich gas suitable for energy recovery. Anaerobic digestion does not utilize energy and is an energy positive process.

Typically, high strength waste from local industries, restaurants and households is present in the sewer system as grease, industrial discharges or other forms of concentrated organic discharges. These high strength wastes contribute to sewer degradation and increased maintenance due to clogging and obstruction of the sewer system. They also contribute to increased odors and septic conditions of the sewer system.

The presentation will focus on the use of anaerobic digestion to degrade organic matter present in high strength organic wastes in the treatment system. The presentation will focus on the benefits of collaboration with eh local industry to remove the high strength organic wastes from the sewer system and deliver them directly to the wastewater treatment facility.

The presentation will provide data on the concentration and composition of several high strength wastes and the monetary benefits of routing and degrading them in the wastewater treatment facility anaerobic digestion system.

TECHNICAL RESOURCES FOR PRETREATMENT PROGRAMS AND DISCHARGERS

John, Pollution Prevention Projects Manager
UNR Business Environmental Program

The basis of the paper will concern the technical resources available to businesses and municipalities in Nevada from the Nevada Business Environmental Program (BEP). The Nevada Business Environmental Program (BEP) is a partnership program that has operated through the Nevada Small Business Development Centers since 1988. The Program provides free and confidential regulatory compliance and pollution prevention assistance to Nevada businesses. BEP provides information and assistance statewide to several thousand businesses a year. Services and outreach mechanisms include: environmental assistance line, training seminars, newsletter and fact sheets, and on-site assessments. BEP routinely works with all types of manufacturers, printers, vehicle and heavy equipment maintenance, collision repair shops, drycleaners, photo processors, mining operations, and hotel/casino/hospitality facilities (as well as government operations).

The BEP is also the parent sponsor for the Western Regional Pollution Prevention Network (WRPPN). WRPPN consists of over 170 programs of which many provide direct technical assistance to small businesses and industry. WRPPN is a member of the Pollution Prevention Resource Exchange, (P2Rx.org) centers which provide effective tools for source reduction to the service provider, but it also seeks to promote and make readily available some of the highest quality and most current P2 content developed from members of our Network to a larger, broader, national audience consisting of businesses, industry and other local and state governments.