



ENERGY PIPELINE

COVERING THE ENERGY INDUSTRY IN THE ROCKY MOUNTAIN REGION

BOOM
or
~~Bust~~

WELD COUNTY IS
ON TRACK TO TOP
100 MILLION
BARRELS OF OIL
PRODUCTION IN 2015

ELECTRIC EXPERIMENT

Northern Colorado chosen as
site of electric vehicle program

FILLING THE GAP

Construction industry
picks up lost oil, gas jobs

NATURAL FRACKING

U.S. Well Services brings
Clean Fleet to Weld County

NOV | VOL 3 | ISSUE 3

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TECH TALK

WATER POWERED LED LANTERN AND USB PORT

BY GARY BEERS • FOR ENERGY PIPELINE

DID YOU KNOW that a glass of produced water can provide electricity to power a LED lantern or a USB device for eight hours?

When produced water (350 ml) from an oil well in Colorado is poured into the lantern, immediately the array of 10 LED (Light-Emitting Diode) lights came on (Figure 1). Also, the lantern's USB connection can be used to power a cell phone or laptop computer. The 1.5 volts of DC power is enough to generate 55 lumens of light and 4.5 volts for charging USB devices. The lantern will operate for eight hours before the water in the internal tank must be replaced. The internal rod needs to be replaced after 120 hours of operation.

CLEVER APPLICATIONS OF ANCIENT SCIENCE

The scientific principle behind this device has been known for centuries; that is, electricity is produced when two different connected metals are submerged in an electrolyte. The lantern uses salty water as the electrolyte, a magnesium rod as an anode, and a carbon rod as a cathode. The magnesium rod is slowly destroyed by electrolysis as the magnesium ions travel to the carbon rod, generating electricity.

While seawater-activated batteries have been widely used for life-jacket lights, ocean-buoy beacons and undersea applications for more than a century, there is a recent breakout of new applications by entrepreneurs in Japan and other western Pacific countries.

These applications have focused on low-tech, emergency sources of light since many areas (such as the 7,000 islands of the Philippines) have no access to electricity and life stops after dark. Further, many people in Japan have sought portable, reliable light sources after the devastating Tohoku earthquake and tsunami in 2011. Examples of the novel, very effective, low-tech devices for furnishing light for individuals are:

GREEN HOUSE SALT WATER POWERED LED LANTERN

(shown in Figure 1)

CAPABILITIES

Power lantern (55 lumens)
USB devices (4.5 volts)

DURATION

Replace anode every 120 hours
Replace seawater every 8 hours

COST \$41 **COUNTRY** Japan

WEBSITE www.japantrendshop.com/green-house-salt-water-powered-led-lantern-p-1504.html

SALT* LAMP

(*Sustainable Alternative Lighting)

CAPABILITIES

Power lantern (90 lumens)
USB devices

DURATION

Replace anode every 120 hours
Replace seawater every 8 hours

COST \$35 (Projected, available late 2015)

COUNTRY Philippines

WEBSITE www.salt.ph/



For over 50 years, **GARY BEERS**, has worked in numerous fields of environmental science as a consultant, regulator and educator. This career included senior management position with major consulting, nonprofit and public organizations. He has founded several successful firms to capture emerging resource management markets. One of his latest ventures, EnviroScienceINFO, provides content for public media.



Table 1. TDS Ranges of Produced Water				
TDS (mg/l)	Wells		Water Classification	
	Number	Percentage of Total Wells	Type	Percentage of Total Wells
Less than 5,000	534	26.73	Fresh (<1,000)	79
			Brackish (1,000 - 5,000)	
5,000 - 10,000	370	18.52	Highly Brackish (5,000 – 15,000)	
10,000 - 20,000	477	23.87	Saline (15,000 – 30,000)	
20,000 - 30,000	204	10.21	Seawater	5
30,000 - 40,000	99	4.95		
40,000 - 50,000	53	2.65		
50,000 - 60,000	45	2.25		
60,000 - 70,000	50	2.50		
70,000 - 80,000	17	0.85	Brine	16
80,000 - 100,000	29	1.45		
More than 100,000	120	6.01		
Source of TDS and well data : "Produced Water Quality Characterization and Prediction for Wattenberg Field", H. Li, MS Thesis, Colorado State University, 2013				

For comparison with another "green" lantern, a solar-powered, portable light with USB port is:

SUN KING PRO AN

CAPABILITIES

Power lantern (100 lumens)
USB devices (5.5 volts)

DURATION

45 hours of light on one day's charge

COST \$50

COUNTRY India

WEBSITE store.greenlightplanet.com/products/sun-king-pro

Finally, for a larger power source, there is a portable, 12-volt seawater-powered battery made for boaters and campers.

ENVIRO-GEN 12 SALTWATER GENERATOR

CAPABILITIES

Lighting (1.5-12V), Radio (6V)
Navigation gear (12V), CD player (9V)

DURATION

Replace anodes every 100 hours

COST \$130

COUNTRY USA

WEBSITE dragonet.com/fhp/

PRODUCED WATER QUALITY

For produced water to work as a replacement for seawater in the above devices, the salt concentrations (i.e., total dissolved solids, TDS) must be essentially the same as seawater or higher. Based on representative data from Colorado (Table 1), produced water from about 21 percent of the oil/gas wells is a suitable replacement electrolyte.

Finally, the sample of produced water used to test the lantern (Figure 1) is from an oil well in western Colorado which has a TDS level of 305,000 mg/l, which is about 10 times the salinity of seawater. On this basis, produced water with a TDS of 30,500 will operate the lantern for the expected 8 hours. The lantern will light up when filled with produced water with a lower TDS (i.e., 7,500 mg/l), which is more representative of the majority of produced waters. However, the lantern will provide light for less than 8 hours due to the lower concentrations in the electrolyte. ♦





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