UCF Stands For Opportunity

UCF Office of Research
& Commercialization
12201 Research Parkway
Suite 501
Orlando, FL 32826

UCF MCA 0606RES010-7/06

SUMMER 2006

A QUARTERLY PUBLICATION HIGHLIGHTING RESEARCH ACTIVITIES AT UCF

UCF Research & Commercialization

Water

[THE SCIENCE SURROUNDING H20]

MEMBRANE TECHNOLOGY • STORMWATER MANAGEMENT • SUSTAINABLE LANDSCAPING • WASTEWATER TREATMENT • STORM SURGE PREDICTIONS

UCF Research & Commercialization

Cookin' with M.J.

Vice President For Research M.J. Soileau

Working on Ways to Keep Clean Water Flowing

It is hard to convince people that Florida has a water problem. There are lakes everywhere. Rivers and springs grace the state with their beauty and bounty of wildlife. And for six months of the year it rains every day, sometimes at rates of multiple inches per hour.

A closer look starts to reveal some trouble in paradise. Lake Jesup is a good example. The water is green, its bottom covered in muck. Remnants of fishing camps can still be found on the lake's shores, a testament to the not-too-distant past in which Jesup was a crystal clear haven for bass. The elimination of a critical channel from the St. John's River into Lake Jesup, the introduction of untold amounts of treated sewage from neighboring cities and the building of dikes to prevent seasonal flooding of adjacent lowlands have combined to make Lake Jesup second only to Lake Apopka in pollution.

Pure stormwater now rushes off rooftops and down asphalt roads, carrying the waste and grime of 'civilization' into our lakes and rivers. Wetlands have been drained and filled and, in some cases, rivers channeled to speed the runoff that is no longer held back by natural vegetation. Uplands that once sifted stormwater through cleansing sands and helped fill our aquifer with clean water now are paved over with rooftops and roads.

Uh oh, I'm starting to betray my 'tree hugger' mentality. I had better change the subject! For the moment let's put aside the issue of soiling our surface water. After all, the state of Florida sits atop a wonderful aquifer. From time to time the aquifer penetrates the surface to produce beautiful crystal clear streams of cool, clean water. Nature provides a wonderful bounty for our consumption, use and recreation!

If only it were so. We have passed the point of 'harvesting' nature's bounty of clean water. We now 'mine' the aquifer, removing water at a rate greater than it is replenished.

We are rapidly reaching the point where our ability to absorb a net increase of 700 people per day in Florida will come to an end. When that happens, the building industry, now second only to tourism in Florida's economy, will be adversely affected as will a multitude of other initiatives we have cultivated to diversify our economy.

But here is some good news: UCF has been working on this problem for decades. Our skilled graduates are working in the public and private sectors to ways to ensure future generations will have access to the clean and plentiful resources we take for granted. Our faculty-scholars in water treatment and water management and their students are developing better ways to clean ground and surface water, model and manage stormwater, model surface and sub-surface water resources and apply breakthroughs in basic science (such as nanoparticles) to this important issue.

As a metropolitan research university, we take great pride in working with government, community and industry to solve problems in our region, state and nation. This publication gives a sampling of the expertise our faculty and partners are contributing toward ensuring an abundant and sustainable supply of clean water for our region and state.

Cheers! *MJS*

mj@mail.ucf.edu

John C. Hitt
President, University of Central Florida
jhitt@mail.ucf.edu

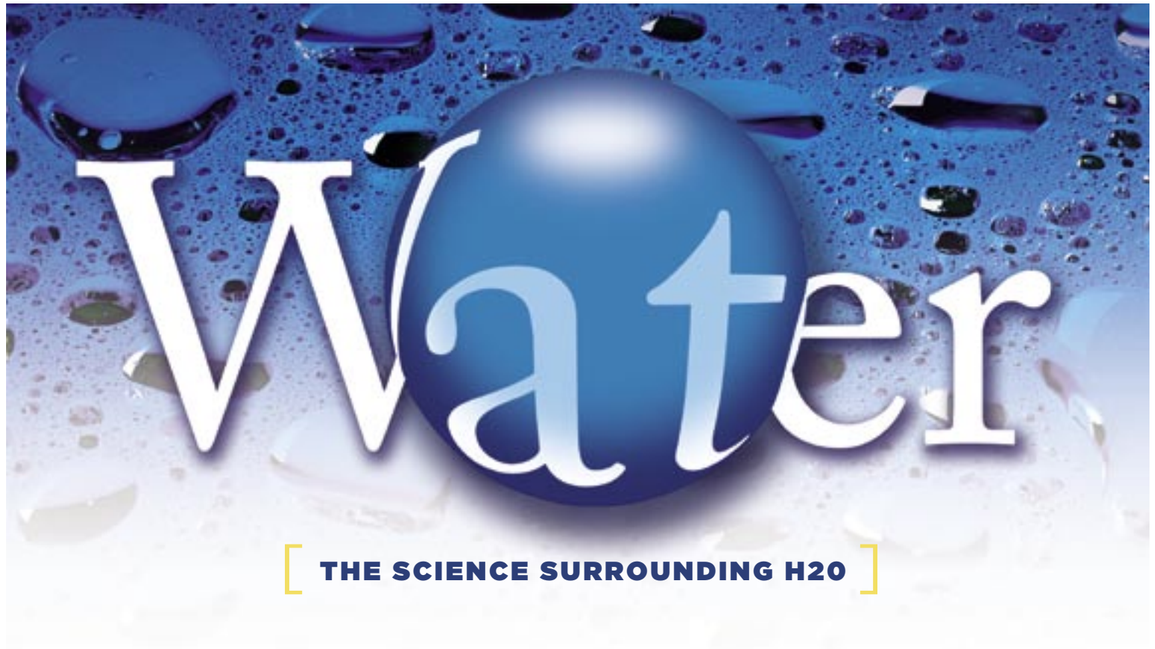
Terry Hickey
Provost and Vice President
thickey@mail.ucf.edu

M. J. Soileau
Vice President for Research
mj@mail.ucf.edu

Tom O'Neal
Associate Vice President for Research
Chief Executive Officer,
UCF Technology Incubator
oneal@mail.ucf.edu

Barb Compton Abney
Editor
babney@mail.ucf.edu

UCF RESEARCH is produced by the Office of Research & Commercialization at the University of Central Florida. For more information about UCF's sponsored research activities, contact Tom O'Neal, Associate Vice President for Research, 12443 Research Parkway, Suite 301, Orlando, FL 32826 (407-882-1120). For information about stories contained in the newsletter, contact the editor or the appropriate Web site.



A QUARTERLY PUBLICATION HIGHLIGHTING RESEARCH ACTIVITIES AT UCF

Contents

Water, Water Everywhere...

But is it really?

THE UNITED NATIONS has declared the global shortage of water to be one of its most pressing issues for 2005-2015. Nearly 75 percent of the Earth's surface is covered with water. Our own bodies are 70 percent water. If there is so much water around us, why isn't there enough to drink?

Availability and quality, says James Taylor, Alexander Professor of Civil and Environmental Engineering and director of UCF's Environmental Systems Engineering Institute. To start with, nearly 97 percent of the water on earth is in the oceans, making it unfit for human consumption without desalinization. The majority of the world's freshwater is tied up in glaciers and icecaps leaving a very small percentage of potential potable water from the start.

The groundwater, lakes and rivers that provide the most reliable sources of drinking water are subject to vast fluctuations in availability. With varying weather patterns and the unpredictable impact of natural disasters, many regions of the world alternate between a plentiful supply and scarcity.

In Florida, nearly 92 percent of drinking water comes from aquifers or groupings of saturated, permeable material such as rocks or sand that easily give up the water to wells and springs. While the aquifers are replenished by rainfall, the erratic dispersal of precipitation combined with the state's explosive growth have put a strain on this base supply.

Taylor and fellow researchers have been studying methods of treating water from traditional as well as alternative sources for more than 30 years. They are known throughout the world for their expertise in membrane technology.

Taylor maintains that proper treatment can make water from any source suitable for human consumption. In fact, he and Sudipta Seal, professor of mechanical, materials and aerospace engineering and UCF's nanoinitiative coordinator, received funding from the National Science Foundation to combine oxide nanoparticles with membrane filtration systems to made mobile water purifiers suitable for use in emergency situations such as Hurricane Katrina.

Taylor, John Dietz and Andrew Randall, faculty in the Department of Civil and Environmental Engineering, have received

the bulk of their research funding for projects focused on removing pathogens, chemical carcinogens and other toxic substances from ground, surface and saline water sources and then integrating those blended waters successfully in our distribution systems. That integration might sound simple, but a troubling event in Tucson, Arizona, in the mid-1990s shows otherwise. Like most Florida cities, Tucson had for decades used only groundwater for drinking water supply.

To facilitate a transition to surface water, officials there constructed a surface water plant capable of treating 125 million gallons of water transferred from the Colorado River via open canal every day. What they didn't anticipate was the disruption of equilibrium between the source water and the chemical and biological deposits on pipes used for distribution.

Hence the water emitted from the new system was rust colored and smelled foul. Citizens complained about clothes washed in the water being tinged red and many refused to drink it. What happened? A chemical imbalance that resulted from sending water from a new source (surface water) through pipes that had balanced themselves to a different type of water (groundwater).

Taylor warns that Florida's efforts to use sources other than aquifers for potable water could have similar consequences if proper steps aren't taken to properly integrate the water into distribution systems.

Tampa Bay Water, in response to a directive from The Southwest Water Management District, is developing methods of using regional surface water and desalinated water to meet drinking water demands. The UCF team has received $5 million in funding to determine how to predict water quality change based on blend, treatment and time.

The funding comes from Tampa Bay Water and its member governments (Pasco, Pinellas and Hillsborough counties, and the cities of Tampa, St. Petersburg and New Port Richey) and the American Water Works Association Research Foundation. The UCF project has resulted in changes in surface water quality that have enabled it to meld with existing "films" or deposits on pipes throughout the Florida's west coast.

"Chemical, physical and biological parameters such as temperature, trace metals, and biofilms must be considered in any water that enters our distribution systems in order to maintain acceptable water quality," Taylor said. "We have received inquiries about our work from across the United States, Europe and the Middle East as this problem occurs everywhere alternate waters are utilized, which will eventually be everywhere in our world," he added.

New technology is continually being developed to assist this effort. Taylor says he is particularly excited about the potential for incorporating nanoparticles into water treatment techniques. In addition to offering the ability to immediately cleanse biological agents from surfaces, nanoparticles can also be used in conventional water treatment processes to enhance coagulation, sedimentation, disinfection and distribution system water quality. The potential for utilization of nanoparticles is virtually unlimited in water treatment.

Such innovations offer infinite possibilities for the continuing challenge of making one of nature's most precious resources available for all to use.

- *Barb Abney*

Stormwater Academy Studies What Many Overlook: Rain

WITH THE NEED for potable water at critical levels, researchers are looking to get every drop from every possible source – even overhead. UCF has taken the lead in studying the often overlooked area of stormwater use and reuse.

Established in 2002, UCF's Stormwater Management Academy, the only one of its kind in the United States, is dedicated to increasing government and public awareness of the many benefits of stormwater reuse, serving as a leading source for stormwater management research and providing the most innovative education and training programs in the nation.

While most people are familiar with the use of stormwater in irrigation, many don't realize the extent to which the water that falls from the sky affects all other water uses, including the production of clean drinking water.

In what stormwater researchers refer to as "pointless personal pollution," everyday activities from driving a car to mowing the grass to walking the dog contribute to the degradation of the natural water supply.

Combine these factors with the influx of development and there is a critical need to address the quality of stormwater runoff.

"Urban development causes significant changes in patterns of stormwater flow from land into receiving waters, which can consequently affect water quality when runoff carries sediment or other pollutants into streams, wetlands, lakes or into groundwater," said Martin Wanielista, academy director.

For that reason, pollution and sediment control are major problems being investigated by the academy today.

With its home at one of the fastest developing universities in the nation, the academy has focused on protecting the university's natural resources by keeping stormwater discharge rates and volume at the same levels after development as they were before.

One way they have done this is with the I2 Water system, a patented design that provides water for irrigation or reuse based on environmental and meteorological sensors used to distribute water from different sources such as stormwater, reclaimed water (treated sewage) and groundwater.

In addition to innovative irrigation techniques, the academy is incorporating specialized projects such as the construction of the campus' first green roof.

Another low-impact development technique used by UCF is pervious concrete. According to the United States Environmental Protection Agency, stormwater runoff can send as much as 90 percent of the pollutants – such as oil and other hydrocarbon liquids found on the surface of traditional parking lots – directly into rivers and streams. Pervious concrete has been recognized by the EPA as a best management practice to address this environmental concern. The open cell structure of pervious concrete breaks down many of the pollutants that seep from parked cars, while allowing for three to eight gallons of water per minute to pass through each square foot. The Stormwater Academy is serving as a pervious concrete demonstration site and plans to pave lab parking areas with it next year.

The innovative new technologies being developed by the Stormwater Management Academy are, as a result, ensuring the protection and enhancement of valuable groundwater supplies for both present and future generations.

For more information about the UCF Stormwater Management Academy, visit http://stormwater.ucf.edu.

- *Lauren Davis*

Green Roof Saves Stormwater

As the first university in Florida to install a "green" roof on a major building, UCF is reaping a bevy of benefits and making some significant water-saving discoveries.

The roof on UCF's Student Union uses a special soil that stayed far moister than expected, reducing the need for irrigation and saving the water collected from rainfall for other uses, said Martin Quigley, director of the UCF Arboretum and a leader in the installation of the roof last spring.

The soil needed to be exceptionally lightweight and capable of tolerating intense sunlight.

Quigley said a combination of organic matter, shredded recycled tires and heat-treated shale (think of popcorn) did the trick. "This combination won't break down and won't get real heavy when saturated," Quigley said. "It's great for plant roots."

The 1,500-square-foot roof has been awash in dune sunflowers, coral honeysuckles and blanket flowers since its installation. The green roof is expected to cut the energy costs of that section of the building by about 50 percent and extend the life of the roof from 20 to 50 years.

The State Department of Environmental Protection provided UCF with a grant of about $340,000 to create, maintain and study the effects of the green roof, which covers half of the roof of the Student Union expansion. The other half is a standard roof that will be used as a comparison for temperatures, water runoff levels and the condition of the green roof.

Martin Wanielista

UCF plans to install more green roofs which should help the university accomplish its goal of reducing storm-water runoff on campus so it is less than before the land was developed, said Martin Wanielista, director of the UCF Stormwater Management Academy and the overall leader of the Student Union project.

Professor Works to Clean Up Waste

Debra Reinhart and team

A UCF RESEARCHER and her team are developing cleaner, more efficient methods of municipal solid waste disposal that have the potential to improve the quality of both land and air.

Debra Reinhart, professor and executive associate dean for the College of Engineering and Computer Science, works with a team of engineers to optimize conditions and monitor the environmental effects of bioreactor landfills. Her work has been supported by the Florida Center for Solid and Hazardous Waste Management and the Environmental Research and Education Foundation.

With roughly 122 sanitary landfills in Florida alone, and the rapid spread of urban development, safe disposal of municipal solid waste has become an ever-increasing problem. While most people have the luxury of remaining unaware of the issue, researchers around the world are searching for ways to safely and effectively manage these wastes.

As defined by the Solid Waste Association of North America (SWANA), a bioreactor landfill is "any landfill cell where liquid and/or air is injected in a controlled fashion into the waste mass in order to accelerate decomposition and stabilization of the waste." Researchers combine leachate, or liquid that has drained from solid waste, with other liquids, including stormwater, wastewater, and wastewater treatment plant sludges to create a brew that moves through a bioreactor landfill to decompose waste more rapidly than traditional methods.

Wastewater generated from landfills must be treated before being disposed, a difficult task because of the high levels of ammonia and other organics contained in the leachate.

With a grant from the Florida High Tech Corridor, Reinhart and her team are exploring the use of a highly oxidized form of iron ferrate, to treat wastewater and industrial water. Ferrate has been shown in laboratory tests to reduce the concentration of organic compounds in leachate. Reinhart's group hopes to commercialize ferrate as a safe disinfectant and coagulant for water and wastewater treatment.

Ferrate also has implications for assisting with the global issue of aquatic nuisance species contained in ballast water from cargo ships. Ballast water – or water drawn into a ship's cargo hold for stabilization, has been identified by the Global Ballast Water Management Programme (GBWMP) as one of the four major threats to the world's oceans. The problem arises when the water, which is pumped into the hold at one port, is released into the ocean as cargo is loaded, sometimes half a world away. If it is not treated, this water contains contaminants and invasive foreign species of fish and other marine organisms.

The devastating effects of transferring ballast water can be seen in the example of the zebra mussel – its population exploded to infest more than 40 percent of internal U.S. waterways and required between $750 million and $1 billion in expenditure on control measures between 1989 and 2000, according to the GBWMP.

With no official global standard, international sterilization measures include methods ranging from filtration to physical treatments. Scientists the world over are now looking at chemical treatment methods to eradicate the problem, a technology that Reinhart and her team are trying to perfect with their ferrate research.

The commercialization of these chemical treatment methods for industrial water and wastewater stand to revolutionize the way polluted waters are sanitized.

For more information on wastewater and solid waste treatment and Reinhart's research, visit http://people.cecs.ucf.edu/reinhart.

- Kerry Gregovich

FACULTY PROFILE:

Fidelia "Ola" Nnadi, *Department of Civil and Environmental Engineering*

FIDELIA "OLA" NNADI specializes in water resources engineering and environmental hydraulics with applications to civil, agricultural, industrial and environmental systems. Her research interests include stormwater management in both urban and rural areas; development of forecasting tools that predict the fate and transport of trace contaminants using Global Information Systems, applicable to surface water and groundwater; wetland conservation, associated with its morphology, hydrodynamics, sedimentation and water quality; and engineering control of pollutants in aquatic systems.

Nnadi has received more than $800,000 in funding from the city of Kissimmee to develop a regional stormwater management program to enable the city to meet state-mandated reductions in the amount of pollutants in stormwater. She also received more than $200,000 from the Florida Department of Environmental Protection to investigate the pollution removal effectiveness of three proprietary systems. The research will help governments and organizations required to implement stricter stormwater standards without the benefit of time-tested management systems.

What do you see as Florida's biggest water-related challenge in the next decade?

Florida's biggest water-related challenge can be addressed with the question, "Will Florida have adequate potable water for its citizens by the year 2025?" The answer to this question remains for ALL to address. There is a need for the consumers, the stakeholders and researchers alike to work together to address the question.

Does Florida's water supply problem affect your research? If so, how?

My research focuses on managing the available water resources. The water quality aspect is of concern, thus, providing more challenges to study.

Is there anything you would recommend everyone do to help conserve water?

Florida's Water Management Districts have comprehensive public awareness and education programs. There is no point in reinventing the wheel. My recommendation is that these programs be encouraged to get to the grass roots through public awareness efforts.

Any additional comments?

We all know the saying "Charity begins at home"; therefore, if everybody makes a conscious effort to protect and conserve the water resources within our locale, then the global effect will become a reality.

Bottled vs. Tap

Is drinking bottled water any better for you than what comes out of the tap? According to a study conducted by UCF's Environmental Systems Engineering Institute in 2002, the answer is a resounding, "No."

The researchers examined 10 water samples – five from bottled water and five from municipal sources across Central Florida. After running a variety of chemical and biological tests, the researchers concluded that although both types of water met state and federal water quality regulations, the biological water quality was better in municipal waters than in bottled waters. Two of the bottled waters had high bacterial counts while the municipal water was, in general, harder, with more salt and other residual and organic content.

"Both supplies meet U.S. Environmental Protection Agency regulations, but the fact is, municipal water is monitored more frequently than bottled water, and since bottled water is more costly, I drink tap water regularly" said James Taylor, director of UCF's water treatment laboratory.

Taylor suggests cost-conscious consumers might want to consider another statistic. While the cost of municipal water averages 2.5 cents a pound, the corresponding price for bottled water is $2.20 – or 10,000 times more.

- Barb Abney

CHAMPS Lab Helps Warn about Water at Its Fiercest

IMAGES FROM HURRICANE KATRINA and the Asian tsunami left the world with an indelible imprint of the destructive power of water at its most ferocious. A UCF engineer who has spent his career studying storm surges has developed a model to help predict, with unparalleled accuracy, what areas will be hit by a major storm and with how much water.


Scott Hagen

Scott Hagen, an associate professor of Civil and Environmental Engineering, and his team of graduate students developed a model that divides an area stretching from the mid-Atlantic to the U.S. East Coast and through the Gulf of Mexico and Caribbean Sea into thousands of triangular elements. Real-time data, depths and water velocities are regularly calculated for each reference point, allowing for the effect of currents and rising and falling tides.

Because of the last two record-breaking hurricane seasons, the researchers started studying potential storm impacts on Florida coastal cities. In a recent test, the team found that a Category 4 storm could cause a surge of as much as 25 feet in parts of Tampa Bay.

"We'll never have a flood up to our rooftops like New Orleans, but that doesn't mean there won't be pockets of flooding in our cities that have the potential to cause drownings," said Hagen, who is also director of the Coastal Hydroscience Analysis, Modeling and Predictive Simulations Laboratory, which is known as the CHAMPS Lab.

Hagen said cities will have to balance their risks of storm surges with the costs of fortifying sea walls and levees when they decide how much protection they want to add. They also need to consider the gradually rising sea level, he said.

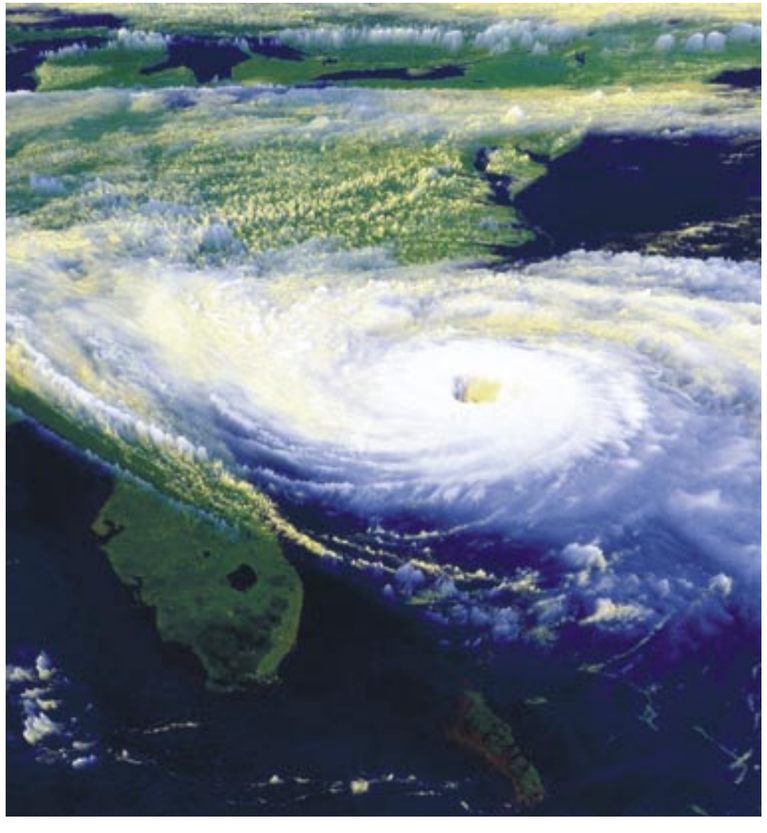
"Usually, we'll say if we have a 99.5 percent confidence level that it's not going to fail, we're going to feel pretty good," Hagen said. "We can live with that year in and year out, but there's still that one-half percent chance, and that's what you saw in New Orleans."

Graduate students working with Hagen are Peter Bacopoulos of Daytona Beach, David Coggin of Orange Park, Yuji Funakoshi of Tokyo and Mike Salisbury of Fort Pierce.

In related efforts, Hagen and the students are part of a program created to improve the national system for forecasting winds, waves and storm surges related to hurricanes. The goal of that project, which received $5 million from the National Oceanographic Partnership Program, is to generate real-time, probabilistic storm surge elevations for the United States' East Coast and Gulf of Mexico based on potential hurricane tracks. The results will help government agencies issue more accurate emergency advisories during storms. UCF's partners in that effort include the universities of Miami and Florida, the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration/ Atlantic Oceanographic and Meteorological Laboratory Hurricane Research Division and Oceanweather Inc.

Hagen and his students also collaborate with the National Weather Service Southeast River Forecast Center in Peachtree City, Georgia, on real-time forecasting for coastal rivers. The National Oceanic and Atmospheric Administration Office of Hydrologic Development is funding the CHAMPS Lab to develop a real-time forecasting system model for the St. Johns River.

For more information on the storm surge predictions, go to http://www.champs.cecs.ucf.edu/.



NEWS

Local Business Brings Lakes Back to Life

A WINTER PARK BIOTECHNOLOGY company with ties to UCF has developed a unique process for restoring the natural balance of polluted lakes at rapid speeds, with minimal land requirements and without the harmful byproducts of traditional techniques.


G. Thomas Bland, Jr.

Through the use of a multi-patented technology, AquaFiber Technologies Corporation is able to remove harmful levels of phosphorus, nitrogen, carbon, calcium, sulfur, iron, lead, mercury, arsenic, selenium and other elements from tainted ground and surface water up to 1,000 times more effectively than natural or other constructed wetlands techniques.

AquaFiber was co-founded by G. Thomas Bland, Jr., a former adjunct faculty member in UCF's College of Business Administration and a recently inducted member of that college's Hall of Fame. Bland said the company was started out of a concern for the ever-worsening state of the world's surface waters.

During the past two years, AquaFiber has been demonstrating its remediation technology on Lake Apopka, once dubbed Florida's most polluted large lake. The St. John's River Water Management District has been working on restoring the lake for the past 20 years. While the efforts have significantly improved the water quality and clarity, they required the purchase of more than 19,000 acres of former farmland along the lakeshore to reduce the amount of phosphorous and pesticide run-off entering the water and the re-flooding of nearly 7,500 acres to instigate wetland restoration. AquaFiber believes it could remove all the lake's phosphorous in just 10 years, using as little as 65 acres of land.

Currently, with two 500-foot long filtering channels located on 1/10 of an acre of land, AquaFiber has been able to produce potable quality water from Lake Apopka and remove hundreds of pounds of undesirable nutrients. The system is estimated to be able to treat up to 10 million gallons of water per day per acre of land utilized. The secret lies in the patented oxygenation process, periphyton algae and expertise in the floway process.

"Our technology can treat the volume of an entire lake every 30 days using an area equivalent to one percent of the area of the lake," Bland.

While the company is currently focusing on perfecting and demonstrating its technology at the Lake Apopka site, plans call for contracting with municipalities and developers worldwide.

- Barb Abney and Kevin Felker

Professor Proposes Sustainable Landscaping for Florida Lawns and Gardens


Martin Quigley

While utility companies and municipalities are quick to warn Floridians of the penalties for irrigating too frequently, a UCF researcher is asking why the region's landscaping doesn't take better advantage of the climate that exists here.

Martin Quigley, director of UCF's Arboretum and a professor of urban landscape ecology, says Central Florida's two primary landscaping concerns are the need for shade and the conservation of rainwater.

"People come to Florida for the year-round sunshine, but aside from sports activity, outdoor living here requires shade," he says. And with the torrential rainstorms during the summer months, some method for collecting and reusing runoff water is essential. Design themes beyond the popular Mediterranean concept are needed to take advantage of Florida's unique subtropical monsoon climate, he says.

"Florida is not like California," Quigley says. "There are some beautiful plants in the Mediterranean climates that can't handle our hot, humid July."

Quigley advocates a return to some classical design themes that both conserve and beautify. "Around the globe there are many beautiful, functional old-world inspirations for comfortable and sustainable constructed landscapes in monsoon and Mediterranean climates," he said.

While trees, planted closely enough together so that they touch, can provide shade – a structure such as a colonnade or pergola, often covered with vines, is necessary for rain shelter. Such features are common in hot-weather regions and examples are plentiful in old-world architecture.

What people tend to think about less frequently is the collection and storage of rainwater. While storing water during months of plenty for use during the ensuing drought is a strategy adopted by ancient societies, the concept has not been seen as a need in modern U.S. design.

Quigley would like to see such pools become desired features of Central Florida homes and offices. Water can be funneled from rooftops and higher elevation areas into stone-paved or tiled pools and held until it is needed for irrigation when it can either be pumped out or drained into holding tanks. During the dry season the pool areas are purely decorative.

Another concept that is growing in popularity across the country is the rain garden. These are depressed areas dug into the ground to collect water runoff and slowly filter it through a variety of roots and soils until it is gradually absorbed into the surrounding landscape rather than the nearest sewer.

Such options provide attractive, inexpensive alternatives to traditional design that can ultimately end up saving valuable natural resources, Quigley says.

For more information, contact Quigley at mquigley@mail.ucf.edu.

A SAMPLING OF WATER-RELATED RESEARCH AT UCF

RESEARCH	PROJECT/TITLE	DESCRIPTION	AGENCIES
[ENERGY EFFICIENCY]			
Collier, R. K. (PI)	Transition to Hydrogen Power	Determination of reaction mechanisms and the reaction kinetics of various photoelectrochemical development of reactor concepts that are applicable reactions forto the scale-up and design of large-scale hydrogen production units by splitting water and other hydrogen carriers using colloidally-suspended particulate semiconductors	National Renewable Energy Lab
Dhere, Neelkanth G. (PI)	Photoelectrochemical Water Splitting for Hydrogen Production Using Photovoltaic Cell Combined Thin-Film Catalyst	Generate photoelectrochemical water splitting for hydrogen production using photovoltaic cell combined thin-film catalysts	Research Institute of Innovative Technology
Dhere, Neelkanth G. (PI)	Photoelectrochemical Water Splitting for Hydrogen Production Using Photovoltaic Cell Combined Thin-Film Catalyst	Study PEC cell based on a catalyst-coated wide bandgap p-type CIGS2 thin-film for generation of hydrogen by splitting water	Research Institute of Innovative Technology
Gu, Lixing (PI), Colon, Carlos (Co-PI), Vieira, Robin (Co-PI)	Combined Tankless Water and Space Heating Residential Gas System	Develop prototype buildings and inputs for three Florida climate zones for Energy Plus simulations in order to make comparisons of energy use compared to other gas systems	Jeff Householder & Company
Hampton, Michael D. (PI)	Sub A - Hydrogen From Renewables	Development of a method for concentrating and measuring nonvolatile residue (NVR) in water wash solutions	National Renewable Energy Lab
Harrison, John (PI), Huggins, James (co-PI)	Solar Water Heating Workshop on Solar Water Heating for Facility Staff	Develop and conduct a one-day workshop on solar water heating for facility staff	Orange County Public Schools
Linkous, Clovis A. (PI)	Solar Photocalytic H2 Production from Water Using a Dual Bed Photosystem	Test photoconductive solids specifically chosen for thier H2- or O2-evolving ability to demonstrate net water decomposition	US Department of Energy
Thornbloom, Mark D. (PI), Huggins, James C. (CoPI), Harrison, John L. (CoPI)	Development of a Solar Water Heating System Inspection Video and Checklist for Code Officials	Review relevant national plumbing codes, develop a checklist reference document and training video for code officials	Sandia National Labs
Vieira, Robin K. (CoPI), Martin, Eric D. (PI)	Two-group study of Gainesville area new home utility bills	Apportion and compare heating, cooling, and water heating energy use from utility bills for Gainesville, Florida area new homes;conduct comparison between two groups, those marked as energy-efficient homes and a control group.	University of Florida
[ENVIRONMENTAL/CONSERVATION ISSUES]			
Ehrhart, Llewellen (PI)	Satellite Tracking Juveline Green Turtles	Follow the largest immature green turtles inhabiting Florida waters, to learn more about migration routes, schedules and destinations	Caribbean Conservation Corporation
Fauth, John, (PI), Stout, Jack, (Co-PI)	Assessment of Rare and Listed Herptiles and Mammals on the Seminole Ranch Conservation Area	Conduct research on the ecology, natural history, and conservation of amphibians, reptiles, and mammals in the Upper St. Johns River	St. Johns River Water Management District
Gu. Lixing (PI), Barkaszi, Stephen, (Co-PI)	Development of manatee warm-water refuge construction plans	Converse a project organizing committee meeting, re-examine enclosure heating requirements, and develop construction plans for a warm-water manatee enclosure and associated solar heating system	Marine Mammal Commission
Hagen, Scott C. (PI)	Water Usage Analysis for the St. Johns River Water Management District	Analyze the effect of water usage restrictions for SJRWMD	St. Johns River Water Management Distrct
Nnadi, Fidelia (PI)	Integrated Regional Stormwater Program: City of Kissimmee	The Clean Water Act passed in 1972 set the framework for the water quality standards in the State of Florida	City of Kissimmee
Soskin, Mark (PI),	Assistance with Economic Feasibility Analysis of Consumptive Use (CUP) Permit Applications for St. Johns River Water Management District	Due to the analytical complexity associated with implementing SJRWMD's economic feasibility CUP review, standard outside economic consulting expertise and experience from UCF is needed to provide advising to District staff on ongoing and special needs basis	St. John's River Water Management District
Walters, Linda (PI)	Impact of Boat Waves on the Eastern Oyster Crassostrea virginica in the Southeastern United States	Experimentally determine if boats are negatively impacting oyster reefs in shallow-water estuaries and appropriate restoration protocols for this habitat type	Florida Sea Grant College Program
Walters, Linda (PI)	Killer Algae: Reducing the Risk of a Tampa Bay Invasion of Caulerpa taxifolia – Mediterranean Strain through Research, Outreach and Education	Survey Tampa Bay waters, aquarium shops, and e-commerce distributors for Caulerpa; also, to develop lesson plans and a fact sheet on marine invasives in Florida	National Fish and Wildlife Foundation
Walters, Linda (PI)	Restoration of Intertidal Oyster Reefs in Florida: Implementation of Successful Techniques in Areas with Intense Boating Activity	Implement a scientifically-based restoration technique that minimizes wake damage from recreational vessels on intertidal reefs of the eastern oyster Crassostrea virginica	St. Johns River Water Management District
Wanielista, Martin P. (PI)	Econlockhatchee Basin Restoration	Development of a plan to regulate the restoration and preservation of the Econlockhatchee River basin at minimum cost, and provide watershed, water quality and water quantity data to aid local, regional, state and federal permit processes while documenting the hydrologic and environmental conditions of the river and its watershed	FL Department of Environmental Protection
Yeh, George (PI)	Mechanistic-based Watershed Modeling for Evaluation of Ecosystem Conditions	Develop a robust, efficient, mechanistic based watershed numerical model for ecosystem modeling, that is comprised of river/stream, overland, and saturated/unsaturated subsurface media and accounts for hydrodynamic, sediment transport, pollutant transport, fate and transformation; the model will be highly modularized and adapted to high performance computing environments and will be linked to several user-friendly platforms of modeling environment	U.S. Environmental Protection Agency
Yeh, George (PI), Hagen, Scott (Co-PI)	Loxahatchee River Three Dimensional Integrated Surface and Groundwater Model	To develop an integrated surface and groundwater model and to apply the model for assessing the migration of salinity in loxahatchee River Estuaries	FL Department of Environmental Protection, South Florida Water Management District
[MEMBRANE TECHNOLOGY]			
Seal, Sudipta (PI), Taylor, James (Co-PI)	Development of a Novel Membrane Process for the Immediate Production of Drinking Water from Varying Quality Aqueous Sources	Integration of nanoparticles in membrane for water quality — problems addressed to Katrina disaster	National Science Foundation
Taylor, James S. (PI), Dietz, John D. (CoPI), Randall, Andrew A. (CoPI)	Required Treatment and Water Quality Criteria for Distribution System Blending of Treated, Surface and Ground Water	Control distribution system water quality as affected by blending of surface, saline and ground water	American Water Works Association Research Foundation
Taylor, James S. (PI), Randall, Andrew A. (CoPI), Dietz, John D. (CoPI)	Control of Distribution System Water Quality Control in a Changing Water Environment Using Inhibitors	Mitigate iron release, lead release, residual loss, lack of biological stability, nitrification and other adverse effects caused by changing distribution system water quality due to blending finished waters produced from ground, surface and saline	American Water Works Association Research Foundation

RESEARCH	PROJECT/TITLE	DESCRIPTION	AGENCIES
[STORM SURGE PREDICTION]			
Hagen Scott (PI)	Morphos 3D, High Resolution Water Level Field Specification	Enhance an existing finite element model mesh(es) to create adequate resolution and topographic definition in key project areas (i.e., land-falling regions of Hurricanes Charlie, Frances, Ivan, and Jeanne) for local-scale application	Woolpert, Inc.
Hagen, Scott (PI),	Simulation of tidal currents in the Lower St. Johns River and on the adjacent continental shelf	This work primarily involves application of the Western North Atlantic Tidal model domain to the Lower St. Johns River and Lake George for the purpose of providing tidal velocities and residual flows	St. John's River Water Management District
[STORMWATER MANAGEMENT]			
Wanielista, Martin P. (PI)	Rainfall Frequency Analysis for IDF Curves	Update the Florida Department of Transportation FL/DOT) intensity-duration-frequency (IDF) curves incorporating current rainfall data and coordinating with Water Management District Methods to eliminate duplication of drainage design efforts	FL Department of Transportation
Wanielista, Martin P. (PI)	Rainfall Excess	Characterize watersheds based upon a number of variables; the characterizations will be used to compare predictions of rainfall excesses with measured/observed data	St. Johns River Water Management Distrct
Wanielista, Martin P. (PI)	Hydrologic Balance: Econ River Basin	Study the hydrologic balance for the Econlockhatchee River watershed and take recommendations to the River District concerning the implementation of basin-specific engineering design criteria	St. Johns River Water Management Distrct
Wanielista, Martin P. (PI)	The Effectiveness of a stormwater Reuse systemusing naturally selected, biologically activatedDeep-Bed Filtration Producing Irrigation Quality Water	Test the pollution control effectiveness of a retention pond with a horizontal well to produce irrigation quality water	FL Department of Environmental Protection
Wanielista, Martin P. (PI)	Review of Lake Butler Water Quality preformed by the SJRWMD	Assess and review data collection to help restore Lake Butler	Orange County/Dept. of Environ. Protection
Wanielista, Martin P. (PI)	Stormwater Intelligent Controller System	Prove the operational effective reuse of water from mutliple sources while evaluating water quality	FL Department of Environmental Protection
Wanielista, Martin P. (PI)	Regional Stormwater Irrigation Facilities	Document the water quality in Regional Stormwater Facilities and oppurtunities for irrigation from these facilities	FL Department of Transportation
Wanielista, Martin P. (PI), Nnadi, Fidelia N. (CoPI) , Yeh, Gour-Tsyh (CoPI) , Finnoff, David C. (CoPI) , Milon, Joseph W. (CoPI)	Storage Value	Value water storage	FL Department of Environmental Protection
Wanielista, Marty (PI)	Waste Tires for Pollution control	Crumb and chip tires are used for stormwater management and septic tank pollution control	Seminole County Government
[WASTEWATER AND SOLID WASTE TREATMENT]			
Randall, Andrew A. (CoPI), Reinhart, Debra R. (PI)	Commercializing Ferrate (Iron VI) for Use in Municipal and Industrial Water and Wastewater Treatment	Evaluate efficiency and dosage requirements of ferrate iron	Ferrate Treatment Technologies, LLC
Randall, Andrew A. (PI)	Mosquito Lagoon Stormwater and Groundwater Project	Determine the efficacy of various additives on the removal of total suspended solids and other substances in combined stormwater and groundwater prior to entering the Mosquito Lagoon through an existingtrench/stormwater sewer in New Smyrna Beach, Florida	Cetacean Logic Foundation
Reinhart, Debra (PI)	Lake County Ash Co-Disposal Study	Evaluate toxicity effects of using two water sources (leachate from an ash landfill and ground water containing benzene) as additional moisture in bioreactor landfills; additional moisture is needed in bioreactors to promote anaerobic biodegradation through the solid waste matrix; thus, this experiment will focus on evaluating toxicity effects of each of the two moisture sources on methane producing microorganisms (responsible for producing methane in landfills) using bench scale reactors that simulate bioreactor landfills	Brown & Caldwell
Reinhart, Debra R. (PI), Chopra, Manoj B. (CoPI)	Design and Operational Issues Related to the Co-disposal of Sludges and Biosolids in Class I Landfills	Develop guidance on the operational procedures necessary to safety landfill water and wastewater residuals	University of Florida-FCSHWM
Reinhart, Debra R. (PI), Chopra, Manoj B. (CoPI)	Design and Operational Issues Related to the Co-disposal of Studies and Biosolids in Class I Landfills- Phase II	Investigate the best practices for application of biosolids in the field	University of Florida-FCSHWM
Reinhart, Debra R. (PI), Chopra, Manoj B. (CoPI)	Design and Operational Issues Related to the Co-Disposal of Sludges and Biosolids in Class I Landfill	Develop guidance on the operational procedures necessary to safely landfill water and wastewater residuals; a related geotechnical study of the overall stability of the landfill resulting from the addition of residuals is also a major goal	University of Florida-FCSHWM
Reinhart, Debra R. (PI), Randall, Andrew A. (CoPI)	Optimization of Ferrate Use for Municipal and Industrial Water and Wastewater Treatment	Determine if ferrate is an effective biocide for bilge water and an effective oxidant for other water treatment processes	UCF/I-4
Reinhart, Debra R. (PI), Randall, Andrew A. (CoPI), Walters, Linda J. (CoPI)	Laboratory-Scale Investigation of Ballast Water Treatment Using Ferrate	Introduction of non-indigenous species into marine ecosystems by the shipping industry is caused by species carried on ship hulls and in ballast water into new marine environments; ferrate offers a cost-effective, highly efficient means of removing these nuisance species from ballast water on board	Gulf Coast Hazardous Substance Research Center
Reinhart, Debra R. (PI), Walters, Linda J. (CoPI), Randall, Andrew A. (CoPI)	Laboratory-scale Investigation of Ballast Water Treatment Using Ferrate	Conduct a laboratory-scale investigation of the effectiveness of ferrate to eliminate phytoplankton, microorganisms, and zooplankton from ship ballast water and to optimize the process with respect to efficiency, cost, and implementation	Ferrate Treatment Technologies, LLC
Shieh, Chih-Shin (PI), Reinhart, Debra (Co-PI)	Use of Ferrate (Iron VI) for Pond Water Managemet – Discharge or Reuse	The primary objectives of the proposed study are (1) to investigate a methodology of applying ferrate (iron VI) to pond water of phosphoric acid process origin for surface water discharge practice, and (2) to determine if the application of ferrate (iron VI) to pond water can meet the criteria for reuse in the phosphoric acid process; the effectiveness of removal of selective elements from pond water by means of ferrate (iron VI) application will be examined; elements of interest will be selected from primary constituents of pond water, including P (as PO43-), SO42-, F, Si, NH4-N, Na, Mg, Ca, K, Fe, Al, and Cl, as identified by other researchers (Kennedy et al., 1992; FIPR 2005); the economics of using liquid ferrate, generated on site will be compared to traditional treatment schemes currently in use, such as the double liming approach	Florida Institute of Phosphate Research

For more information on any of these projects, visit ***www.research.ucf.edu***

BEYOND THE LAB

NAME:
Robert Reiss, P.E.

TITLE/COMPANY:
Founder and President,
Reiss Environmental Inc. (REI)

EDUCATION:
Ph.D., Environmental Engineering, University of Central Florida
M.S.E., Environmental Engineering, University of Central Florida
B.S.E., Environmental Engineering, University of Central Florida, Cum Laude

ABOUT THE COMPANY:
Reiss Environmental, Inc. (REI) provides water and wastewater professional engineering services to clients locally, nationally and abroad. The firm specializes in water processing solutions by using its in-depth knowledge of conventional and advanced treatment processes, membrane piloting and treatment, process optimization, water chemistry, and regulatory requirements.

SPECIFIC AREAS OF TECHNOLOGY EXPERTISE:
- Regulatory compliance/permitting effectiveness
- Water quality, chemistry and treatment
- Advanced water treatment processes
- Membrane treatment
- Pilot study facilitation
- Master planning
- Water/Wastewater treatment preliminary and final design
- Reclaimed water implementation
- Hydraulic modeling/GIS conversion

TECHNOLOGY AND ITS IMPACT:
Advanced water and wastewater treatment plays an important role not only in protecting and preserving natural water resources but also in exploring alternative water supplies to meet future water demands. In particular, advanced water/wastewater treatment processes assist in improving the quality of potable drinking water and wastewater treatment. Increased groundwater withdrawals and improper disposal of wastewater produced every day could impact water bodies (such as lakes, springs, and wetlands), wildlife and other important environmental resources.

While at one time, only approximately one percent of the earth's water was available for drinking, advanced water treatment expertise and technologies have expanded this availability. Exploration of alternative water supplies, including brackish groundwater, brackish surface water and seawater, is necessary for meeting future water demands. These alternative water sources must be treated in order to remove minerals, such as salt, to produce potable water. Pressure-drive membrane processes including reverse osmosis and nanofiltration are used for this purpose.

THE FUTURE OF THIS INDUSTRY:
The future will be shaped by increased global demand for water resources, scarcity of natural resources, continued industry consolidation, increased public health awareness, the need to meet regulatory requirements, and increased municipal privatization and industrial outsourcing. These industrial trends will demand professionals in the field to focus on issues such as greater water reuse, new and improved treatment technologies, conservation and more efficient usage of valuable natural resources to provide cost-effective treatment solutions and address regulatory requirements.

NAME:
Jacqueline Quinn

TITLE/COMPANY:
Environmental Engineer, Technology Implementation Directorate,
Applied Sciences Division,
NASA Kennedy Space Center

EDUCATION:
Ph.D. Environmental Engineering, University of Central Florida
M.S., Environmental Engineering, University of Central Florida
B.C.E., Environmental Engineering, Georgia Institute of Technology

DEPARTMENT SPECIALTY:
The department is responsible for the development of applied technologies in support of the nation's vision for exploration. The applied technology directorate specializes in mid-level technology readiness level development activities in the areas of launch vehicle and spacecraft processing and also develops technologies required for future long-duration human missions to the moon and Mars.

SPECIFIC AREAS OF TECHNOLOGY EXPERTISE:
- Environmental Cleanup – Like most federal agencies, NASA is in the process of restoring land it owns that was contaminated prior to the establishment of the U.S. Environmental Protection Agency and the subsequent guidelines the EPA established to protect natural resources. Quinn had the opportunity to work on new science related to the cleanup of chlorinated solvents and metals in groundwater and soil.

TECHNOLOGY AND ITS IMPACT:
Quinn has been involved with the development and deployment of three technologies targeting groundwater cleanup that have been issued U.S. patents and three technologies which are U.S. Patent Pending. These technologies, in order of development, include the use of ultrasound within a zero-valent iron permeable treatment barrier, a deep barrier emplacement technique, emulsified zero-valent iron for solvent or metals cleanup, emulsified zero-valent metal for soil remediation and several emerging technologies aimed at removing polychlorinated biphenyls from either natural media or structural components. All of these technologies have the ability to impact a large sector of the public by minimizing or eliminating potential health hazards from drinking water resources.

THE FUTURE OF THIS INDUSTRY:
The science surrounding environmental cleanup is relatively young and immature. We are only now beginning to understand the complexities surrounding the removal and treatment of specific contaminants in an aquifer or surface water system. Therefore, there is significant growth and research potential in this field. With a huge decline in student enrollment in the environmental engineering field over the last five years within the U.S., employment opportunities in the future should be excellent for those who are seeking this degree now.

Q & A

with JAMES TAYLOR

SINCE 1975, PROFESSOR JAMES TAYLOR has conducted water treatment research that has been awarded more than $10 million in grants. He is the director of UCF's Environmental Systems Engineering Institute, leader of the UCF Membrane Focus Group and holds the Alexander Chair for Civil and Environmental Engineering. He is recognized worldwide for his expertise in drinking water treatment.

Q: The United Nations is calling the suffering and loss of life associated with clean water shortages a crisis. Florida Gov. Jeb Bush has used the same term to describe the depletion of Florida's natural water supplies. Can you briefly describe the problem?

Florida has historically used groundwater for drinking water supply, and today 92 percent of our drinking water supply comes from the ground such that we are taking water from the ground faster than it is naturally being restored. Hence, we are mining groundwater in Florida. We have to use conservation, alternate water sources and reuse to meet our future water needs. Consequently, new technologies will have to be developed and implemented to successfully integrate drinking waters produced from alternate sources into our current supply.

Q: What do Floridians in particular need to know regarding the availability of clean water?

That technology is available to make any source of water as clean as needed. The question is not quantity but what is the cost for producing the quality that is currently required, and that will be required in the future.

Q: What changes can we expect to see in water availability in the next decade? The next 25 years?

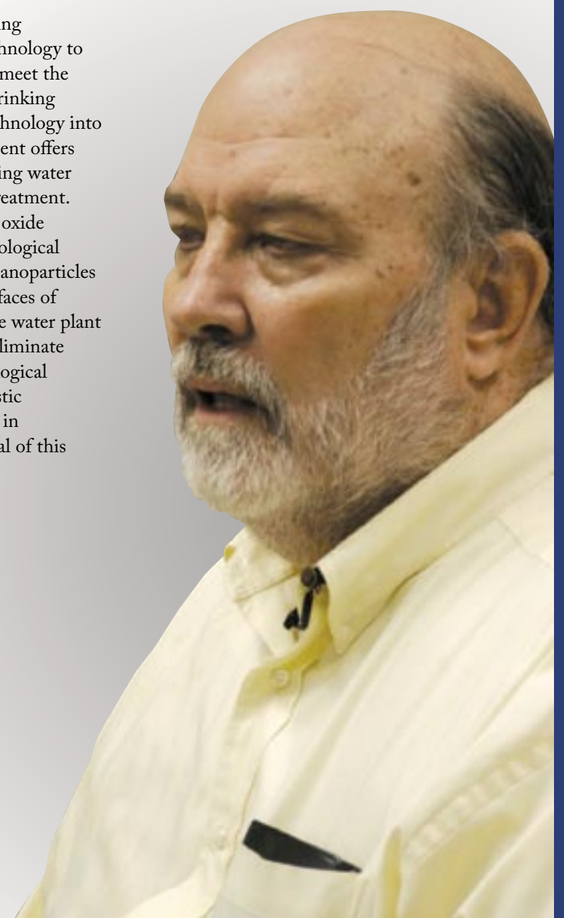
We can expect to see drinking water produced from surface waters, such as the St. Johns River and the associated lakes, and the Atlantic and associated brackish waters, integrated into our supplies. Correspondingly, the water requirements will increase, and the impact of using alternate sources and better technology will require the cost to increase.

Q: Will the purchase of drinking water become a given?

It is what we do now. The cost of drinking water will increase and the sources (surface, ocean, brackish, wastewater, stormwater) for drinking water will increase. As the cost increases it is highly likely that more private companies will begin to supply water to consumers or utilities, hence, purchase at a higher cost is a given.

Q: How is the research being conducted at UCF helping to alleviate these water issues?

At UCF, we are optimizing existing processes for developing new technology to treat alternate water sources and meet the ever-tightening regulations for drinking water. The integration of nanotechnology into existing methods of water treatment offers tremendous potential for improving water supply, water quality and water treatment. For example, the combination of oxide nanoparticles can help control biological growth on surfaces. Using such nanoparticles on membrane surfaces or the surfaces of pipes transporting water from the water plant to the consumers can reduce or eliminate membrane fouling and microbiological regrowth or release of opportunistic pathogens or problem organisms in distribution systems. The potential of this technology is nearly unlimited.



"Florida has historically used groundwater for drinking water supply, and today 92 percent of our drinking water supply comes from the ground such that we are taking water from the ground faster than it is naturally being restored. Hence, we are mining groundwater in Florida. We have to use conservation, alternate water sources and re-use to meet our future water needs. "

James Taylor
Alexander Professor of Civil and Environmental Engineering
Director, UCF Environmental Systems Engineering Institute