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Research Highlights . . .

DOE Pulse

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Bugs in a bottle

Researchers at DOE's National Energy Technology Laboratory successfully sustained a population of bacteria that produces almost as much as their containment vessel's volume, in hydrogen, every day. Tested for over 45 days in a 10 liter bioreactor, the bacteria, Thermotoga neapolitana, produced an estimated 8 liters of hydrogen in 24 hours. This unusual thermophilic (heat-requiring) strain converts sugar into hydrogen with nearly 100 percent efficiency. Tests were conducted with pure sugar—a standard that allows comparisons to results of similar research. However, NETL researchers have established that a wide range of sugar and carbohydrate food sources, including organic wastes, would be practical as feedstock.

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Fermilab Tevatron sets new luminosity record

On July 26, the chances that a proton would collide with an antiproton at DOE's Fermilab reached an all-time high. That chance is determined by luminosity, or beam brightness, which is achieved by squeezing as many particles as possible into as small a space as you can. The higher the luminosity, the greater the chance for physics discoveries. The new record, set during Run II of the Tevatron , is 2.64E31 (2.64 x 10<supercase>31) protons per square centimeter per second, an improvement over the previous record—set in 1995—of 2.50E31. Fermilab hopes to push the Tevatron's luminosity even further in the next few months, and has set a goal of 4.00E31 by October 1.

[Pamela Zerbinos, 630/840-2237, zerbinos@fnal.gov]

'Lite' done right

Better performance for less hassle that's the advantage of Ames Laboratory's new message-passing library, MP_Lite. The innovative library can extract optimum performance from both workstation and personal computer clusters, as well as from large massively parallel computers. It supports and enhances the basic capabilities that most software programs require to communicate between computers. MP_Lite is a "slimmed-down," user-friendly version of the more complex message-passing interface standard, MPI. Although it can be scaled up easily, MP_Lite offers only the core MPI functions, implementing them in the most efficient manner to provide all the performance without all the extras.

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Sniffing out chemical dangers

A "microelectronic nose" that sniffs out chemical poisons, including non-lethal concentrations of cyanogen chloride and hydrogen cyanide gases, has been developed by DOE's Argonne National Laboratory. Part of the homeland security effort, the palm-sized instrument can also be used to detect VX, sarin and mustard gases. The ceramic-metallic sensor arrays, which are smaller than postage stamps and can be integrated into personal monitors, identify "fingerprints" given off by chemicals in contact with the sensors. Each chemical changes the electrical resistance of the detector's components, allowing a computer to pass small amounts of chemicals over the sensors and determine the presence and concentration of each chemical.

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DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Fast glass!

Researchers at DOE's Pacific Northwest National Laboratory and the Savannah River Technology Center have developed a new formula for vitrifying radioactive waste that will allow more waste to be incorporated into each batch of glass and will produce the glass faster. These improvements may significantly reduce the price of vitrifying waste, an integral part of cleaning up the nation's nuclear waste.

"This work is an excellent example of the benefits of working together in teams across laboratory boundaries. The impact of this change will save taxpayers money with low operational risk," said PNNL researcher John Vienna.

A new formula for vitrifying radioactive waste that produces waste faster and more efficiently may significantly reduce the cost of vitrifying nuclear waste.

Scientists at PNNL and SRTC studied the details of the glass-melting process and applied glass property models to develop a new frit, the glass-forming material used in vitrification. The largest waste vitrification plant in the world, the Defense Waste Processing Facility at Savannah River, is currently mixing highly radioactive waste with Frit 200. The mixture is heated until molten and then poured into canisters, which can be disposed of in a federal geologic repository. Although Frit 200 produces excellent glass, it takes a long time for the high-level waste sludge at Savannah River and the frit mixture to melt into glass.

In small-scale melter tests, the new formula, Frit 320, and the waste melted into glass 20 percent faster than mixtures with the current Frit 200. This improvement in the melt rate will save about $1.6 billion. Frit 320 also allows more waste to be incorporated into the glass when combined with a new technology developed by SRTC and is expected to yield significantly higher melter throughput. Each percent of waste loading improvement will save about $300 million.

The Defense Waste Processing Facility at the Savannah River Site in South Carolina has incorporated Frit 320 into its operating plans for the future.

Submitted by DOE's Pacific Northwest National Laboratory

Stadler enjoys challenge of new INEEL geocentrifuge

Alan Stadler

Alan Stadler joined the DOE's Idaho National Engineering and Environmental Laboratory in February 2002 as the principal investigator for the Subsurface Science Initiative's (SSI) new two-meter Geocentrifuge Research Laboratory. Stadler said he was drawn to the position by the startup nature of the SSI program and the chance to set up a new geocentrifuge.

"A two-meter geocentrifuge doesn't come online every day...or even every decade," he said. "It's rare for a scientist to be given a blank slate like this. It's a once-in-a-career opportunity."

Stadler's role includes developing the physical infrastructure of the new facility, and initiating and facilitating research activities, especially in the area of caps and barriers. "One of my jobs will be to reach out to the broader research community to make this a true user facility," said Stadler. "Having a large geocentrifuge in the Northwest is a great resource, particularly for regional universities. It is important to get the word out. I would like to see a lot of peer-reviewed publications produced as a result of this resource."

The two-meter centrifuge has a load capacity of 50 times the force of gravity for a one-ton payload. This means, for example, that it can rotate one-half ton at 100 g's. Since fluid flow is affected by the g-force induced, 1 hour in the geocentrifuge simulates about 14 months of time, or about 10,000 hours. In effect, the centrifuge simulates an accelerated passage of time for the sample material, enabling researchers to study in a few days or weeks the effects of tens of years of gravity-induced fluid movement.

Stadler's primary area of expertise is geotechnical engineering. He is a registered Professional Engineer in both North and South Carolina and has more than seven years of consulting engineering experience.

Submitted by DOE's Idaho National Engineering and Environmental Laboratory