CWEA 2012 awards winners

2012 CWEA Mid-Size Plant of the Year Award

Veterans in the water environment field

OC team rehabilitates pipe without ruffling feathers

Water desalinization using capacitive deionization with graphene electrodes
I have lived in California nearly all my life. We Californians get bombarded with images of what is wrong with our state all the time: high taxes, poor schools, crime, traffic congestion, poor air quality; and of course there are all those “wackos” who live here. Sometimes it makes you wonder if it is all worth it. But then again, sometimes it takes just a small experience to reaffirm why I will probably never leave.

I recently had the pleasure of attending the WEF Collection Systems Specialty Conference in Sacramento. The social event before the conference was held at the IMAX Theater and attendees were treated to a movie called “Adventures in Wild California.” It was 45 minutes of amazing images of the extreme natural beauty, geographic diversity, and environmental sensitivity of our great state. But it also highlighted the human aspect of some great innovative pioneers such as John Muir, Walt Disney, and Dave Packard. Woven into the story were snippets from modern California pioneers, but mostly by the astounding natural environment. Giant Sequoias, bald eagles, palm oasis, sea otters, and pristine beaches are just some of the examples. These are worth fighting for! This is why I got into the sewer business. I was ready to roll up my sleeves and get to work, and the conference had barely started.

The next morning I spoke at, and attended, the opening general session. After the obligatory point-counterpoint from the agency guy (Stan Dean of Sacramento Regional) and the regulator (Russell Norman of the State Water Board), we were treated to a delightfully entertaining presentation. Historian Marcia Eymann, from the Center for Sacramento History, laid out the story of Sacramento as it rose from a small settlement on the banks of the Sacramento River to the metropolitan capital of California. Her presentation was cleverly crafted to focus on water and sanitation throughout. As Ms. Eymann spun her truthful tale it became apparent that the folks in Sacramento are a hardy bunch. In response to the onslaught of humanity that was the Gold Rush, shelters were thrown together on the banks of the Sacramento River, made of wood and canvas from the ships that sailed there. Almost immediately the area and its temporary structures were devastated by flooding. Then rebuilt. And then flooded again. Then leveled by fire. Again and again. And then some more. Interspersed between floods were outbreaks of cholera and other diseases that took a devastating toll on human populations. Eventually germ theory was improved and modern sanitation, water filtration, and sewers saved the day. Through it all, one thing became apparent: this area Sacramentans call home is worth fighting for.

Then I moved on to the technical program. And again, the amazing diversity of California was on display. Presentations were made on citizen Sanitary Sewer Overflow lawsuits at the El Dorado Irrigation District, difficult-to-access sewers in Los Angeles, flow estimation devices at South Placer Municipal Utilities District and Union Sanitary District, a brand new sewage collection and treatment system on the Central Coast in Los Osos, and a successful movement of backyard sewers to the streets of Yuba City. Again, it was inspiring to see such great work being done by our fellow water environment professionals all over this huge state. Clearly, the people working on these great projects feel their little towns and big cities are worth fighting for.

I made many more discoveries at the conference, but I have run out of time and space. I relearned what I already knew once upon a time, but some times forget. California is an amazing place to live. Its human and natural resources are truly remarkable, but they need protection. Water environment professionals play a key role, and together we can do it.
News Briefs

WEF releases compendium of global stormwater articles


Layperson’s Guide to California Wastewater now available

The Water Education Foundation (Foundation) has just announced the release of the Layperson’s Guide to California Wastewater, funded by CWEA, Sacramento Regional County Sanitation District, and CWEA’s Clean Water Summit Partners (CASA, SCAP, CV CW A, and BACWA). The 28-page guide is an in-depth, easy-to-understand publication that provides background information on the history of wastewater treatment and how wastewater is collected, conveyed, treated and disposed of today. CWEA contributed to the development of the guide to help meet the need to have a credible, readable resource on wastewater. Though members of the Clean Water Summit Partners provided input, the Foundation exercised editorial control, as with all their layperson’s guides, and is responsible for the final content. More at http://wp.cwea.org/?p=7706.

Vallecitos Water District uses biosolids in demonstration garden

If a garden featuring rainwater harvesting, low-water-use plants, synthetic turf and solar power represents the demonstration building blocks for a more sustainable future, then consider the environmentally-friendly fertilizer soon to be applied to it the next phase in achieving that goal. Instead of using chemical fertilizers, Vallecitos Water District will show its support of sustainable practices by applying organic biosolid pellets, composed of treated wastewater solids, on its demonstration garden located in front of its San Marcos Administrative offices. The plant-nourishing pellets are created at the Encina Wastewater Authority’s treatment facility in Carlsbad. Solids that are removed during the wastewater treatment process are heat dried to about 200°F to kill pathogens and remove excess water to create the dry biosolid pellets. Vallecitos is one of six public agencies that own the Encina facility. Read the entire story at http://wp.cwea.org/?p=7610.
Two new north coast certification testing centers open

CWEA is pleased to announce the opening of two new test centers in California’s north coast region. One site is available now at Hank Brenard Environmental Consultants in Fortuna and the other is scheduled to open in the fall at Humboldt State University in Arcata. The sites will provide on-site, on-demand certification testing in all 8 of CWEA’s occupational vocations. CWEA works with Pearson VUE to provide secure and convenient testing at more than 100 locations throughout the state ready to serve our 5000+ certificate holders. Find out more at http://wp.cwea.org/?p=7743.

Victor Valley Water Reclamation Authority takes step toward energy independence

With a unanimous vote of the agency’s Board of Commissioners, the Victor Valley Wastewater Reclamation Authority (VVWRA) entered into a partnership to become energy independent, ultimately saving taxpayers an estimated $9 million over the course of the project. The culmination of five years of effort from VVWRA’s General Manager Logan Olds, the project is slated to complete construction in January 2014. Resource Recovery Company Anaergia will make improvements to VVWRA’s existing, unutilized infrastructure at no additional cost to the agency. The retrofits will allow the facility to accept organic waste and use the natural treatment process to create gas that can be reused to generate enough power to operate the plant. Learn about it at http://wp.cwea.org/?p=7193.
The California Water Environment Association (CWEA) announced the winners of its 2012 awards program at its Annual Conference in Palm Springs on April 19. Congratulations to these agencies and individuals leading the way in the water environment field:

**5S Society**
- Doug Boss from RES
- John Boyd from LABS
- Vicki Caulfield from SAS
- Kirk Clyod from NSJS/CORBS
- Tim Costello from SCVS
- Giti Heravian from RES
- Basil Hewitt from LABS
- Steve Krauthiem from RES
- Juan Martinez from CORBS
- Eric Nielsen from SAS
- Sandra Rabston from WEF
- Michael Simpson from LABS
- Doug Wing from RES

**Collection System of the Year (0-249 Miles)**
- Costa Mesa Sanitary District

**Collection System of the Year (250-500 Miles)**
- City of Glendale

**Collection System of the Year (Over 500 Miles)**
- City of San Diego

**Collection System Person of the Year**
- Jose Rodriguez, Union Sanitary District

**Electrical/Instrumentation Person of the Year**
- Jay Eason, County of Santa Cruz

**Engineering Achievement**
- Orange County Sanitation District, Ocean Outfall Land Section and Ocean Outfall Booster Pump Station Piping Rehabilitation Project

**Engineering Research Achievement**
- Orange County Sanitation District, Ocean Outfall Land Section and Ocean Outfall Booster Pump Station Piping Rehabilitation Project

**Gimmicks & Gadgets**
- 1st Place: Jose Rodriguez Jr., Union Sanitary District, SSOETTS: Sanitary Sewer Overflow Estimation Technical Training System
- 2nd Place: Michael Reilly, County of Santa Cruz, DPW, Sanitation Division, Velocity Measurement Device
- 3rd Place: Trevor Ray, San Luis Obispo Water Reclamation Facility, Clarifier Baffle System & ‘Pop’ Scraper

**Golden Manhole**
- Beverly Stumman, Apex Companies, LLC
- Duane Johnson, Affordable Pipeline Services

**Kirt Brooks Memorial Water Environment Scholarship**
- Ingrid Verastegui
- Edward Couch
- Michael Cunningham
- Richard Fortado
- Rosa Lau
- Aydin Muziani
- Devina Douglas
Laboratory Person of the Year
• Christina Harshell, Fairfield-Suisun Sewer District

Mechanical Technician
• Thomas Powell, South Bayside System Authority

Operator of the Year
• Troy Remisdarfer, Big Bear Area Regional Wastewater Agency

P3S Facility of the Year
• Large North: Super Store Industries, Sunnyside Farms Dairy Division
• Large South: Pioneer Circuits, Inc.
• Certificates of Merit for Outstanding Achievement: ALCOA Global Fasteners, Inc.

P3S Person of the Year
• Allen Grayson, Lawrence Livermore National Laboratory

Plant Safety, Medium
• Encina Wastewater Authority

Plant Safety, Small
• San Eliz Joint Powers Authority

Public Education Person of the Year
• Jackie Davison, City of Sunnyvale

Public Education, Large
• Wastewater Treatment Agencies of Marin County, Wastewater Treatment Agencies of Marin County Public Education Program

Public Education, Small
• City of Sunnyvale, Earth Care Kidz

Environmental Compliance Inspector Study Guide
Free download for CWEA members

www.cwea.org/book.shtml
CWEA 2012 awards winners

Quarter Century Recognition

Student Paper Competition Winner, Undergraduate Level
• Algorithm for Hydraulic Energy Analysis Design Tool for In-Tank Spray Aeration Systems Designed for THM Reduction by Patrick LaBruzzo, California State University, San Jose

Supervisor of the Year
• Marvin Gonzalez, Leucadia Wastewater District

CWEA/Water Environment Federation Awards
Arthur Sidney Bedell
• David Greenwood, LA County Sanitation Districts

George W. Burke Award
• San Elip Joint Powers Authority

William D. Hatfield
• Rick Staggs, City of Fresno

Laboratory Analyst Excellence Award
• Christina Harshell, Fairfield-Suisun Sewer District

Feature Article | CWEA 2012 awards winners

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CWEA Mid-Size Plant of the Year Award

From Daniel Gary, Los Angeles County Sanitation District

Los Angeles Basin Section (LABS) President Alec Mackie and LABS Supergroup chair Daniel Gary had the honor and pleasure of reviewing the 2012 CWEA Plant of the Year Applications for mid-size wastewater treatment plants (greater than or equal to 5 MGD and less than or equal to 20 MGD design flow). There are similar awards given by CWEA for smaller and larger size wastewater treatment plants. Altogether, CWEA awards three sets of annual Plant of the Year awards (small, medium and large size wastewater treatment plant) with first, second and third place awards in each size category. The purpose of the award is to showcase premier wastewater treatment plants in California.

The rules for the award can be found on the CWEA website at www.cwea.org/awards along with the award application. Applicants must use the CWEA specified form and the applications will not be returned. Plants apply for the award through local section competitions. A single nomination for each category of the award may be submitted by each Local Section, on behalf of the Local Section winner, to be considered for the State level award. The Plant of the Year Award process is coordinated by the CWEA Supergroup Committee. The award reviewing team evaluates each written nomination packet and awards points based on the written application. The two sites with the highest written application point totals go into a runoff for first and second place. The third-place finisher is selected based on the written application points alone. Site visits are conducted to the top two award point recipients. Each plant is rigorously inspected by the team that evaluated the written applications. However, the points awarded in the written application process are not considered when deciding between first and second place finishers. Currently, Dale Ducharme is the Supergroup Chair and is in charge of the evaluations. There are separate review teams for each of the three size categories.

For the calendar year 2012, six nominations were received at the CWEA office for mid-size Plant of the Year award. All the applicants had excellent qualifications. The applicants were:

- Western Riverside County Regional Wastewater Authority Treatment Plant
- Central Marin Sanitation Agency
- Delta Diablo Sanitation District
- City of Lodi White Slough Water Pollution Control Facility
- City of Santa Cruz Wastewater Treatment Facility
- Selma-Kingsburg-Fowler County Sanitation District

Each application had strong points that justified the facility’s nomination. In particular, Western Riverside updated how their plant rounds were accomplished. Data was collected and stored by utilizing handheld devices. In addition, Western Riverside converted an oxidation ditch to an aeration basin, replaced a full supervisory control and data acquisition (SCADA) system, installed solar panels to produce 23% of the power consumed and enhanced its internal communications.

Central Marin stood out because it had over 7 years of 100% NPDES permit compliance. Central Marin also incorporated its second 5-year strategic business plan (SBP) that outlined a 10-year capital improvement plan with many process improvements. In addition, Central Marin upgraded its anaerobic digesters by utilizing pump mixing and incorporated the introduction of food wastes (FW) to fats, oils and grease (FOG) into its digesters for enhanced biogas production. Other Central Marin accomplishments included obtaining...
Delta Diablo Sanitation District expanded its Antioch recycled water project, enhanced its public outreach, and improved its computer management system. Delta Diablo also partook in a number of collaborative projects including a regional partnership for wastewater operator training (BACWWE), the Bay Area Regional Biosolids to Energy Project (B2E), and a recycled water coalition (BARWC). Delta Diablo Sanitation District also owns and operates a hazardous waste collection facility that accepts household and small business hazardous waste. Delta Diablo offers a “Re-use Room” where residents can pick up perfectly good products others have dropped off (e.g. paint and cleaning supplies) at no charge.

The City of Lodi’s White Slough Water Pollution Control Facility designed and installed a bypass around treatment not necessary for discharge of its effluent during the summer. They saved over $100,000 in construction costs alone by doing it with internal staff. In addition, the White Slough staff created a humorous and user-friendly way to communicate daily among industrial pretreatment, laboratory and plant operations. White Slough also implemented computer software that allowed staff to collect and coordinate data entries for many unit operations in a compatible way with the Regional Water Quality Control Board’s California Integrated Water Quality System Electronic Monthly Reporting System. Finally, White Slough continued to provide Title 22 effluent for cooling water to an energy provider for revenue of $1 million per year.

The City of Santa Cruz made improvements to its odor control system, solids dewatering system, digesters, fuel storage tank, bar screens, power generation equipment, gas metering valves and air compressor. In addition, the facility became Green Business Certified, improved laboratory techniques, improved its ability to remove contaminants of emerging concern, conducted experiments obtaining jet fuel from algae, and completed an electrical safety program. Santa Cruz also diverted dry weather flow that discharged to a lagoon and redirected it to the treatment plant.

The Selma-Kingsburg-Fowler Sanitation District installed new secondary treatment air blowers, put in a new SCADA system, upgraded its headworks and effluent pump station, and implemented a 10-year Capital Improvement Program (CIP). The CIP included a facilities plan to maximize the efficiency of the treatment plant and a strategic plan blueprint detailing how the District will respond to future challenges.

Choosing the semi-finalist was not easy. However, the applications for Santa Cruz, Delta Diablo and...
Central Marin were particularly strong. All six applicants were judged based on numeric scores of certain sections of the application, allowing for side-by-side comparisons of the applications. Santa Cruz was the third place, meaning that the judges would have to visit Central Marin and Delta Diablo to determine the first and second place winners. The decision to give Santa Cruz third place was difficult, as Santa Cruz listed 17 different improvements it had made to its maintenance, laboratory operations or other programs that it had made in the last few years.

Improvements recently added to the Central Marin Sanitation Agency include incorporation of a strategic business plan that allows CMSA to plan and develop improvements to its treatment process and agency efficiency. The strategic business plan resulted in improved planning and communications; upgrades for increased wet-weather capacity; improved asset management; incorporation of green business principles; and development of an easy-to-understand popular annual financial report.

In particular, CMSA changed the way it charged its regional customers to one based on the volume of wastewater flow to the CMSA treatment plant and away from a plan based on the number of equivalent dwelling units (EDU). Six CMSA employees received CWEA awards from the local Redwood Empire (EDU). Six CMSA employees received CWEA awards from the local Redwood Empire (EDU).

Delta Diablo Sanitation District.

Applying for Plant of the Year is a large task. It forces the facility to maximize its efforts, optimize efficiency, and incorporate innovation. The six applicants submitted this year are all excellent role-models of efficient, clean and well-managed wastewater treatment plants. Finally, Delta Diablo operates a program that accepts household and small business hazardous waste at its own hazardous waste collection facility.

The Plant of the Year judges compared the positive aspects of both the CMSA and Delta Diablo treatment facilities. CMSA was a well-maintained and spotless facility, while the staff at Delta Diablo Sanitation District assumed many leadership roles in regional issues. Both facilities had superior laboratory directors that also oversaw the industrial waste discharge monitoring groups. Both facilities had superior education programs and were committed to communicating well with their customers. Both strived for energy efficiency. In the end, the judges decided to give the award to Delta Diablo Sanitation District.

What set Delta Diablo District apart from the other wastewater treatment plants were the regional partner-ship efforts that Delta Diablo partook in and the leadership roles that the Delta Diablo District staff assumed. These regional partnerships are joint ventures among many publicly owned treatment works addressing regional issues and allowing for the pooling of resources. Delta Diablo leads coalitions regarding wastewater operator education (BACWWE), the bay Area Regional Biosolids Project (B2E), the Recycled Water Coalition (BARWC) and the Delta Household Hazardous Waste Collection Facility. The facility typically can have up to five student interns training each year. Plant Manager Steve Dominguez also assists other student trainees in locating employment opportunities at wastewater treatment plants throughout the area. Staff at Delta Diablo led the Bay Area Biosolids to Energy Coalition that is studying sustainable biosolids to energy solutions. In another regional effort, Delta Diablo staff partakes in a coalition for obtaining federal dollars to assist San Joaquin Valley and San Francisco Bay Area agencies with funding the development of recycled water projects.
CWEA would like to thank all of the AC13 exhibitors and sponsors.

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California veterans—becoming California’s leaders in the water environment field

Did you attend the 2013 Annual Conference (AC) in Palm Springs earlier this spring? You might have noticed quite a few more students in the hallways of the convention center, sitting in technical sessions, or assisting room moderators with collecting contact hour stamps. Twenty of the students at AC were veterans from all branches of the military who are now enrolled in the Silas Bruce Water Education & Training Program for Veterans at San Bernardino Valley College (SBVC).

This program, also called Project Transition II (PT2), started in January 2013 and is a re-creation of the original Project Transition Program started in the early 1970s. The original Project Transition Program was created decades ago by the Department of Defense and the Environmental Protection Agency at Orange Coast College in response to the overwhelming number of service personnel returning home from the Vietnam War and looking for sustainable careers. The water environment field—an area the federal government invested heavily in—was selected as a viable profession to train and place veterans in. Coming home from active duty can be challenging (sometimes even scary). Unfortunately, many of our veterans are welcomed home without the education they need to succeed in life after the military. Project Transition was a successful solution due to the efforts of Silas Bruce, a retired veteran and the program’s lead professor.

Project Transition II combines the academic Water Supply Technology Certificate Program sponsored by SBVC with the Water and Environmental Technician On-the-Job Training coordinated by U.S. Vets and Environmental Services Incorporated. As Clarence Mansell, a 1974 graduate of Project Transition and a retired Wastewater Operator states, the goal of the program is to “train veterans for stable and well-paying jobs in the water and wastewater field.”

PT2 seeks to recreate that success for today’s veterans. PT2 is a comprehensive academic education and volunteer work experience training program designed to maximize opportunities for veterans to qualify for and find employment in the water environment profession.

Nearly forty-three years after its creation, the legacy of Project Transition and Silas Bruce continues to educate our veterans through a yearlong program that requires a minimum of 12 academic course units per semester along with 4 units of work experience. Project Transition II was an “opportunity for me to reinvent myself and learn different skills,” states Patricia Sledge, SBVC Student interested in water conservation and compliance.

With a wide variety of classes to choose from, students gain knowledge in such topics as water distribution, water treatment, wastewater collection systems, utility management, and environmental laboratory practices. During the program, SBVC students are encouraged to test for certifications throughout the semester to get acclimated to the test-taking process. For example, in March students have the option of testing for the California Department of Public Health (CDPH) Water Distribution Operator Grade 1 or 2 Certification. In April, students can test for the State Water Resource Control Board (SWRCB) Wastewater Treatment Grade 1 or 2 Certification. In May, students can test for the CDPH Water-Treatment Grade 1 or 2 Certification. In addition to the above certifications, students are expected to pass the American Water Works Association (AWWA) Water Use Efficiency (conservation) Certificate Grade 1, Cross Connection Control Certification, and the Back Flow Prevention Certification.

Although classroom training is important, students are encouraged to network with professionals in the field whenever they have the opportunity. Offering a wide variety of technical sessions that aim to help individuals grow in their profession, technical tours, and an interactive exhibition hall that gives wastewater professionals a first-hand glimpse at the newest products, services, equipment, and cost effective marketing tools within the wastewater field, CWEA’s Annual Conference was the perfect place for SBVC students to connect with water quality professionals across the state of California. Patricia Sledge, a SBVC student attended the conference to “learn about water conservation, compliance and participate in networking opportunities.”

If you are a student looking for a rewarding and challenging career protecting public health and the environment, CWEA has many learning and networking opportunities to choose from. From certification preparation sessions, to specialty conferences, to events held by our seventeen local sections, CWEA is a great resource for students and young professionals starting their career in the water environment field. For more information on upcoming CWEA events, please visit our website at www.cwea.org and look under the CWEA Events Calendar or call (510)-582-7900, extension 125.

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RES-BCT
Find out what it means to the city
By Ray Busch and Don Clark, City of Hayward

The Hayward City Council continues to list ‘green’ principles as a top priority for the future. In keeping with this direction, the City is the first municipality in the entire Pacific Gas and Electric service area to apply for the Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) tariff. The RES-BCT tariffs, approved by the California Public Utilities Commission (CPUC) in accordance with Public Utilities Code 2830, were created by AB 2466 in 2008. RES-BCT tariffs allow local governments to generate electricity at one account and transfer any available excess amount as bill credits (in dollars) to other accounts owned by the same local government.

The City of Hayward has projected annual savings of $410,000 from a new combined heat and power cogeneration project coupled with the existing solar project and excess energy of 1.66 million kilowatt hours (kWh). These savings are to be spread amongst four drinking water reservoir pump stations and one sanitary sewer lift station.

To put those numbers in perspective, 1.66 million kWh can power approximately 186 single family homes year-round. The average household in the United States uses about 8,900 kilowatt hours of electricity each year.

The Hayward Water Pollution Control Facility is helping to deliver on the directive through four methods:

1. Upgrading and upsizing the WPCF cogeneration facility: Hayward will be replacing two old and tired 500 hp Caterpillar cogeneration engine generators (rated at 375 kW) to a new Combined Heat and Power (CHP) Jenbacher 1.157 kW generator. About half of the waste heat will be captured to maintain digester temperature. Thus the overall efficiency of the CHP will be greater than 60%.

2. New Fats, Oils, and Grease (FOG) Receiving Station: To upsize the generator, the plant designed and built a new FOG receiving station that holds 20,000 gallons of FOG and delivers from 3 to 33 gpm through a double disc pump to the three digesters. This new FOG system, at 16,000 to 20,000 gpd, will add an estimated 80 scfm of biogas. The WPCF has a high-pressure gas storage tank to smooth out the ups-and-downs of gas production because the digester covers do not allow for storage. FOG diverted to the water pollution control facility is FOG not going to landfills, or being discharged into the sewer system and clogging the collection mains.

The Environmental Green Sweet Spot
Hayward’s City Council has set the agenda of going green. The Hayward Water Pollution Control Facility is helping to deliver on the directive through four methods:

3. One Megawatt Solar Array: A one megawatt solar array with 5,152 panels attached to 202 fixed horizontal axis that track the sun from east to west was built and is owned by the City. There are plans and soil grading underway for a second one megawatt solar array.

4. Calpine Partnership: The City has partnered with Calpine and is providing 2.5 to 4.0 MGD of secondary effluent to the Calpine-owned Russell City Energy Center (a combined cycle 642 megawatt plant). The effluent is used for cooling in the steam generator thermodynamic cycle. This reduces City-treated effluent disposal energy requirements by an average of 20%.

The Economic Green Sweet Spot
Beyond environmental benefits, the projects mentioned above qualify for unique funding and grant opportunities that can also positively impact rate payers.

Value of Special Funding Opportunities

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<th>WPCF PG&amp;E Charge Avoidance</th>
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<td>RES-BCT Tariff</td>
<td>Value of Bill Credit Transfer (exported energy)</td>
</tr>
<tr>
<td>Performance Based Incentive (PBI)</td>
<td>$2,267,039 (reserved over 5 years)</td>
</tr>
<tr>
<td>Fats, Oils and Grease (FOG)</td>
<td>Tipping fee revenue</td>
</tr>
</tbody>
</table>

The RES-BCT tariff, coupled with the Self Generation Incentive Program (SGIP) funding at 2.5 cents/watt, is a significant inducement to upsize the cogeneration system and to pursue a first-class fats, oils and grease (FOG) receiving system.

The SGIP provides incentives to support existing, new, and emerging distributed energy resources. The SGIP provides rebates for qualifying distributed energy systems installed on the customer’s side of the utility meter. Qualifying technologies include wind turbines, waste heat-to-power technologies, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, fuel cells, and advanced energy storage systems.

Performance-Based Incentives (PBI) are offered through PG&E for solar projects larger than 50 kW. This measure delivers monthly incentive payments for five years based on actual performance (output) of the system as measured by a separate performance meter. Green inducements such as PBI were a strong motivator to have the 1 megawatt solar array designed and constructed at the WPCF.

In addition to seeking and maximizing funding opportunities to further their green mission, the WPCF also provides special opportunities to make sound environmental and local economic decisions such as the agreement to give Calpine’s Russell City Energy Center 2.5 – 4.0 MGD of highly treated secondary effluent at no cost. The Calpine energy center pays local taxes, provides good employment opportunities, and has yielded a major construction project to the local economy. Not insignificantly, it recycles and diverts 2.5 MGD of treated wastewater from disposal.
Orange County team rehabilitates pipe without ruffling feathers

From Mike Dummer (Staff Engineer, Black & Veatch)1, Jon Hay (Engineering Manager, Black & Veatch)1, and Pam Koester (Project Manager, OCSD)2

Sutting down Plant No. 2, a 220 MGD secondary wastewater treatment plant, to repair a deteriorated beach junction box at Huntington Beach State Park was not an option when Black & Veatch and the Orange County Sanitation District (OCSD) launched a project to prolong the life of the ocean outfall system. Black & Veatch worked closely with the district to develop a design solution for the environmentally sensitive area tucked between the Least Tern Natural Preserve and the Santa Ana River Estuary in Huntington Beach, California.

The Ocean Outfall Land Section and Ocean Outfall Booster Pump Station (OOBS) Piping Rehabilitation Project (Project No. J-112) team assessed the condition of the land portion of the district’s primary outfall and performed repairs to ensure its safe and reliable operation for the next 50 years. A portion of the primary outfall’s land section is buried approximately 10 feet underground and extends one quarter of a mile from the OCSD plant boundary to the Pacific Ocean at the Huntington Beach shoreline. This area is surrounded by estuaries, sensitive habitats for birds and plants, warm sandy beaches, and the Santa Ana River. Priorities for the project were to preserve the pristine quality of the environment, avoiding disruptions to beachgoers, keeping bike trails open, and minimizing perturbations to the community — including neighbors residing in luxury houses in Newport Beach.

OCSD Outfall Infrastructure

The district owns and operates two ocean outfalls, two pump stations, two surge towers, and more than six miles of submerged pipe as part of its outfall system. The primary outfall, which is comprised of 120-inch-diameter steel pipe and reinforced concrete pipe (RCP), discharges approximately five miles offshore in 195 feet of water. The standby outfall, which is permitted for use during flow emergencies, mostly consists of RCP sections that range from 120 inches to 78 inches. It discharges one mile offshore in 65 feet of water.

The ocean outfall booster pump station (OOBS) has 600 MGD of pumping capacity with various lengths of 54-inch steel suction and discharge piping, and the effluent pump station annex (EPSA) has a 560-MGD pumping capacity. Each surge tower is 26 feet in diameter and nearly nine stories tall. The outfalls each have one surge tower to provide hydraulic relief and dampen flow fluctuations. Valving and various piping connections allow flows from either pump station to be diverted to either outfall. This provides operational flexibility, making it possible for OCSD to isolate the primary outfall for repair and divert flow to the standby outfall.

Project J-112 focused on rehabilitating the land portion of the primary outfall pipe (1,000 feet of steel pipe, 2,000 feet of RCP), OOBS, and Surge Tower 2. The major outfall components were

Least Tern Natural Preserve at Huntington Beach State Park

From Mike Dummer (Staff Engineer, Black & Veatch)1, Jon Hay (Engineering Manager, Black & Veatch)1, and Pam Koester (Project Manager, OCSD)2

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constructed in phases from the 1970s through the 1990s. Although OCSD periodically performs routine maintenance on the outfall facilities, the district had never shut down the primary outfall system for comprehensive inspection and repairs in more than 40 years.

In the late 2000s, the district performed maintenance inspections of the primary outfall to check for corrosion damage and structural integrity of the various components. Noted deficiencies required more extensive follow-up investigation. Of greatest concern was the structural condition of the beach junction box at Huntington Beach State Park. A cursory inspection of this structure revealed extensive corrosion of an interior bulkhead wall inside the structure, which could potentially lead to a rupture of the bulkheads and a wastewater spill to environmentally sensitive habitat and public beaches. In addition, preliminary condition assessments found that several steel pipe segments in the outfall system were showing signs of internal and external corrosion.

High-Tech Condition Assessment

The project team implemented a state-of-the-art inspection program based on several advanced nondestructive examination (NDE) techniques to assess the condition of the various structures and determine rehabilitation requirements. After shutting down and dewatering the steel portion of the outfall pipe upstream of the surge tower, the team employed a combination of sophisticated tools, including laser profiling, Electromagnetic Acoustic Transducer (EMAT) scanning, B-scan ultrasonic thickness (UT) testing, and phased-array UT testing during an extended shut-down period. During this time, water was rerouted through other portions of the outfall system.

In order to expedite the project, EMAT proved useful for prescreening large sections of buried steel piping and allowed the slower, more accurate, B-scan UT to focus on specific corrosion-damaged areas rather than the entire piping system. In addition, the team used remote operating vehicle (ROV) inspection, mini-camera inspection, and concrete core sampling to determine the integrity of the RCP outfall section, which extends 2,000 feet from the surge tower to beach junction box. The RCP...
A project team carefully analyzed the findings to pinpoint the corrosion-damaged areas, determine the level of corrosion at each location, identify rehabilitation requirements, and design repair solutions. Narrowing the project to finite areas within the primary outfall made it possible for Black & Veatch to tailor the design to specific areas within the piping system. This allowed the team to develop realistic schedule and cost estimates for completing the rehabilitation work. The construction work was organized as two work packages with 10 project elements.

The first package primarily focused on a 1,000-foot section of steel pipe between OOBs and the Surge Tower No. 2, and installation of a temporary sampling facility and flowmeter on the standby outfall. Making these two improvements to the standby outfall prior to implementation of the second work package enabled the district to monitor flows and collect water quality data through the standby outfall while work was performed inside the primary outfall system.

The second package entailed isolation of the primary outfall and diversion of effluent flow to the standby outfall. This included rehabilitating critical sections of concrete pipe with carbon fiber reinforced polymer structural linings, repairing and coating corroded areas of the surge tower, inserting a steel liner into the beach junction box, installing a multi-path transit flowmeter, and other associated work.

Constructing the Impossible

The primary outfall had to be isolated from the ocean and dewatered before the construction crew could perform the work. A team of divers deployed an innovative dual-barrier system that consisted of an inflatable plug and mechanical plug to ensure the safety of the construction crew that would be working inside the ocean outfall pipe. The contractor came up with a unique idea for placing the steel sleeve insert into the beach junction box. Rather than install the duplex stainless-steel sleeve in sections and weld them together inside the beach junction box, the contractor opted to prefabricate the entire sleeve assembly, with the exception of the riser section. One of the longitudinal seams was purposely not welded, and the ends of the circular steel section were compressed to produce a collapsed can with a circular cross section of approximately 100 inches – about 20 inches less than the diameter of the outfall.

The contractor inserted a special pipe-transporting vehicle (referred to as the pipe mobile) and the collapsed can into the 26-foot-diameter surge tower with a heavy lift crane. The pipe mobile transported the assembly through 2,000 feet of 120-inch-diameter pipe to the beach junction box. Special arms on the pipe mobile were used to expand the fabrication to match the inside diameter of the existing outfall pipe. The contractor completed re-mining work – including welding the final longitudinal seam and the riser section, anchoring the steel sleeve to the existing outfall pipe, and sealing the voids between the pipe sections – inside the outfall pipe.

This work on the second package was fast tracked and organized based on a 24/7 construction schedule, which shortened the outage for the primary outfall and decreased the discharge period through the standby outfall, thereby minimizing potential environmental impacts to sensitive habitats and the public. This compressed schedule was driven by the nesting season of the least tern and snowy plover, whose protected nesting habitat lies directly adjacent to the failing beach junction box and could not be disturbed during nesting season (April-August). The schedule was additionally restricted by the beach season (May-August) and the rainy season (October-April).

Avoiding Ruffled Feathers

During the construction, OCSD discharged through the standby outfall. This outfall discharges within state waters and is subject to more rigorous water-quality standards. To ensure the public and the regulators that the water was safe, the district committed to achieving beach bacterial standards prior to discharge via the implementation of an enhanced disinfection program. This program included increasing beach disinfection, stabilizing plant operations, and changing the flow splits between the secondary treatment processes.

In addition, OCSD implemented a comprehensive ocean monitoring program, which included remote sensing of the effluent flow paths in the ocean, NASA satellite observations to quickly identify any plume formation, ROV samplers, profile sampling, and increased nearshore sampling. During this short three-week period, the project increased its ocean monitoring efforts nearly twenty-fold and made sample data available to the public via www.sccoos.org.

Technical Article | OC team rehabilitates pipe without ruffling feathers

Protected least tern nesting in habitat preserve

Wastewater Professional August 2013
Capacitive deionization (CDI) using graphene electrodes is our new process that makes solving the world's water needs possible. In our experiment, we created a lab scale experimental platform to determine the parameters of energy usage and recovery. From our data we discovered that our process removes Na+ Cl- ions 20 times faster than other CDI methods. We acquired data from our experimental platform and used a Monte Carlo analysis to estimate energy requirements to reduce the salinity of 2,000, 4,000, and 35,000 parts per million (ppm) water to 500 ppm water. From this analysis we discovered it was possible to use less energy to deionize brackish waters but more energy was needed for sea water when compared to other methods. We then used a simple scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017 for our theorized scale-up model to calculate the approximate price per liter of water to be $0.017.

Key Words: Capacitive Deionization, Graphite Oxide, Graphene, Laser Scribed Graphene

Abbreviations and Acronyms: Capacitive Deionization (CDI), Laser Scribed Graphene (LSG), Graphite Oxide (GO), Total Dissolved Solids (TDS), Parts per Million (ppm)

Acknowledgements: Our experimentation was supported by our mentor, Brent Bettencourt, teachers, and our schools. Their gracious commitment of time, energy, and resources aided in what we believe to be a major material science and engineering breakthrough. Any and all opinions and beliefs expressed in this paper are those of the authors and may not reflect those of the people that have cooperated in the completion of this project. We would like to thank our parents, teachers, friends, and mentors for their support and flexibility throughout this project. Special thanks goes to our mentor, Brent Bettencourt, for helping us with everything from a crash course in calculus to electrical engineering. We would have been lost without him.

Biography: My name is Emily Bettencourt. I am currently enrolled at Northgate High School. I play soccer for my club and high school team. This year I am in Chemistry Honors. Chemistry Honors provided a foundation of understanding for this experiment. Over the summer after my freshman year, I volunteered for a professor at University of California, Berkeley. I was helping on a project that focused on changing soil compositions and soil microbes. This experience made me aware of the water challenges facing our planet. My future plans are to go to college to study chemical engineering and water related issues.

My name is Vernon Wetzell. I am currently a student at La De Salle High School. I am a Honors Biology student and in this class our teacher pushes us to excellence. This is one of the reasons I am entering this prestigious science fair. I enjoy swimming for both my school and summer team, so I am very connected to water in that way. I am also from the islands of Samoa in the South Pacific, where obtaining potable water is an ongoing issue. This is one of the reasons I feel so attached to this project. Beyond my high school career I plan to go to college and study aerospace engineering.

Introduction: Fresh water around the world is becoming scarce by the day. It has become a worldwide crisis even though 71% of the world’s surface is covered by water; because 97% of that water is undrinkable due to the fact that it contains high levels of ions. Currently there are many different ways of solving this issue. A major challenge involved in deionization is the high cost of materials and energy.

The purpose of this project is to help aid in the discovery of a cheaper and more efficient way to deionize water. Our method allows for a relatively small, decentralized system to provide drinking water for rural America and developing nations around the world. We believe this can be done with minimal energy to enable the use of renewable energy sources such as solar or wind to power the process. Our major cost factors include; energy, capital, and operational expenses. To our knowledge, all combined costs will be less than that of current methods. Through this process we are not limited to desalinization. We are able to pull out many species of ions, such as ions found in hard water (calcium or magnesium), toxic minerals produced by fracking, radioactive ions, nitrates, hexavalent chromium, and any other electroactive ions or molecules. Pulling multi-valent ions out of water has proven to be a challenge for many modern methods of deionization. Because of our ability to remove multi-valent ions, our approach is applicable to industrial settings such as the clean-up of water from fracking operations. Our proposed process may also be used to extract rare earth minerals from a water supply or waste stream in a cheaper and less invasive way of obtaining those minerals, for large profit margins. Our purpose was to engineer a lab scale graphene

Advances in Capacitive Deionization (CDI) (Fig. 1) only began within the last 5 decades. Since its beginning, CDI has gone from an amusing idea to a potentially practical solution to world thirst and much more. For the purpose of this paper, we will focus mainly on carbon based CDI. This technology originated by using activated carbon to adsorb ions in a membrane system. This membrane has a large surface area, much of which could not be used due to the materials inaccessible pore structure. More recently, CDI technology has implemented many different forms of carbon to include; carbon aerogels, carbon cloths, carbon sheets, carbon nanotubes, and carbon nano fibers. All of these electrode materials have helped CDI technology to steadily improve over time. Even with these advances, however, CDI is not yet competitive with the other methods of desalinization due to poor electrode conductivity, slow regeneration speeds, low ion adsorption abilities and high cost. When Novoselov and Geim won a Nobel Prize in 2010 for discovering graphene, it introduced a whole new front in CDI adsorption possibilities. With the process of laser scribing graphite oxide, developed by Maher F ElKady et al. [2], the surface area of graphene can be made to reach ~1520 m²/g. This large surface area is interesting for adsorption because of its ability to store more carbon for a given amount of carbon material. With this same process, the...
Wastewater Professional  August 2013

graphene is able to have a bulk material conductivity of 1738 Siemens/meter. This means that there is no apparent need for a metal current collector.

Our proposed method of CDI is unique in several ways. The biggest difference between our design and that of others is the use of graphene as our active electrode material. This material is revolutionary because of its low cost, its fast adsorption and release of ions, its relatively low electrical resistance, the ability for electrons to travel ballistically across it, and probably most importantly it has the ability to recover energy from the ions (in a capacitor) for reuse in later runs. Among all of these advances we also used a bilayer of laser scribed graphene (LSG) to increase surface area and conductivity and then applied unreduced Graphite Oxide (GO) as a dielectric separator that still allowed for ion transport. From an engineering perspective we are also unique because of our theorized “jelly roll” graphene electrode design consisting of several sheets of LSG on a substrate wound around a core with separators between each sheet, which is held in a tube, allowing for a cheap and effective CDI reactor. Our proposed design allows for small decentralized deionization stations. When coupled with energy storage, CDI with LSG electrodes is capable of running off renewable energy sources such as solar or wind.

Materials and Methods:

Materials

Between all 4 experimental platforms that were created we used these materials: graphite oxide (500mg) from ACS Chemical, Lightscribe DVD Hp drive (laserscribing Graphite Oxide), Lightscribe DVD writer software (included with DVD writer), Sonicator (borrowed from high school), Silver conductive paint (GC Electronics 22-023 conductive paint, 1/2 ounce), Conductive adhesive copper tape - (Cory's snail barrier tape - Ace Hardware), Small copper connection wire, 18 gauge (Radio Shack), 0.8 mm Rubber sheet role (Rubber Sheet Roll, LLC), Circle cutter, 5 Plastic separators (HP inkjet printable plastic sheets), 2 Half inch thick Acrylic sheet cut into two 6x5 electrode endplates (Scrap bin acrylic sheet from Tap Plastics), 4 Bolts and wing nuts, 2 Hoses to thread for inlet and outlet, Soldering iron, Unleaded solder, Solar salt, 99.6% pure salt used in salt pool, 4 Distilled waters (Arrowhead distilled water), Adjustable constant current source. 1 milliamp to 20 milliamps, Laptop computer, DataQ model DL155 data acquisition system-13 bit resolution (DataQ software for data capture and analysis includ- ed), Conductivity meter 1 micro-Siemens (Vernier instruments), 250 ohm precision resistor for precise current measurement (.1%), Carbon Fibers (Tap Plastics), Dropper, Blue tape (Sherwin Williams), 2 1000 grit sand paper, Small watercolor paintbrush (Michaels), Analogue multi-meter, 1 gram kitchen scale, Microscope, Lab stand, 5 Lab stand clamps, Monte Carlo software (http://www.montecarlo.com/)

Methods

Overall Experimental Design

For our project, we wanted to engineer a lab scale ultra-capacitor to deionize water to determine the parameters of energy, ion concentration change, and efficiency at a given flow rate. With the information collected from our bench experiments, we were able to simulate a scaled-up water de-ionizer for real world situations. The success of our proposed deionization method was determined by entering the critical values obtained by experimentation into a scaled-up design which was analyzed by a Monte Carlo statistical test.

Experimental Apparatus and Measurement Methods

The experimental apparatus in Fig. 2 consists of eight double stacked DVD discs coated with...
2 layers of approximately 10 micron thick graphite oxide (GO). The applied GO layers were laser treated six times by an off-the-shelf DVD lightscribe disc drive to produce high conductivity (17×38 Siemens/meter), high surface area (1520 m²/gm), thin film laser scribed graphene (LSG) electrodes. Multiple flow channels were created in the experimental platform by 0.8 mm thick O-rings that keep the DVD discs from shorting. Twenty holes at the perimeter of the DVD allowed for radial flow. Deionization occurs when a voltage source or current source is applied and ions are present in solution. Once the electrodes reach their maximum adsorption capacity, they can be shorted, or their current reversed, to expel ions during a “rinse cycle.” The process repeats itself until the desired level of purity has been removed. For more detailed methods of LSG electrode synthesis and apparatus design evolution see Annex I and Annex II, attached. Photos of the experimental apparatus can also be found in Annex III.

Our initial goal was to measure the reduction of ion concentration under flowing conditions with an industry standard total dissolved solids (TDS) probe with resolution down to 0.1 micro-Siemens/cm. However, with the small amount of LSG electrode mass we would need for desalination can be accurately characterized by the energy stored and released (at a given power level) during charge and discharge of the CDI device. We took advantage of Anderson’s insight to characterize our graphene electrodes in a non-flowing static reactor. Our galvanostatic charge/discharge measurements using a constant current source are very repeatable and accurate. This new approach has allowed us a robust way to characterize our CDI electrodes under widely varying currents and salt concentrations. Our galvanostatic testing methods are in compliance with Ruoff et al. [6] and Maxwell Corporations’ industry standard testing practices [4] for ultracapacitor electrode testing. Using a 13 bit analog to digital acquisition system, we are able to accurately measure and archive the following parameters in Fig. 2: Voltage V1, current I in amps by equation (1) [in box above], instantaneous power in watts by equation (2), energy required for desalination without energy recovery in watt-seconds (5), capacitance of graphene electrodes in farads (4), energy stored in ultra capacitor electrodes in watt-seconds (5), net energy required for desalination with energy recovery in watt-seconds (6), and equivalent series resistance equal to V1 / I immediately after turning on or off switch (7) Vmax is equal to 1.2-1.5 Volts to avoid water splitting.

**Summary of Static Tests**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Static One Molar Moderately Fast Discharge Reactor 3</th>
<th>Static Single Pair Reactor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Time (sec)</td>
<td>95.2</td>
<td>14.40</td>
</tr>
<tr>
<td>Current Reversed or Discharged (sec)</td>
<td>110.5</td>
<td>21.90</td>
</tr>
<tr>
<td>Stop time (sec)</td>
<td>115</td>
<td>66.8</td>
</tr>
<tr>
<td>Current (Amps/gm-single electrode)</td>
<td>1.16</td>
<td>0.85</td>
</tr>
<tr>
<td>Current (Amps)</td>
<td>0.0125</td>
<td>0.0023</td>
</tr>
<tr>
<td>Approximate Salinity (ppm)</td>
<td>57000</td>
<td>200</td>
</tr>
<tr>
<td>Measured Device Capacitance per gram (both electrodes) in Farads</td>
<td>4.55</td>
<td>13.51</td>
</tr>
<tr>
<td>Single Electrode Capacitance per gram in Farads</td>
<td>18.18</td>
<td>54.05</td>
</tr>
<tr>
<td>Series Resistance in Ohms</td>
<td>4</td>
<td>67</td>
</tr>
<tr>
<td>Type of Discharge</td>
<td>Constant Current</td>
<td>Constant Current</td>
</tr>
<tr>
<td>Gross Energy Efficiency</td>
<td>33%</td>
<td>26%</td>
</tr>
<tr>
<td>Energy Efficiency Adjusted for Contact Resistance</td>
<td>80%</td>
<td>63%</td>
</tr>
<tr>
<td>Milligrams of Salt Adsorbed and Released per Gram of Electrode</td>
<td>3.3</td>
<td>7</td>
</tr>
<tr>
<td>Milligrams of Salt Adsorbed and Released per Gram of Electrode per Minute</td>
<td>16</td>
<td>19</td>
</tr>
</tbody>
</table>

**Table 1:** Results from different galvanostatic charge/discharge tests at different ion concentrations.

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<td>16</td>
<td>19</td>
</tr>
</tbody>
</table>

**Table 2:** Results from different static single pair tests at different ion concentrations.

**Discussion:**

In Table 1, the results from our original data reduction are shown, summarizing our static tests. Unfortunately, we discovered in our data that we had a shunt resistance (high leakage current) that had manifested itself in the device, skewing our data. Thankfully, we were able to overcome this resistance by using a concentrated solution of 1 molar NaCl which reduced the effect of the shunt resistance to an amount small enough that it was not a factor. What is important to notice in Table 1 is the cell that shows 7mg of salt per gram of active graphene electrodes and energy recovery.
Energy Required for Desalination (KWh/m³) to obtain 300 ppm water

<table>
<thead>
<tr>
<th>Methods</th>
<th>Salinity Levels (ppm)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seawater</td>
<td>Brackish Water</td>
</tr>
<tr>
<td></td>
<td>35000</td>
<td>4000</td>
</tr>
<tr>
<td>1) Reverse Osmosis</td>
<td>No Energy Recovery Assumed</td>
<td>2.9-3.7</td>
</tr>
<tr>
<td>2) Distillation (MSF)</td>
<td>No Energy Recovery Assumed</td>
<td>4</td>
</tr>
<tr>
<td>3) Electrodialysis</td>
<td>Greater than 20</td>
<td>Greater than 3</td>
</tr>
<tr>
<td>4) Decentralized Capacitive Deionization with Aerogel Electrodes</td>
<td>No Energy Recovery Assumed</td>
<td>Greater than 16</td>
</tr>
<tr>
<td>5) CDI with Graphene Electrodes and Energy Recovery of 48% assuming 3 AMPS/gram</td>
<td>Flow rate of 1 m³/hr</td>
<td>16</td>
</tr>
</tbody>
</table>

Accept or Reject Null Hypothesis that Energy Requirements in method 5 to desal a cubic meter of water is greater than that of other methods (1-4) at a given concentration and flow rate

P Value = 0.05

| Cannot Reject null hypothesis | Reject null hypothesis | Reject null hypothesis |

Table 2: Comparison of the use of energy in kWh/hr/m³ of water for several of the current methods including reverse osmosis, distillation, electrodialysis, decentralized capacitive deionization with aerogel electrodes, and our method of capacitive deionization with graphene electrodes and energy recovery. Energy estimates for each technology in the above table were obtained from Oren [5].

Conclusions

By using graphene on our DVD drives, we may have uncovered a new technology to help solve the world's water crisis. However, the true test will be in the continued development of this process through further research and development. For our distributed small water systems, price per liter of water will be dominated by material costs, which are still moderately low. We also have reason to believe that it is possible for our method to function for ten or more years, further lowering the price per liter of water with each day of use. The low energy requirement allows this process to work completely off the grid with solar or wind power, and depending on the application, lowering the price even more. If we are able to scale up effectively, we may have...
created a technology option to de-
ionize water for decades to come.
In summary, there are so many
different ways this technology can
be used. We are now ready to move
from an experimental platform to
an actual working prototype using
our ‘jelly roll’ graphene electrode
architecture. If our working pro-
totype proves to be successful,
we would have to be on the order of
$100,000+ for staff, material, tools,
and testing equipment. If we doreceive a monetary grant, we will
begin work immediately to fix
problems that are impacting bil-
lions of people around the world.
This technology may even be the
way to make fresh water in outer
space (out of waste) thereby al-
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Synthesis of Laser Scribed Graphene Electrodes: We pro-
duced Laser Scribed Graphene (LSG) electrodes in thin films in
accordance with El-Kady et al. [2]. Instead of using the electrodes
solely for ultracapacitor energy
storage as outlined by El-Kady, we
used these electrodes to create a
CDI device capable of desalinating
water. We began by taking Graph-
phosphate oxide (GO) powder from ACS
Chemical and adding it to distilled
water in the ratio of 5.7 mg/mL. We
use ultrasonication this solu-
tion for several hours to disperse
the GO into the water evenly. Next,
we drop cast the ultrasonicated
GO solution directly onto the DVD
disk via pipette. After this, we put
the DVD’s out to air dry for at least
48 hours. As outlined by El-Kady et
al. [2], these films were affixed on
top of a LightScribe-enabled DVD
media disc and moved into the
DVD optical drive for laser treat-
ment. LightScribe is a direct label-
ing technology that patterns text
and graphics onto the surface of
a CD/DVD disc. LightScribe DVD
drives are commercially available
for ~$20 and the LightScribing
process is completely controlled
by a standard desktop computer.
The drive uses a laser (optimum
power output = 5 mW, wavelength = 788 nm) to pattern a computer-
generated image onto a light sensi-
tive dye that changes color when
hit with the laser. We used the GO
film on the DVD instead of this...
The images were patterned in concentric circles, moving outward from the center of the disc. Once the media disc was inserted into the LightScribe drive, we ran it until the entire disc was laser-irradiated and we repeated the process 6 times, at about 25 minutes per cycle, this took roughly two and a half hours per disc. After only three laser treatments, the thin film resistance dropped by 5 orders of magnitude as measured with an analog multi-meter with two probes several centimeters apart.

First Experimental Platform: Our first experimental platform was a double electrode pair unit that was hastily constructed because it was only used for testing design functionality, as shown in Annex III Fig. 5. The only differences between El Kady [2] and our electrode synthesis was that we roughened the surface of the DVDs with 1000 grit sandpaper for adhesion, and we drilled holes in 2 of the 4 DVDs for water flow. We measured comparable resistance to -1V. To create a static environment, we rinsed the reactor with the same parts per million (ppm) water and in between tests of different concentrations, we rinsed with distilled water. Each test was run three times; a run consisted of a voltage rise to 1.2V-1.5V and then a discharge by reversing the polarities to -1V. To create a static environment in the reactor we plugged the bottom with a cork.

Third Experimental Platform: With our third and final experimental platform we followed the same procedures as with the second reactor except that we were able to use electrical current as a control variable in the experiment. We collected the data from a static (no flow) test of distilled water and 200 ppm solution of salt water with the newly added computer data acquisition system (DataQ) receiver. We tested these at 0.3 amps/gram, 0.5 amps/gram, 0.8 amps/gram. Before each test we rinsed the reactor with the same parts per million (ppm) water and in between tests of different concentrations, we rinsed with distilled water. Each test was run three times; a run consisted of a voltage rise to 1.2V-1.5V and then a discharge by reversing the polarities to -1V. To create a static environment in the reactor we plugged the bottom with a cork.

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**Fig. 4: Sequence of making Laser Scribed Graphene(LSG) electrode by drop casting Graphite Oxide(GO) onto a DVD disc and then laser treating it in a DVD drive six times. Upper right most photos shows a laser treated GO film that exhibited a 5 order of magnitude drop in sheet resistance.**

**Fig. 5: This photo shows our apparatus used in platforms 2 & 3, which is connected to our constant current source and data acquisition hardware which feeds into the computer.**

**Fig. 7: This photo shows our apparatus used in platforms 2 & 3, which is connected to our constant current source and data acquisition hardware which feeds into the computer.**

**Photo of Experimental Apparatus**

Golden brown graphite oxide

DVD in lightscribe burner

Black laser scribed graphene

**Fig. 5: Our first platform is shown to the left of this picture which is attached to the multi-meter in the upper right corner.**

**Fig. 6: This is what we discovered upon disassembling the first experimental platform as you can see there are major flakers missing and reduced GO is still left under the graphene.**

**Fig. 7: This photo shows our apparatus used in platforms 2 & 3, which is connected to our constant current source and data acquisition hardware which feeds into the computer.**

**Photos of Experimental Apparatus**

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<tr>
<td>2013 Northern Regional Training Conference</td>
<td>Modesto Doubletree Hotel and Modesto Centre Plaza</td>
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<td>September 10-12, 2013 Modesto, CA</td>
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<tr>
<td>29th Annual Tri State Seminar Register Today</td>
<td>South Point Hotel/Conference Center</td>
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<td>September 24-26, 2013 South Point, NV</td>
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<td>Northern Safety Day</td>
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<td>October 23, 2013 Woodland, CA</td>
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<td>2014 Annual Conference Submit Your Abstract Today</td>
<td>Santa Clara Convention Center &amp; Hyatt Hotel</td>
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<td></td>
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Circulation information
The WASTEWATER PROFESSIONAL is a official publication of the California Water Environment Association, Inc., a non-profit 501(c)(3) educational organization. Since 1928 we have served individuals, agencies and companies involved in municipal and industrial wastewater engineering, collection, analysis, treatment and disposal.

Display advertising rates and formats

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All ads are Black and White unless purchased at a special position (details below).

Position information
Advertising positions are determined by publisher or at a first-come, first-served basis unless a special position (as available) is purchased.

Special positions
- Second (inside front) cover: $1950 per issue
- Third (inside back) cover: $1950 per issue
- Fours (outside back) cover: $2510 per issue

Formatting options:
- Bled: No charge for bleed. 1/8” bleed and 1/2” safe area on all four sides.
- Insert: Call for estimate.

Printing specifications
The WASTEWATER PROFESSIONAL is printed offset, Trim page 8.5 x 11”; 4-color and spot color available (150 line screen), right reading emulsion side up, camera-ready art, or velox prints. Progressive proofs must accompany negatives on 4 color cover ads. Ads supplied on (150 line screen), right reading emulsion side up, camera-ready form, furnish and prepay all transportation charges on all printed material submitted and assume financial responsibility, plus process prompt payment under the terms of the rate card. Agency commissions will only be paid on camera-ready proofs or on camera-ready proofs accompanied by negatives on 4 color cover ads. Ads supplied on disc must include all support files, all art must be 300 dpi at full size. No art in Word.

Issuance & closing dates

- Winter: Cover date due: December 1; insertion order due: December 15; material/copy due: January 1
- Spring: Cover date due: March 1; insertion order due: March 15; material/copy due: April 1
- Summer: Cover date due: June 1; insertion order due: June 15; material/copy due: July 1
- Fall: Cover date due: September 1; insertion order due: September 15; material/copy due: October 1
- Winter: Cover date due: December 1; insertion order due: December 15; material/copy due: January 1
- Spring: Cover date due: March 1; insertion order due: March 15; material/copy due: April 1
- Summer: Cover date due: June 1; insertion order due: June 15; material/copy due: July 1
- Fall: Cover date due: September 1; insertion order due: September 15; material/copy due: October 1

Agency commissions
15% agency commissions are given only to recognized advertising agencies which select the media, handle the order within all deadlines, submit all advertising in camera-ready form, handle and pay all transportation charges on all printed material submitted and assume financial responsibility, plus process prompt payment under the terms of the rate card. Agency commissions will only be paid on camera-ready proofs or on camera-ready proofs accompanied by negatives on 4 color cover ads. Ads supplied on disc must include all support files, all art must be 300 dpi at full size. No art in Word.

Cancellations
Cancellation of any portion of a contract nullifies all rate and position protection for the remainder of a schedule. Cancellations are not acceptable after closing dates. All instructions regarding contracts and/or insertions must be in writing. Cancellations are subject to short-rates.

Liability
CWEA shall not be liable for any failures to print, publish, or circulate all or any portion of an issue. In consideration of publication of an advertisement, the advertiser and agency, jointly and severally, agree to indemnify and hold harmless the Association, its officers, agents and employees against expenses and losses resulting from publication of the advertisement.

General
Advertising must be inserted within 12 months of the first insertion to earn the frequency discount. Rates are subject to change upon 30 days notice in writing from publisher. We reserve the right to change ads in advance. CWEA reserves the right to reject any advertisement that, in its opinion, does not conform to the standards or editorial objectives of the publication.

Advertising insertion order form
Copy the form below and return to:
CWEA - Wastewater Professional Ads
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Phone (510)382-7800 x104, Fax (510)382-7810
Email ldvorak@cwea.org

Payment must accompany orders for Professional Card Listing. All other ads will be billed.

*15% commission given only to recognized advertising agencies.
**15% commission given only to recognized advertising agencies.
***15% additional cost for Advertisers who are not CWEA members.

Ad Space:
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- ___ Full Page
- ___ Winter
- ___ Spring
- ___ Summer
- ___ Fall
- ___ 1 time
- ___ 2 times
- ___ 3 times
- ___ 4 times
- ___ 5 times

Ad Cost Each Issue:
- ___ Total Due: $________

Agency:
- Advertiser:
- Date:
- Ad Cost Each Issue:
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530.243.1447 fax

SOUTHERN OFFICE
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Unit B
Anaheim, CA 92806
714.632.2871
714.632.2874 fax

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Hayward, CA 94545
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