

CORPORATE & TECHNOLOGY

AVS TESTIFIES AT CONGRESSIONAL HEARING



Courtesy: Committee on Science, Space & Technology

Algaeventure Systems (AVS) was invited to testify at a Congressional Hearing on Harmful Algal Blooms (HABs) on June 1, 2011 to discuss strategies for mitigating HABs in freshwater environments. AVS Chief Scientist Dr.

Stephanie Smith addressed the House Committee on Science, Space and Technology's Energy and Environment Subcommittee regarding a new piece of legislation that aims to develop a comprehensive national strategy for

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MULTINATIONAL WATER TECHNOLOGIES COMPANY FURTHER VALIDATES SLS AS A LOW-ENERGY TRANSFORMATIONAL TECHNOLOGY

SLS outperforms centrifuge in comparative analysis

A comparative analysis of microalgae dewatering technologies was conducted through the collaborative efforts of AVS and a multinational water technologies company. This study compared the energy cost and dewatering capabilities of a conventional centrifuge with those of AVS' novel Solid-Liquid Separation (SLS) and Rapid Accumulation & Concentration (RAC) technologies.

Results of the comparative analysis confirmed that the RAC and SLS dramatically outperformed the centrifuge, requiring far less energy to achieve a greater degree of dewatering with the *Scenedesmus dimorphus* and *Chlorella sp.* algal species. Even with a lower starting

concentration, the coupled performance of RAC and SLS was 19 times faster in terms of recovered biomass than the best centrifuge trial, while removing 8 times more water from the algae solution. In terms of process efficiency, the RAC and SLS are over 83 times more cost-effective than a centrifuge on a metric ton basis.

The results further validate the SLS'

Process	Energy Cost	Water Remaining After Dewatering
Centrifuge	\$3,400.00/ton	12,500 L
SLS	\$1.92/ton	5,555 L

Comparison conducted with 10-micron *Chlorella*

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selection as a transformative technology by the U.S. Department of Energy's ARPA-E. As a low-energy technology, the SLS not only has the opportunity to replace existing energy-intensive dewatering systems, but also enable dewatering applications that were not previously cost-effective. The evaluation is promising for the continued development and deployment of these technologies, demonstrating that pre-commercial, non-optimized SLS and RAC platforms outperform a centrifuge, the incumbent and generally accepted technology for dewatering micro-solids from dilute solutions.

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responding to and reducing HABs in coastal, marine and fresh waters.

HABs are increasing globally in both frequency and magnitude and pose a serious threat to human health as well as local economies that depend on afflicted waters for tourism, recreation and real estate revenue. A summer 2010 proliferation of cyanobacteria (blue-green algae) in Grand Lake St. Marys, Ohio's largest inland lake, caused the City of Celina \$60-80 million in lost revenue, as well as several cases of human and animal illness.

Dr. Smith shared her extensive experience with freshwater HABs and AVS' unique perspective as a developer of algal processing and remediation technologies to identify a number of key

considerations in creating a HAB action plan. Among these considerations is the need to bolster the knowledge

*“Addressing freshwater HABs will require a suite of technologies which must be developed at both the fundamental and applied levels.”
Dr. Stephanie Smith, Chief Scientist*

base and monitoring effort of freshwater HABs in inland lakes, as strategies for addressing marine HABs may not suit freshwater blooms.

A key point of Dr. Smith's testimony was the need to increase responsive-

ness to ongoing freshwater HABs with a strong focus on not only monitoring and prevention, but also control and mitigation after a HAB has taken hold. To address this need, AVS is continuing to test and develop technologies that can have a significant impact on a freshwater HAB once it has proliferated in a lake environment. “Far more appears to be known about monitoring and prevention of HABs than about control and mitigation,” explained Dr. Smith, “addressing freshwater HABs will require a suite of technologies which must be developed at both the fundamental and applied levels.”

Please visit science.house.gov to view an archived webcast of the congressional hearing.

THREE SLS LAB MODEL PURCHASE ORDERS

Following the commercial introduction of its SLS Lab Model, AVS has received purchase orders from the Ohio State University Food Industries Center (FIC), a multinational water technologies company, and a renewable energy company based in Hungary. These customers will be the first to receive the SLS Lab Model and evaluate its low-energy dewatering potential in a variety of applications from algae to food products. By deploying this sys-

tem early into a variety of markets, AVS will gain insight into new applications for which the SLS is an ideal dewatering method.

The SLS Lab Model was developed from the HDD platform technology, recognized by the U.S. Department of Energy's ARPA-E as a “potentially transformative innovation” for its ability to remove micro-solids from dilute solutions with very little energy. The SLS Lab Model is

waste effluent, livestock manure and chemical processing industries. “Our SLS technology opens the door to a wide range of low-energy solid-liquid separation applications with industrial

The SLS offers improved performance at a lower cost than a centrifuge across a wide range of markets.



ideal for universities and research institutes to conduct precise comparative analysis and explore technology scale-up opportunities. Offering improved performance at a lower cost than a centrifuge, the SLS Lab Model has demonstrated applications pharmaceutical, nutraceutical, bio-fuel, food, industrial

potential,” said CEO Ross Youngs. “We have developed the SLS Lab Model for researchers in all fields, allowing the identification of new methods in the lab that lead to greater success in production environments.”

For purchase inquiries or more information about the SLS Lab Model, please contact us at sales@algaevs.com or call 937-645-4618.

AVS ADDS CHIEF SCIENTIST AND PATENT ATTORNEY TO TEAM

AVS is pleased to welcome Dr. Stephanie Smith and Christopher Allen to the team. With extensive professional experience in distinct areas of expertise, these two new team members will greatly benefit AVS' technology development and commercialization efforts.

As the company's Chief Scientist, Dr. Smith will oversee the development of scientific programs and assist with the development of algal growth systems, processing equipment and related intellectual property. With over 15 years of hands-on experience in microbiology, biochemistry and metabolic engineering, Dr. Smith gained her expertise in microbial photosynthesis and carbon fixation as a doctoral candidate at The Ohio State University. Upon completion of her Ph.D. in Microbiology, she did her postdoctoral work at Battelle and went on to build an extramurally funded research program at Wright State University in Dayton, OH. Dr. Smith's professional projects have been at the interface of microbiology and engineering, where the two disciplines come together to solve complex problems in



bioprocessing, bioengineering, bioremediation, biodegradation and biodefection.

Dr. Smith will be a valuable addition to the AVS team as the company continues to develop and deploy novel technologies to grow and process biomass for the emerging algal industry.

As the company's first in-house intellectual property (IP) attorney, Mr. Allen will achieve four broad objectives: (1) capture and protect new developments created by AVS employees; (2) lever-

age AVS' current IP; (3) advise AVS on how to proceed with customers and developmental partners; and, (4) create and maintain an IP culture that is an efficient and productive sector of AVS. Many AVS technologies, including the US Department of Energy (ARPA-E) selected SLS technology, have patents applied for or pending and will benefit from Mr. Allen's expertise in developing an exclusive and defensible IP position. Mr. Allen will also assist AVS in technology licensing for "field of use" distribution.

Before Mr. Allen joined the AVS team, he was of counsel at Standley Law Group LLP in Dublin, OH where he practiced patent and copyright litigation around the country while also prosecuting patent applications before the United States Patent and Trademark Office.

To learn more about AVS' technology development or the expansion of the team, please contact us at contactus@algaevs.com.

3RD YEAR ANNIVERSARY

This past season, Algaeventure Systems is celebrated its third anniversary. In a very short period of time, AVS has made some remarkable steps as

a small business, from being selected by the Advanced Research Projects Agency to testifying before Congress. As AVS looks to the future, it is taking

a look back on the many notable milestones in its development and deployment of innovative technologies.

2008

- AVS founded in Marysville, Ohio
- Presentation of AVS vision to Ohio representatives, businessmen, academic and community leaders

2009

- Unveiling of SLS at Biomass Conference, Washington D.C.
- ARPA-E award to develop SLS and RAC, \$6M
- Air Force Research Laboratory award, \$360K
- First sale of SLS for DARPA-funded project
- Sales of SLS Pilot systems and licenses in New Zealand, Austria, Australia, U.S.

2010

- Private placement offering
- Ohio Department of Agriculture award, \$25K
- Inc. Magazine article showcasing SLS
- Introduced and sold SLS Lab Model: Japan, Hungary, U.S.
- Submitted SLS patent application

2011

- Added Chief Scientist and Patent Attorney to team
- Financial support from State of Ohio totaling \$2.4M
- Invited for expert testimony on harmful algal blooms to U.S. House of Representatives
- Submitted RAC patent application

We would like to thank our network of collaborators, whose hard work and collaboration have helped us achieve rapid development and progress. We continue to value our collaborative teams and look forward to sharing our continued progress.

IMPROVING THE SLS: WET MATERIAL REMOVAL

AVS has developed a novel system for the removal of wet solids from the SLS filter belt, overcoming a significant processing challenge as the SLS is optimized for rapidly processing large volumes of material. The Wet Material Removal system improves system throughput, improving the capability and efficiency of the SLS for capturing micro-solids in dilute concentrations. This innovation enables the capture of

materials between 15-50% solids and will be available for all SLS systems.

The Wet Material Removal system leverages the SLS' greatest competitive advantage, low-energy dewatering, and is designed to complement a range of final drying methods, removing wet material from the filter belt as a thin cake for low-energy drying. This SLS component opens the door to

promising new dewatering applications that require fine-tuned separation for further drying and processing.

To learn more, please contact a member of our product support team at contactus@algaevs.com.

DEVELOPMENTS IN THE AVS LABORATORY



Algaeventure Systems is continuing to expand its laboratory capabilities, introducing new custom testing services for technology development. Because of the great variability across algal growth systems, AVS is offering a variety of evaluation and processing services to characterize algae. This range of services enables clients to better utilize AVS' technologies and assess production performance.

To support efforts to optimize the RAC and SLS systems for clients and collaborators, AVS

has obtained a FloCam system for precise particle analysis, a Bomb Calorimeter for energy testing, and developed a custom capillary material testing ap-



paratus, or "Capparatus." The Capparatus is used for bench top testing the portfolio of capillary and filter materials, as well as determining the properties of various algal species. Utilizing the Capparatus, AVS is able to more accurately and effectively select filter and capillary materials for the SLS, bringing a carefully tailored configuration to each customer's material.

For more information on algae evaluation & processing, please contact us at contactus@algaevs.com.

EMERGING APPLICATIONS

VALUE FROM WASTE: DEWATERING ANAEROBIC DIGESTATE

Anaerobic digestion (AD) offers a viable method for capturing livestock waste and converting it into valuable methane gas, although still results in a large amount of dilute effluent that must be properly managed. The SLS has been successfully demonstrated as a system for dewatering AD effluent, capturing solids that can lead to both the creation of co-products as well as reduced handling and disposal costs. AVS has received international inquiries from stakeholders in the AD industry and has conducted numerous demonstrations with various kinds of livestock waste. In economically dewatering AD effluent, the SLS presents a tremendous economic and environmental opportunity to create valuable products while mitigating the potential adverse effects of a waste stream.

The consolidation of livestock farms into large-scale operations has resulted in greater volumes of waste than

ever before. This has led to increased pressure to develop alternative, improved waste management practices, including safer and more economical storage, transportation and disposal. Waste is often collected and reapplied to the land as a nutrient-rich fertilizer, benefiting crop production. However, this has the potential to adversely affect air and water quality, often resulting in the development of harmful algal blooms (HABs) in lakes and watersheds.

At the center of this application is the SLS' novel low-energy dewatering method,

removing large volumes of water from dilute effluent streams with much less energy than competing systems. AVS anticipates increased interest in this area as improved waste management systems are increasingly sought-after and the SLS is further evaluated for AD dewatering.



PROJECT UPDATES

ARPA-E DEMONSTRATION

Demonstrating industrial-scale SLS technology

AVS is progressing with the development of the SLS technology under the DOE ARPA-E grant, meeting and surpassing project milestones. Following the successful laboratory demonstration of the SLS Industrial Model, AVS is evaluating prospective demonstration sites for the project's field testing phase. The SLS Industrial Model is designed for automated processing of large quantities of dilute algal solu-



tions (3-20 g/L), dewatering to 25-30% solids. In the field testing phase, the nation's leading algae producers will have the opportunity to demonstrate the system under real-world conditions in an algal production environment.

If you are interested in the SLS Industrial Model for large-scale, low-energy dewatering, please contact us at contactus@algaevs.com or 937-645-4618.

UPCOMING & RECENT EVENTS



1st International Conference on Algal Biomass, Biofuels & Bioproducts

Location: Westin St. Louis

811 Spruce Street, St. Louis, MO

Date(s): July 17-20, 2011

Time(s): 5:00 pm

Website: <http://www.algalbbb.com/index.html>

More Information: Ross Youngs will speak on Wednesday, July 20 in a presentation entitled “Low-Energy Concentration and Dewatering of Microalgae for Fuels, Products and Remediation.” The conference will bring together leaders in the scientific field, strategic partners and international delegates with an emphasis on unpublished technical and scientific results. Mr. Youngs will discuss R&D efforts and technologies currently on the path to commercialization.



Biomass 2011: Replace the Whole Barrel, Supply the Whole Market

Location: Gaylord National Resort and Convention Center
201 Waterfront St., National Harbor, MD

Date(s): July 26-27, 2011

Time(s): 8:15 pm

Website: http://www1.eere.energy.gov/biomass/biomass_2011.html

More Information: This year’s conference will focus on topics surrounding the use of biomass as a replacement for petroleum to supply the energy, products, and power markets. The Biomass 2011 theme will explore the new horizons of bioenergy technologies and deployment strategies, business practices, policies, and partnerships that will help sustainably transform the energy landscape.



NAA Collaboration, Strategic Alliances and Networking Conference

Location: Santa Fe Community College
6401 Richards Avenue, Santa Fe, NM

Date(s): August 1, 2011

Time(s): 8:00 am

Website: <http://www.nationalalgaeassociation.com/Events.html>

More Information: David Coho, Vice President of Business Development, will speak at 3:45 about progress in technology development and discovering new customer applications. The conference will focus on progress in growing, harvesting and extraction methods, updates on proven technologies that are ready for commercial-scale algae production, and curriculum for workforce development. Committed speakers include Algaeventure Systems, BARD Holding, New Mexico State University and Santa Fe Community College, NAA’s Algae Oil Spec Committee, the USDA, New Solutions Energy, Waterwheel Factory, Solutions4CO2, MerckMillipore, CBO Financial, Algae Industry Magazine and Emerging Markets Online.



Algal Biomass Summit 2011

Location: Hyatt Regency Minneapolis
1300 Nicollet Mall, Minneapolis, MN

Date(s): October 22-28, 2011

Time(s): 5:00 pm

Website: <http://algaebiomasssummit.org/ema/Display-Page.aspx?pagelD=About>

More Information: This dynamic event unites industry professionals from all sectors of the world’s algae utilization industries including, but not limited to, financing, algal ecology, genetic systems, carbon partitioning, engineering & analysis, biofuels, animal feeds, fertilizers, bioplastics, supplements and foods. Please visit <http://www.algaevs.com/events> for updates regarding AVS presentations, panel discussions, and exhibits at the conference.