



## EED NEWSLETTER

ENVIRONMENTAL ENGINEERING features the Application of ENVIRONMENTAL Technologies to ENGINEERING Systems to attain OPTIMAL Performance according to ESTABLISHED Standards.

The Newsletter of the Environmental Engineering Division (EED) will attempt to highlight a Variety of Environmental Technology Applications aimed at Enhancing Engineering Systems Performances in accordance with the Latest Standards by presenting Excerpts of and Links to Selected Articles from a Variety of Websites. EED Members are encouraged to forward materials on Environmental Engineering topics for review by the Newsletter Editorial Staff. EED Newsletter Readers are urged to forward comments on materials that appear in its content.

The EED Newsletter will feature presentations in **Seven** Sections:

1. ENVIRONMENTAL TECHNOLOGIES
2. ENVIRONMENTAL REGULATIONS
3. EDITORIAL BOARD SELECTIONS
4. EED CHAIRMAN/DIVISION NEWS
5. NEWSLETTER READER COMMENTS
6. EDITORIAL BOARD MEMBERS
7. NEWSLETTER ARTICLE REFERENCES

It is envisioned that the EED Newsletter will be Monthly enterprise involving ALL members of the EED in its production. Your participation in providing and reviewing EED Newsletter materials will be greatly appreciated.

## 1. ENVIRONMENTAL TECHNOLOGIES

### BETTER BATTERIES – 1

A glassy solid-state electrolyte (SSE) developed by researchers from the University of Texas at Austin will aid in the evolution of safer, longer-lasting rechargeable batteries. A major concern with the use of lithium- and sodium-ion batteries is the formation of dendrites, which can interfere with liquid and crystalline electrolytes, causing battery short-circuits or worse - explosions and fires.



## 1. ENVIRONMENTAL TECHNOLOGIES

### **BETTER BATTERIES - 1**

UT's glassy electrolytes are non-flammable and allow for homogenous plating on the cathode and anode, which eliminates the formation of dendrites. Furthermore, the electrolyte will not oxidize at the voltages needed to charge and discharge the electrodes that are currently available on the market. Simplified battery-cell fabrication, high volumetric energy density and faster rates of recharge are among the benefits of the glass-electrolyte battery systems. (Ref 1)

### **STOPPING LEAKS BEFORE THEY HAPPEN**

In much of the world, aging infrastructure causes cities to lose a staggering amount of water to leakage before it can ever reach a home or business. In 2014, it was reported that a sixth of America's treated water volume is lost to leakage - a total of 2.1 trillion gallons annually.

Aquarius Spectrum is a startup located just north of Tel Aviv, Israel. Founded in 2009, the company develops both sensors and software that can work together to monitor a water utility's pipe system and send alerts at the very moment a leak starts to develop. Every night at the same time, Aquarius sensors take acoustic measurements and then send them to a cloud server. The company's software then uses correlation in order to determine the distance of a leak from a sensor.

By analyzing these sounds, Aquarius Spectrum technology can pinpoint the location of a leak with an average deviation of 1 percent. In other words, if a leak is determined to be 100 feet away from a sensor, Aquarius Spectrum claims that in the end, an underground leak's location will be off by only one foot at most. As Aquarius CEO, Oded Fruchtman stated: "When you can find leaks that accurately, you don't have to react in an emergency manner" (Ref 2)



## 1. ENVIRONMENTAL TECHNOLOGIES

### BETTER BATTERIES - 2

Researchers at The City College of New York (CUNY) announce the development of a novel low cost, rechargeable, high energy density battery that makes the widespread use of solar and wind power possible in the future. It is based on manganese dioxide ( $MnO_2$ ) - an abundant, safe and non-toxic material. The CUNY scientists report that the uniqueness of the battery is that it is able to achieve both high cycle life and high areal capacity. Achieving high areal capacity is critical for packing many battery electrodes together into a battery case. Essentially, a high areal capacity is required to build a real, practical battery, as opposed to a small toy battery.

Past researchers have achieved either high cycle life or high areal capacity, but never both together. The innovation that made this possible in the CUNY work is intercalating copper (Cu) into bismuth-modified  $\delta$ - $MnO_2$ , which is called birnessite. Birnessite was discovered by the Ford Motor Company in the 1980s but it was never known how to use it at high areal capacity until now. The battery is intended for use at the scale of the power grid. This would make widespread use of solar and wind power possible. (Ref 3)

### FROM BIRNESSITE IN THE 1980'S TO BAMBOO IN THE 2010'S

Ford Motor Company is tinkering with the idea of using bamboo as a raw material. The company's Asia-Pacific division says it is working with suppliers to evaluate the viability of bamboo for both upholstery and plastic car parts.

Ford's research team concluded that bamboo performs much better than other natural and synthetic fibers when it is subjected to extreme heat, as well as in impact and tensile strength tests. Ford's research on bamboo products is happening at its research and engineering center in Nanjing, China. (Ref 4)



## 1. ENVIRONMENTAL TECHNOLOGIES

### **BETTER BATTERIES - 3**

Yale scientists have developed an ultra-thin coating material that has the potential to extend the life and improve the efficiency of lithium-sulfur batteries, one of the most promising areas of energy research today. Researchers describe the new material as a dendrimer-graphene oxide composite film that can be applied to any sulfur cathode - the positive terminal on a battery.

According to the researchers, sulfur cathodes coated with the material can be stably discharged and recharged for more than 1,000 cycles, enhancing the battery's efficiency and number of cycles. The developed film is so thin and light it will not affect the overall size or weight of the battery, and thus it will function without compromising the energy and power density of the device."

New types of electrodes -- positive and negative terminals -- are considered essential for the development of a new generation of high energy-density batteries. As lithium-ion batteries begin to reach their capacity limits, many researchers are looking at lithium-sulfur as a solution. Sulfur is both lightweight and abundant, with a high theoretical energy capacity. However, existing lithium-sulfur battery technology suffers from a loss of capacity during cycling. (Ref 5)

### **BETTER BATTERIES - 4**

When lithium-based rechargeable batteries were first developed in the 1970s, researchers used lithium metal for the negative electrode, called an anode. Lithium was chosen because it has ten times more energy storage capacity than graphite. Problem was, the lithium-carrying electrolyte reacted with the lithium anode and caused microscopic lithium nanoparticles and branches called dendrites to grow on the anode surface, and led the early batteries to fail.



## 1. ENVIRONMENTAL TECHNOLOGIES

### **BETTER BATTERIES - 4**

Thinking today's rechargeable lithium-ion batteries with graphite anodes could be near their peak energy capacity, the DOE Pacific Northwest National Laboratory (PNNL) looked at the older design with lithium metal as an anode. The electrolytes PNNL produced resulted in a battery that was super-efficient but charged slowly and could not work in higher-voltage batteries or a faster-charging battery that was unstable and had low voltages.

PNNL next tried adding small amounts of a salt that is already used in lithium-ion batteries - lithium hexafluorophosphate - to their fast-charging electrolyte. They paired the newly juiced-up electrolyte with a lithium anode and a lithium nickel manganese cobalt oxide cathode. It turned out to be a winning combination, resulting in a fast, efficient, high-voltage battery. The additive produced a 4.3-volt battery that retained more than 97 percent of its initial charge after 500 repeated charges and discharges while carrying 1.75 mA of electrical current per square centimeter of area. It took the battery about one hour to fully charge. (Ref 6)

### **FILTERING THE SALT OUT OF SALT-WATER**

Graphene-oxide membranes developed at the National Graphene Institute have already demonstrated the potential of filtering out small nanoparticles, organic molecules, and even large salts. Until now, however, they could not be used for sieving common salts used in desalination technologies, which require even smaller sieves. Previous research at The University of Manchester found that if immersed in water, graphene-oxide membranes become slightly swollen and smaller salts flow through the membrane along with water, but larger ions or molecules are blocked.



## 1. ENVIRONMENTAL TECHNOLOGIES

### **FILTERING THE SALT OUT OF SALT-WATER**

The Manchester-based group has now further developed these graphene membranes and found a strategy to avoid the swelling of the membrane when exposed to water. The pore size in the membrane can be precisely controlled to sieve common salts out of salty water and make it safe to drink.

When the common salts are dissolved in water, they always form a 'shell' of water molecules around the salts molecules. This allows the tiny capillaries of the graphene-oxide membranes to block the salt from flowing along with the water. Water molecules are able to pass through the membrane barrier and flow fast. This is an ideal scenario for the application of these membranes to desalination.

Professor Rahul Nair, at The University of Manchester said: "Realization of scalable membranes with uniform pore size down to atomic scale is a significant step forward and will open new possibilities for improving the efficiency of desalination technology. We also demonstrate that there are realistic possibilities to scale up the described approach and mass produce graphene-based membranes with required sieve sizes." (Ref 7)

### **SWEET BIODIESEL FROM SUGARCANE**

A team led by the University of Illinois (UI) has proven that sugarcane can be genetically engineered to produce oil in its leaves and stems for biodiesel production. Surprisingly, the modified sugarcane plants also produced more sugar, which could be used for ethanol production.

The dual-purpose bioenergy crops are predicted to be more than five times more profitable per acre than soybeans and two times more profitable than corn. More



## 1. ENVIRONMENTAL TECHNOLOGIES

### **SWEET BIODIESEL FROM SUGARCANE**

importantly, sugarcane can be grown on marginal land in the Gulf Coast region that does not support good corn or soybean yields.

"Instead of fields of oil pumps, we envision fields of green plants sustainably producing biofuel in perpetuity on our nation's soil, particularly marginal soil that is not well suited to food production," said Stephen Long, the Gutgsell Endowed Professor of Plant Biology and Crop Sciences at UI. Long leads the research project Plants Engineered to Replace Oil in Sugarcane and Sweet Sorghum (PETROSS) that has pioneered this work at UI. (Ref 8)

### **A REUSABLE OILY SPONGE?**

When the Deepwater Horizon drilling pipe blew out seven years ago, beginning the worst oil spill in U.S. history, those in charge of the recovery discovered a new wrinkle: the millions of gallons of oil bubbling from the sea floor were not all collecting on the surface where it could be skimmed or burned. Some of it was forming a plume and drifting through the ocean under the surface.

Now, scientists at the U.S. Department of Energy's (DOE) Argonne National Laboratory have invented a new foam, called Oleo Sponge that addresses this problem. The material not only easily absorbs oil from water - it is also reusable and can pull dispersed oil from the entire water column -- not just the surface.

In tests at a giant seawater tank at the National Oil Spill Response Research & Renewable Energy Test Facility in New Jersey, the Oleo Sponge successfully collected diesel and crude oil from both below the surface and on the water surface. (Ref 9)



## 1. ENVIRONMENTAL TECHNOLOGIES

### **SPYING ON PIPELINES WITH DRONES**

A new Canadian aerospace company has developed an unmanned aircraft systems (UAS) specifically targeted for the oil and gas industry. Based in the Toronto, Ontario, area, SkyX was founded by Didi Horn, a former Israeli Air Force captain. The company's SkyOne vertical-takeoff-and-landing (VTOL) drone was specifically designed for pipeline inspections, mapping and security surveillance.

The SkyOne drone can travel at 90 miles per hour for 70 min while detecting leaks, vandalism, vegetation encroachment and other potential problems. Unlike other drones, SkyOne can recharge in the field. The drone flies to the nearest available remote, autonomous station where it recharges in a weather-shielded dome before continuing its mission.

Currently, the oil and gas sector relies primarily on road vehicles, helicopters and other manned aircraft to detect damage and threats to pipelines—an estimated \$37 billion annually for monitoring expenses. SkyX said SkyOne allows for unlimited data collection 24 hours a day in real-time and offers users a far wider scope of information. (Ref 10)

## 2. ENVIRONMENTAL REGULATIONS

### **MARYLAND PASSES AMERICA'S FIRST TAX CREDIT FOR ENERGY STORAGE**

Tax credits for renewable energy projects, such as solar and wind installations, cheer clean-technology advocates and flummox opponents. While recent advances in design helped these technologies generate renewable power far more efficiently and cheaply, it is hard to argue against the role tax credits and other financial incentives played in giving these new sources of power a lift.



## 2. ENVIRONMENTAL REGULATIONS

### **MARYLAND PASSES AMERICA'S FIRST TAX CREDIT FOR ENERGY STORAGE**

Maryland is the first state in the U.S. to pass legislation that will provide tax credits to consumers that invest in energy storage systems. Senate Bill 758 will offer a 30 percent tax credit on the costs of installing an energy storage system between New Year's Day of 2018 and the end of 2022.

Any system that can store electrical power for use at a later time or to offset electricity generation at peak times will be eligible in Maryland's program. The bill is now waiting for Gov. Larry Hogan's signature. The legislation passed an overwhelmingly Democratic legislature, but its unanimous passage in the state Senate and the 101-11 approval in the House make a veto by the Republican governor highly unlikely. Could other states follow suit and boost the proliferation of products such as Tesla's [Powerwall](#) to the point that they become a familiar sight in homes and offices? (Ref 11)

## 3. EDITORIAL BOARD SELECTIONS

### **PEBBLE BED REACTORS THAT ROCK**

X-Energy, LLC announced that it has held a Conceptual Design Readiness Review to prepare for a future licensing of its Xe-100 High Temperature, Gas Cooled PEBBLE BED Modular Reactor. The Xe-100 Modular Reactor uses tennis ball-sized pebbles composed of thousands of TRISO micro-fuel U-235 particles (Ref 12) that are surrounded by graphite shells. A gas that does not react with the fuel pebbles cools the pebbles that create the reactor core. As the pebbles are used, they drop out of the bottom of the core and are replaced from above so that the reactor does not need to shut down to refuel.

### 3. EDITORIAL BOARD SELECTIONS

#### PEBBLE BED REACTORS THAT ROCK

Because the reactor is designed to handle high temperatures like 1,600°C, it can be cooled by natural circulation and still survive any accident. High temperatures also provide higher thermal efficiencies and more power per unit of fuel than traditional reactors that operate near 400°C.

The Xe-100 reactor has an additional feature in that the gases in the core do not absorb neutrons as water does, so the core has almost no radioactive fluids. Last year, the United States Department of Energy awarded X-energy a five-year \$53 million Advanced Reactor Concept Cooperative Agreement to move the Xe-100 development forward. (Ref 13)

(CONTRIBUTED BY DR. JAMES ZUCCHETTO, EED NEWSLETTER ASSOCIATE EDITOR)

### 4. CHAIRMAN/DIVISION NEWS

On behalf of the ASME Environmental Engineering Division, we would like to formally invite you to participate in the EED Panel Discussion during the Power Conference to be held at the Charlotte Convention Center, Charlotte, NC during the week of June 26-30, 2017. Potential Topics are:

- Status of the Clean Power Plan in National Policy
- Emissions/Waste Reduction in Carbon Capture/Storage (CCS) Units
- Permitting (Multi-Media) in CCS Units at Power Plants
- Water Conservation Developments in Power Plants
- Role of ASME Codes & Standards in Environmental Regulations
- Environmental Impacts and Mitigation of Renewable Energy Sources



## 5. EED NEWSLETTER READER COMMENTS

**YOU ARE ENCOURAGED TO FORWARD YOUR COMMENTS ON THE TOPICS AND DISCUSSIONS PRESENTED IN THE EED NEWSLETTER. PLEASE FORWARD YOUR COMMENTS BY EMAIL TO ANY MEMBER OF THE EED NEWSLETTER EDITORIAL BOARD. THEIR EMAIL ADDRESSES APPEAR IN THE SECTION BELOW.**

## 6. EED NEWSLETTER EDITORIAL BOARD

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