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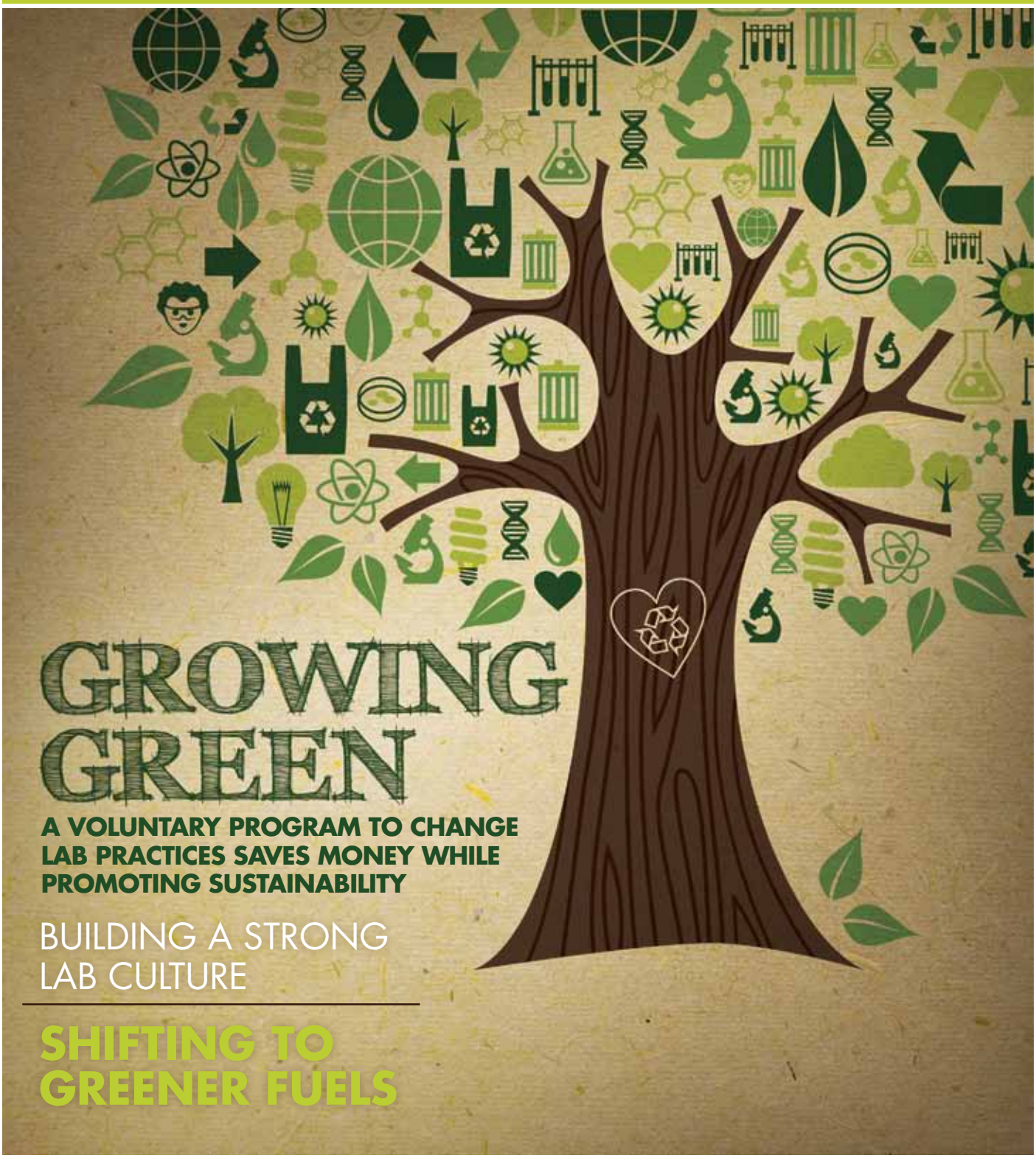

GROWING GREEN

A VOLUNTARY PROGRAM TO CHANGE LAB PRACTICES SAVES MONEY WHILE PROMOTING SUSTAINABILITY

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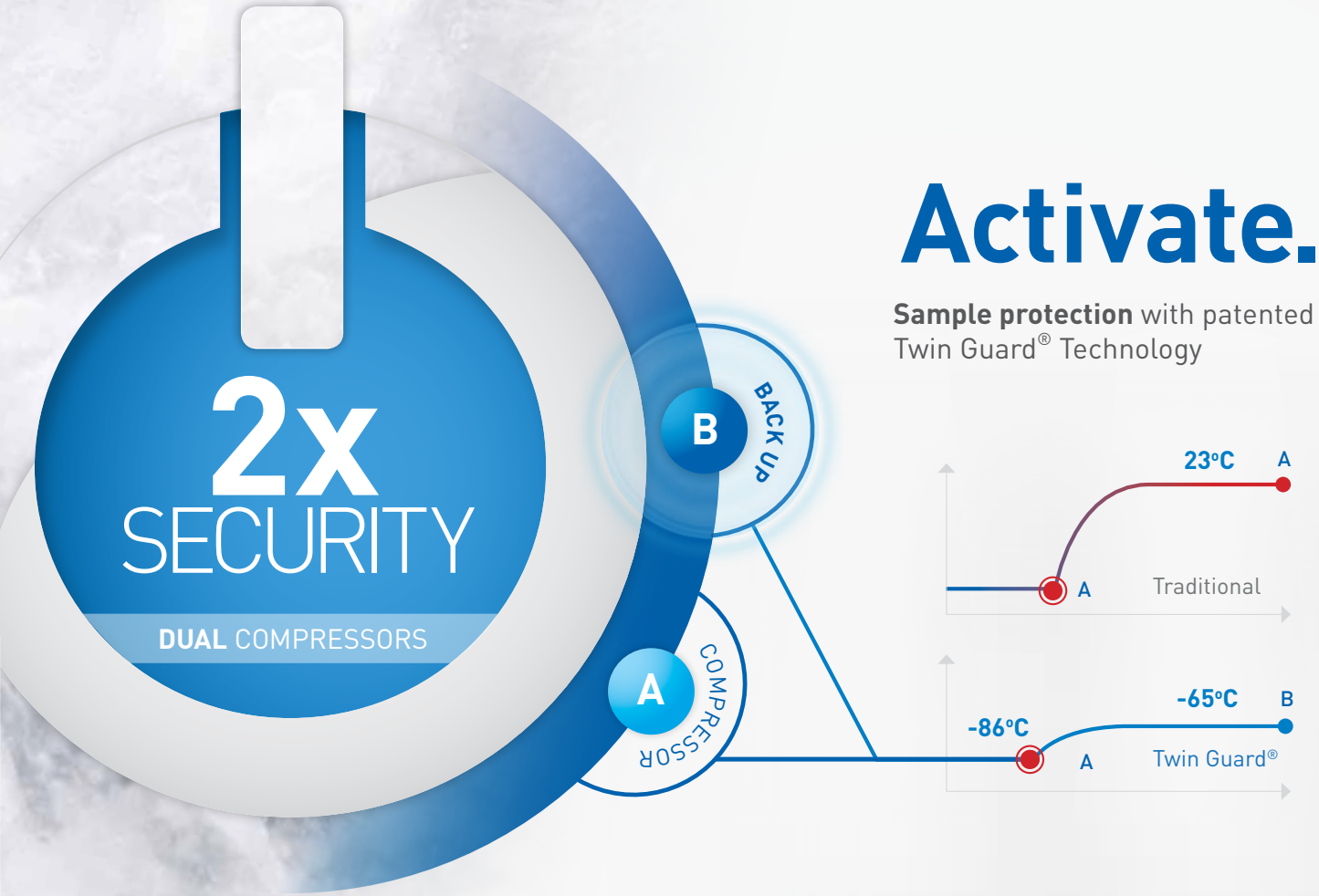

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Post Pittcon News

Another Pittcon has passed, with lots of great new products and visits from those of you who were able to make it to the show. We hope those of you who attended our Bootcamp this year found it useful and engaging. Highlights from the show include the winners of the Pittcon 2014 Editors' Awards for most innovative product. Texas Instruments took the gold medal for its DLP® NIRscan™ evaluation module for spectroscopy while Waters snagged silver for its ACQUITY® QDa™ mass detector. See page 72 of our December 2013 issue for a Product Spotlight on the QDa. AB Sciex rounded out the winners by taking bronze with its CESI 8000 high performance separation-ESI module, which is profiled on page 64 of this issue. Look for more great Pittcon releases in the Technology News section this month and keep a watch for our Pittcon roundup in May.

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Eco-friendlier

Though they say this winter on the east coast was NOT the longest or snowiest on record, I'm hard pressed to believe it. The stubborn patch of snow I'm looking at outside my office window indicates otherwise and shows absolutely no sign of melting. Fortunately, I've got my seed starter kit up and running, with eggplant and kale sprouting and tomato seeds at the ready for planting this weekend. It's those little tiny green seedlings poking through the soil under the grow light that makes this lingering winter tolerable. Which brings us to this month's "green" issue.

Initiatives to reduce a laboratory's environmental footprint abound, with very ambitious programs such as LEED and others. But for smaller, existing labs, or those with tighter budgets, there are still important changes they can make to improve their eco-friendly efforts. According to Dennis Nolan, author of this month's cover story, "While many institutions have implemented green lab design and use energy-efficient equipment, few have looked at attempting to change the practices of the lab users. Often people do not realize what they are wasting because they have not been made aware of it." Key to the success of such a program is that it be voluntary and self-regulated. Turn to page 14 to find out how your lab measures up and what additional eco-friendly changes you can make.

Creating a strong laboratory culture involves the same principles as creating a voluntary green lab program, which is to foster each individual's commitment to shared goals. This is done first and foremost through active and constant communication, but also requires the careful selection of staff, encouragement of self-starters, mutual respect, and much more. "In a strong lab culture, team members are productive and involved, have clarity about the goals of the lab, and have positive relationships with other team members," says author Lina Genovesi. Turn to page 20 to learn more.

In this month's Perspective On article, Russell Leu shares his experiences running an environmental laboratory in the Montana State Department of Public Health & Human Services. In addition to discussing his research, business, and staffing challenges, he reflects on the changes in environmental awareness and practices during his career. "When I first started out, I worked on a college campus. When we had excess organic solvent, it was put on a steam table and up the stack it went, so the answer to pollution was dilution," he says. "Nowadays, we don't get by with that. You save all your organic solvent, and when you get a certain amount, someone comes and collects it." We have obviously made some headway here.

Speaking of handling solvents, this month's Business Management article makes a financial case for investing in a digital chemical inventory management system, arguing that a poorly managed chemical inventory wastes money and creates unnecessary and menial tasks, such as searching for chemical containers and reordering stock that can't be found. There are other benefits as well, says author Anne Sefried. Monitoring inventory levels and ordering 'just in time,' "eliminates the compliance and safety risks of having excess chemicals on-site and the cost of sending unused containers to chemical waste facilities."

Though it may turn out that the further "greening" of your lab will be seemingly modest, it is never a wasted effort.

Here's to Spring!

Pamela Ahlberg
Editor-in-Chief

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GROWING GREEN

A VOLUNTARY PROGRAM TO CHANGE LAB PRACTICES SAVES MONEY WHILE PROMOTING SUSTAINABILITY

by Dennis Nolan

Laboratories can be one of the largest users of electricity and water at an institution. They are also among the largest consumers of materials and generators of hazardous waste. Lab equipment can use a lot of electricity. Some of this equipment must be left on continuously. Laboratories can also use a lot of water. Water-cooled equipment, vacuum aspirators, and rinse washers use a continuous stream of water that is not recirculated and goes directly down the drain.

While many institutions have implemented green lab design and use energy-efficient equipment, few have looked at attempting to change the practices of the lab users. Lab personnel may not consider their environmental impacts. This may be due to a lack of information about their "footprint." Often people do not realize what they are wasting because they have not been made aware of.

In higher education, there is a growing movement among institutions to develop programs that encourage labs to be green. Green lab programs have the potential to save researchers and facilities money while benefiting the environment. Given today's budgetary climate, a program that promotes sustainability at minimal cost but with the potential for significant savings is a win-win scenario.

At The University of Texas at Austin, the Green Lab program started in 2010 while benchmarking institutions for ideas to encourage researchers to self-inspect their own labs. UT Austin noticed several universities had started green lab programs and decided to start a pilot program. A founding concept was that the program had to be voluntary. UT Austin did not want to force labs to be green. A Green Lab recruitment email went out on Earth Day, and a small group of ten labs volunteered to be the pilot group.

One of the components that many green lab programs employ is a self-evaluation that lab personnel can use to assess the "greenness" of their lab. We asked our labs to complete a Green Lab self-evaluation form. [See sidebar on page 14.]

Once completed, the Green Lab team (the director of sustainability and the assistant director of EHS) met with the lab manager or principal investigator to review their self-evaluation and see what additional innovative green lab practices they were doing. We also asked them for suggestions on how to promote the program and to set a goal for the year.

> "Often people do not realize what they are wasting because they have not been made aware of it."

Growing a green labs program

After talking with the lab managers, we decided to implement several marketing strategies to encourage participation. During meetings with the lab managers, they suggested developing some type of recognition. We developed a sticker that could be placed outside the lab for others to see. We also created a promotional video to increase awareness of the program. [See website.] We asked lab managers and faculty to participate with the intent that their peers would be better advocates

than the administration. We were very pleased when the dean of the College of Natural Sciences volunteered her lab to become a Green Lab.

Green Lab sticker

Being green does not have to be expensive

Many Green Lab practices cost little or no money. For example, by maintaining an accurate inventory of chemicals and supplies, lab managers can reduce the potential for over-ordering unnecessary materials. Having a first in, first out policy can also reduce the potential for expired reagents.

MIT implemented a website called the "Green Alternatives Wizard" (http://ehs.mit.edu/greenchem/). This website assists researchers by providing them with less hazardous chemical or process alternatives. Such practices have the potential to lower institutional costs by decreasing hazardous waste disposal fees. In some cases, alternative chemicals may be safer to use as well.

Similar to your dishwasher at home, consolidating loads in glass washers and autoclaves saves energy and water. Heating blocks and water baths use a lot of electricity to maintain a constant temperature. Some of our researchers now use timers to turn on these pieces of equipment a few hours before they come into work, instead of leaving them on all night.

Ultralow freezers

While some labs call them minus-86 freezers, Allen Doyle of the University of California, Davis, stresses that they should be called ultralow freezers. Lab personnel have the tendency to think that these freezers should be set at minus-86. Second to fume hoods, ultralow freezers are often the second-largest energy consumer in the lab. A full-size ultralow freezer can use as much electricity in a year as a house. They also put out as much heat as a small gas grill. When you set the temperature to minus-86, it puts a strain on the compressors to maintain maximum coldness. For every ten degrees an ultralow freezer is turned up, it will typically save $100 in electricity a year.

Having worked in a lab, I remember days when I had to put on cryo-gloves to search for a single sample. This process could sometimes take hours because the freezer was not inventoried. After finding the sample, it would take hours to get the freezer back to regular temperature, and the next time I went into that freezer, sample boxes were iced over. Give your freezer a break by inventorying the contents and posting it on the freezer door.

Most lab personnel do not think about preventive maintenance of their lab refrigerators and freezers. This is not wise. If you do not do preventive maintenance on your car, the car will not last very long. The same can be true for your lab refrigerators and freezers. Considering

that these units can cost $10,000 to $15,000, you want them to last as long as possible.

UT Austin conducted a survey of over 300 freezers on campus and found many needed maintenance. Cleaning the coils, filters, and gaskets will extend the life of your equipment. Labs should also periodically defrost their freezers. UT Austin's Energy Resource and Conservation program purchased several spare ultralow freezers for the university so that labs can defrost and service their freezers. They also act as a backup for researchers in case a freezer fails.

▲ *The Energy Star label*

Green labs and environmental health and safety

Being a green lab can also improve safety in your lab. You may be able to get your EHS person to support a green lab program.

Environmental Health and Safety implemented a close-the-sash program in 2012. Fume hoods can cost more than $5,000 a year to operate when they lose conditioned air. Keeping the fume hood sash closed protects the lab users and can also reduce operational costs.

▲ *Fume hood sticker*

Using less-hazardous chemicals and smaller quantities reduces the impact of spills and disposal. When Environmental Health and Safety realized that mercury spills were costing hundreds of dollars in cleanup and disposal costs, they implemented a thermometer exchange program. Labs could turn in their mercury thermometers in exchange for free alcohol thermometers.

Purchasing

When purchasing equipment, look for Energy Star labels. Most lab equipment will not have this logo, but if you are buying conventional refrigerators, you will see it. Many lab freezers and biosafety cabinets now list their electrical usage. Try to buy the most efficient unit. When you purchase fume hoods, consider using low-flow hoods. When purchasing lab equipment, look for equipment that can be programmed to hibernate when not in use.

Composting

One of our recent initiatives has been a composting program for our animal bedding. We mirrored a program at Emory University that composts its animal bedding. The bedding is picked up by the same company that composts our food waste from our dining halls. In one year we estimate that we have diverted a semitrailer load of animal bedding from the landfill.

Recycling and reuse

Another green lab opportunity is recycling. Check to see whether your lab plastics have a recycle symbol on them. Most likely they can be recycled if they are not contaminated. One of our faculty spearheaded a program to recycle Styrofoam from the labs. Each month labs bring their Styrofoam to the loading dock for recycling. Consider implementing a Craigslist-type program to reuse unwanted materials and equipment. The lab next door might have something you want and they don't need!

Recycling bins

Starting your own green lab program

When you start a green lab program, I suggest starting small and letting it grow. We had ten participants in our pilot. The following year we set a goal of getting ten more to join. We now have more than 30 lab groups in the program. Remember that you do not have to do everything, but try to do something. One of our faculty said that while an individual may not make a big impact, many working together can have a huge impact.

Getting more information

Information on green labs can be found at the Labs21 web page, http://www.labs21century.gov/. Academic institutions that have green lab programs often have web pages that you can use to get more ideas. Enter "green labs" in your favorite search engine. UT Austin's Green Lab's web page can be found at http://www.utexas.edu/sustainability/initiatives/greenlabs.php.

***Dennis Nolan**, MPH, MS, CBSP, assistant director, environmental health and safety, the University of Texas at Austin, can be reached at dnolan@austin.utexas.edu or by phone at 512-232-4999.*

GREEN LABS SELF-EVALUATION

The University of Texas at Austin

Green Laboratory Self Evaluation

Principal Investigator: _____

UTEID: _____ Phone: _____

Email: _____ Date of Evaluation: _____

This voluntary checklist was developed to assist researchers in making their laboratory greener. Laboratories use more energy than any other facility on campus. They are also significant material consumers and waste generators.

Having a Green Lab can save researchers money. By using green laboratory practices, researchers spend less on unnecessary materials and equipment. Green lab practices also benefit the environment by consuming and disposing less.

Note that these practices should only be considered and used when it is safe to do so. Safety first!

Check "yes" only if your laboratory exhibits a characteristic 75% of the time or more.

CHEMICALS Does the lab:	**Y**	**N**	**N/A**
1. Maintain and review their chemical inventory to prevent over-purchasing	○	○	○
2. Use chemicals/reagents first in, first out	○	○	○
3. Use mercury-free equipment whenever possible (thermometers, electrodes)	○	○	○
4. Use green chemistry practices…			
a. Scale down procedures to use less chemicals	○	○	○
b. Use more efficient chemical reactions	○	○	○
c. Substitute with less toxic chemicals in experiments	○	○	○
d. Use computer simulations as a substitute	○	○	○

PURCHASING Does the lab:	**Y**	**N**	**N/A**
Materials			
5. Maintain an inventory of supplies and equipment and check before ordering	○	○	○
6. Purchase recycled products whenever possible	○	○	○
7. Not order more materials than expected to be used in a reasonable amount of time	○	○	○

Equipment	Y	N	N/A
8. Check with Surplus before purchasing equipment, office furniture and appliances	○	○	○
9. Use vendor equipment buy-back programs	○	○	○
10. Purchase energy efficient (such as Energy Star) equipment whenever possible	○	○	○
RECYCLING Does the lab:	**Y**	**N**	**N/A**
11. Use a shared office and lab supplies area	○	○	○
12. Recycle paper (good on one side) and other office supplies	○	○	○
13. Print/copy double-sided whenever possible	○	○	○
14. Recycle wire hangers for lab coats	○	○	○
15. Use rechargeable batteries	○	○	○
ELECTRICITY Does the lab:	**Y**	**N**	**N/A**
16. Turn off equipment when not in use	○	○	○
17. Disconnect unused equipment to reduce phantom loads	○	○	○
18. Put computers, copiers, printers in sleep mode when not in use	○	○	○
19. Turn off lights when leaving (even during the day)	○	○	○
20. Consolidate materials in freezers and refrigerators to use less equipment	○	○	○
21. Use room temperature storage methods for DNA/RNA	○	○	○
22. Turn off biosafety cabinet when not in use and turn off UV lights after 1 hour	○	○	○
AIR Does the lab:	**Y**	**N**	**N/A**
23. Keep chemical fume hood sash lowered as much as possible to reduce volume of conditioned air being exhausted to the outside	○	○	○
WATER/STEAM Does the lab:	**Y**	**N**	**N/A**
24. Cooling lines: use a closed loop chilling instead of a single pass system	○	○	○
25. Report water leaks to Facility Services immediately	○	○	○
26. Turn off pipette washer/rinser as soon as pipettes are clean	○	○	○
WASTE Does the lab:	**Y**	**N**	**N/A**
27. Autoclaves: consolidate loads when possible. Defrost frozen materials before autoclaving.	○	○	○
28. Biohazardous and Sharps waste: Dispose only when 2/3 full.	○	○	○
29. Mail: Remove names from vendor catalog mailing lists	○	○	○
TRAINING Does the lab:	**Y**	**N**	**N/A**
30. Train lab personnel on green lab practices	○	○	○

OTHER GREEN INITIATIVES

Please describe any additional green initiatives that your laboratory has implemented.

MANAGING YOUR CHEMICAL INVENTORY

HOW DIGITAL SYSTEMS CAN SAVE MONEY, ELIMINATE SAFETY RISKS, AND INCREASE PRODUCTIVITY

by Anne Sefried

As with any other organization, successful management of your laboratory entails a significant deal of business strategy and savvy. While size and complexity differ considerably among laboratories, every lab manager must master a few essential tasks. They fit into two main categories: overseeing physical assets and managing human resources, with the synergistic goal of maximizing efficiency.

If you're exploring methods to increase the efficiency and return on investment of your laboratory, your first step should be to update your chemical inventory system (CIS). How you manage your chemical inventory—the building blocks of research—has the potential to make or break your budget. The daily function of laboratories revolves around the chemical inventory. Chemicals are the raw materials for experiments, holding the key to research innovations.

Antiquated chemical inventory management systems have a tendency to create menial tasks for the whole organization, from spending time searching for chemical containers to reordering stock that can't be found. After years of research, what may seem to be inconsequential losses of time and funds can add up to a serious amount of wasted resources. You may also be rightly concerned about staying in compliance if you aren't sure where your regulated chemicals are at all times. This affects not only the qualitative environment of the lab but also your organization's long-term operational costs.

Accounting for lab managers

In addition to their daily managerial responsibilities, lab managers tell us time and again that accounting is one of the most pertinent challenges. By planning ahead with a budget, lab managers devise the best plan of action to fit the needs and resources of the lab. Comprehensive accounting audits reveal your organization's exact spending habits and precise needs, aiding in budgeting for the future. In particular, meticulous accounting helps uncover the discrepancies between your perceived and actual chemical inventory expenditures.

The hidden costs of chemical inventory management

Inefficient chemical inventory management could be draining your laboratory of valuable time and money. Let's take a look at the life span of a single chemical in your lab from "cradle to grave" to help illustrate.

Your initial purchase of a chemical for your lab is its first *direct* cost. If you purchase it under an urgent deadline, additional fees will likely be added for expedited delivery and special handling. With a traditional system, your chemical will be documented upon arrival and added to the inventory list by a designated employee. Safety and compliance measures, such as safety data sheets, employee training, and special storage measures, require additional time and funds to address.

During the chemicals' life span, containers are likely to be shared among multiple laboratory employees. While this is an efficient use of resources, in the event that a single chemical is needed simultaneously in two places or is misplaced, someone may order an additional supply of the chemical. Without planning ahead, it is all too easy to accumulate numerous stores of the same chemical, often in different locations with disparate expiration dates. Alternatively, many laboratories contain "emergency" stores of chemicals to safeguard against depletion. While this may seem an appropriate strategy, it is only a Band-Aid on a larger organization issue, and in the end, chemical stockpiles can end up costing more as unused bulk supplies expire. The more prudent approach is to monitor

inventory levels and order "just in time" as needed; this eliminates the compliance and safety risks of having excess chemicals on-site and the cost of sending unused containers to chemical waste facilities.

Hoarding excess inventory adds a host of costs to the lab. First, many chemicals are governed under strict laws that regulate total volume, with substantial fines applied during safety inspections. A cluttered laboratory bench and storage space mean greater risk of dangerous chemical spills, workplace injuries, and liability. Second, lab storage space can be expensive, especially for chemicals that need special storage arrangements, such as refrigeration, which accrue additional electricity costs.

"Meticulous accounting helps uncover the discrepancies between your perceived and actual chemical inventory expenditures."

Third, when chemicals expire, you pay to dispose of them properly, whether or not you have had a chance to use them. There's no greater tragedy in inventory organization than discarding unopened chemical containers!

At every step of the way, a single container accumulates these hidden costs of time and funds. Yet another inconspicuous expenditure is opportunity cost. Time and money that are spent on inventory management could be spent on your more profitable lab projects.

Without a systematic way to manage your laboratory's chemical inventory, it is easy to get sidetracked with seemingly more urgent tasks. However, it is well documented that a poorly managed inventory can snowball into more "headaches" and more cost than you and your employees can afford. No matter the size of your chemical inventory, it is critical to implement a thorough, accurate chemical inventory system.

How do you manage your chemical inventory data?

If you're like many laboratories we've visited around the world, your chemical inventory may be recorded on a piece of paper that is tucked away in a binder or a cabinet, or on a digital spreadsheet, or on the lab manager's desktop computer. Occasionally, this list will come out of storage for several common reasons. First,

the purchase of new chemicals requires their addition to your inventory list. Second, in the unfortunate case of a spill, fire, or other accident, these records contain safety information that you or the relevant safety personnel need to access.

Besides these two events, however, the typical chemical inventory list usually sees little use. Instead, record keeping takes a back seat to more urgent research tasks. Chemical inventory management is anything but a back-seat matter, however. If your daily tasks revolve around the use of chemicals, then your chemical inventory list is relevant minute by minute. As your laboratory uses chemicals, the inventory is in fact changing. Quantities are shrinking, and chemicals are gradually approaching their expiration date. Reordering cannot and should not wait until your chemicals are depleted or expired; this adds additional headache, stress, and expedited shipping costs. What, then, is the best way to keep your inventory records current?

Chemical inventory systems for the modern laboratory

Paper records are no longer adequate for the majority of modern laboratories. While they may suffice for extremely small-scale facilities, laboratories with tens, hundreds, or thousands of chemicals require a different organizational system. As the scale and scope of your research expand, inventory management should evolve as well. The solution to the demands of the modern lab is a digital inventory management system with bar-code technology that can track chemicals from receipt to disposal. Almost immediately, it transforms your chemical inventory from an afterthought to a real-time research tool that saves time, resources, and other troubles.

The benefits of a digital inventory system

How exactly can a digital chemical inventory management system transform your research and save you money? By tracking your chemicals' inventory, location, quantity, safety information, users, and regulatory compliance requirements, you have this data available at the touch of a button.

With a best-practices system in place, real-time data about your inventory becomes available to every relevant individual. You can look up exactly what you have, where it's located, how much you use and how often, when to reorder, and how to use, store, and dispose of the chemical safely.

In daily use, a best-practices chemical inventory system can shave hours off inventory searches and dollars off redundant orders. In emergencies, a remotely accessible, real-time inventory list can serve as a critical guide for emergency responders to react appropriately to an accident. The cost of installing the software and training your staff is typically recovered within a surprisingly short period. For instance, a study of Accelrys' CISPro inventory system calculated a potential $770,500 cost savings per year for a mid-sized research company with 50 employees and 10,000 chemicals. For your organization, this yearly savings could amount to $12,900 per laboratory employee and $12.50 per container of chemical inventory.

Personnel time and funding enable your valuable research, so efforts to improve efficiency vastly expand the quality and quantity of results that your laboratory can produce. When you use a chemical inventory system with bar-code technology, you and your staff are free to pursue new avenues of research instead of spending hours trying to track down and reorder

chemical inventory. The difference is both quantitative, with an improved return on investment, and qualitative, with increased productivity and employee morale.

Transitioning to digital chemical inventory management

When you decide to implement chemical inventory software, be sure to choose a system that is right for your lab's needs. It should be configurable, scalable, and intuitive enough that everyone in your lab, from assistants to the principal investigator, can learn to input and interpret data with minimal training. With a bar-code tracking system, a unique bar code adheres to every chemical container. When scanned, this bar code reveals the location, identity, quantity, and all safety information pertaining to the chemical. In addition, web-based chemical inventory systems provide access to all the inventory data you need at any time. The option to access your inventory information remotely, even when you're visiting a facility in another city, means more convenient, flexible, and worry-free monitoring of safety and inventory information.

Being a lab manager today is a more complex job than ever, requiring expert juggling of a gamut of responsibilities and taking on some personal liability for team safety and compliance. As your laboratory's research grows in scope and the size of your chemical inventory expands, make sure you can keep up by upgrading to a best-practices chemical inventory system.

Note: The full study referenced in this article is a part of Accelrys' white paper titled "Quantifying the Financial Benefits of Chemical Inventory Management Using CISPro." It can be accessed online at http://media.accelrys.com/literature/misc/White-Paper-How-to-Calculate-the-Financial-Benefits-of-a-Chemical-Inventory-Management-System.pdf.

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BUILDING A STRONG LAB CULTURE

CHOOSE THE RIGHT PEOPLE AND HELP THEM GROW

by Lina Genovesi, PhD

The responsibilities of a lab manager are to lead and manage the lab in the midst of team dynamics. In a weak lab culture, team members have low productivity, are confused about their assignments, complain about other team members, and show a lack of involvement. In a strong lab culture, team members are productive and involved, have clarity about the goals of the lab, and have positive relationships with other team members.

Because team dynamics define "lab culture," building a strong lab culture starts with building the right team.

Selecting team members

Building the right team begins with selecting the right team members. The right team members will have the skill set required, a personality that matches the core values of the company, and a desirable work ethic and will measure to the expectations of the lab.

"Motivation is an important work ethic," says Mark Lloyd, staff scientist, analytic microscopy core at the H. Lee Moffitt Cancer Center & Research Institute (Tampa, FL). "Individuals who are motivated and empowered to go above and beyond their duties contribute to a strong lab culture, which leads to a high retention rate."

Josephine C. Longoria, regional lab director, Guadalupe-Blanco River Authority (Seguin, TX), believes that being committed is an important work ethic. "Showing commitment to the team by finishing what someone starts goes a long way in a team," says Longoria.

Being a problem solver is another important work ethic. "That is what I call the hidden asset," adds Longoria. "When someone is willing to try to solve a problem before bringing it to the attention of the lab manager, that has often been a reason to promote someone."

The process of selecting team members is not static. As the team grows beyond the initial team members, the role of the team members and the required skill set might shift and expand. "You need to continue cultivating an understanding of the skill set needed for your team," says Longoria. "If you want to hire a new team member, involve your existing team members in evaluating the candidate so that the new hire will fit into your existing team."

Setting the tone

Team members will appreciate the goals of the lab if expectations are communicated to them at the outset, as expectations represent the collective belief system on which the lab is based and the information gathered from lab training over time, Longoria says.

One common approach is to articulate the lab expectations in a mission statement and to use it as a guiding principle in decision making.

"I am clear at the outset with my lab members that the mission statement of this lab is to contribute to the prevention of and cure for cancer," says Lloyd.

However, as more team members are hired and the lab grows, the mission statement may require some adjustments. "You may need to involve your employees in fine-tuning the mission statement," says Longoria. "Read it, refresh it, and reflect on it often."

Expectations and a mission statement may provide the backbone. While some employees will be highly motivated regardless of how a lab manager acts, most employees will follow the lead of the lab manager, who sets the tone by his or her actions.

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"A lab manager has to 'walk the walk,'" says Lloyd. "I spend time in waiting rooms talking to patients. I spend time listening to MDs to learn what could make their jobs easier or more efficient. Then I bring this knowledge back to the lab, as does each of our members, and we share it."

Setting an infrastructure

Team members function best within a well-defined infrastructure for ordering supplies and using the shared equipment and lab space. A well-defined infrastructure will cut down on conflicts among lab members.

"It is helpful for the lab to have a simple way of ordering supplies, to reduce cumbersome procedures when not required, to invite dialogue and solutions to try to solve a problem, and to have the attitude that two heads are better than one when solving a problem," says Longoria.

> "Individuals who are motivated and empowered to go above and beyond their duties contribute to a strong lab culture."

Every team member should be encouraged to be responsible for keeping things organized and be responsible for their part. "Team members should own up to their process," says Eric Collop, lab manager, quality control lab, Lifeline Foods (Saint Joseph, MO). "Each lab technician documents what goes on during a shift and communicates it to incoming technicians at the changeover."

In today's tough funding environment, asking team members to consider cost savings and effectiveness is also important to running a successful lab. "You should make everyone in the lab aware of the financial aspects of the lab," Longoria says. "You should also encourage reduction of use of consumables, where possible."

Solving problems

Promoting problem solving through teams with specific skills is a significant factor in defining the relationship dynamics between team members and setting the tone for a strong lab culture.

Successful problem solving is on a case-by case basis.

"The success of grouping individuals into teams depends on the issues that need to be resolved," says Lloyd. "If there are scientific issues, then a team is formed that is diverse enough to bring multiple perspectives, while being cohesive enough so the team members work well together."

"Because team dynamics define 'lab culture,' building a strong lab culture starts with building the right team."

The success of solving problems through teams also depends on the level of commitment of the team members to the team. "Team members may not want to commit," says Longoria. "In some instances, forming teams may be something that team members reject if it takes too much time away from lab time."

Promoting communication

Positive communication is an important factor to a well-functioning lab, and poor communication is indicative of a lack of commitment to the team.

"Promoting communication—verbal, email, text, phone, radio, and documentation—is key," says Collop. "Team members who communicate well are those who work toward a single mission or vision and are motivated on their own to go beyond their duties."

For Longoria, taking into account the diversity of team members' cultural backgrounds is important in creating a positive, open environment for communication.

"To promote communication, you need to be accepting and welcoming of diversity, whether it is cultural, local, or external," she says.

Promoting collaboration

Emphasizing the importance of each team member will go a long way in diffusing any ill will between team members. It will also make it easier for team members to collaborate as a group.

"If someone offers a suggestion or solution to something you have a problem with, refrain from putting someone down and/or one-upping someone," Longoria says.

Emphasizing mutual respect between team members diffuses any perceived favoritism and promotes positive relationships and collaboration. "Lab members should listen to and respect their coworkers," adds Longoria. "They should show patience, share knowledge, encourage cross training, and be accepting of different learning styles. They should also be constructive with criticism and always offer an alternative or a solution to a problem if you have to state the problem."

Acknowledging contribution

When team members feel that the company is making a positive impact on the world, they will be empowered by the acknowledgment of their own contribution and impact on the company. For example, Lloyd is careful to highlight the contribution of his lab to the Cancer Center and the patients who are the top priorities.

"We emphasize that our work is not only about the basic science we perform but also about affecting patients and their experiences," says Lloyd. "This builds a sense of involvement, which inspires lab members to excel."

Encouraging growth

When team members are encouraged to grow in their roles, they will be empowered to work harder.

> "If you want to hire a new team member, involve your existing team members in evaluating the candidate."

To encourage the growth of his team members, Lloyd acknowledges the contribution of each team member. "I provide lab members with a sense of ownership of their projects," says Lloyd. "I also try to give the message that everyone is making a significant contribution to the research, regardless of their specific title or role."

Lab managers can also help team members grow through opportunities for training and continued education, something Longoria feels is very important in her lab. "I encourage external training for specific analytical needs as well as professional development through webinars and other training," she says. "I also encourage continued education by offering a partial tuition reimbursement program."

Lloyd says that team members grow more effectively in the context of their own plans and ambitions. "It is important that you know their individual goals and help them achieve them rather than spend all your time pressing your goals on them," adds Lloyd. "You may provide growth as a career ladder for some or a structured model for moving on for others."

Encouraging work-life balance

Including fun and occasions for sharing in the life of the lab promotes work-life balance, which not only benefits team members but also boosts work productivity.

"Having fun and sharing occasions are important for our lab," says Longoria. "We often

have a lunch outside the lab with all the lab staff present. We also have companywide occasions to allow the staff to feel that they are also part of the bigger picture and the entire team."

Likewise, putting an emphasis on community involvement promotes work-life balance.

"To promote communication, you need to be accepting and welcoming of diversity."

"I encourage volunteer work under the company's name," says Longoria. "I also encourage personal involvement with other civic organizations and allow for time needed to complete volunteer work."

Lloyd encourages community involvement on the job through interaction of team members with patients and their families. "We encourage interaction with patients through various volunteer programs or simply by walking the halls," says Lloyd. "This builds a sense of involvement, which inspires lab members to excel."

Showing appreciation

Team members want to feel appreciated and recognized for their hard work and contribution. Appreciation comes in the form of pay raises, bonuses, or public recognition.

For Longoria, public recognition includes nominating employees for external organizational awards, encouraging membership with associated organizations that promote their professional development, and announcing during meetings their small or large successes and accomplishments.

Appreciation may take other forms such as perks or incentive programs. "We reward results through company-sponsored lunches, tickets to sporting events, gift certificates, and an employee bonus plan," says Collop.

There is a caveat when relying on perks or incentive programs. "Perks or incentive programs must have a meaning for the specific team member," says Longoria. "Understanding the psychology of the team member is a must; otherwise, a good perk to one may be an insult to another."

Bottom line

A strong lab culture is the result of a combination of factors such as nurturing the growth of each team member while requiring that person's continued commitment and collaboration to the team. Achieving and maintaining this balance has certain benefits to the lab manager and the team members, such as positive relationships, business longevity, and growth.

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CUSTOMER-CENTERED NEGOTIATIONS

By Rick Wemmers

Negotiating skills can make the difference between disappointment and great joy in dealing with others to get what you need….and what you want.

Negotiating can work both ways in a discussion; however, the person who initiates the negotiating action usually has specific terms they want or desire. The other side of the table can be weak or strong in accepting or rejecting these terms. In some cases, they can be trying to use their own negotiating skills on you. Part of being a good negotiator is determining the strengths of the opposing party.

Becoming a good negotiator is not easy or hard. There are specific steps in a winning process which greatly increase the opportunity for success if followed properly. Typically, it takes practicing negotiation in six or more real-life situations to begin mastery of this profitable and success-oriented skill.

So, what separates a good negotiator from a great one? It is the one who consistently gets what they want, on the terms they want. There are five basic rules to winning negotiations:

The first point to remember is that you need to convince the other party that you have what they want, albeit not in the exact form they have in mind. Negotiating *always* begins *after* your proposition is accepted by the other party:

1. Before starting the conversation, negotiators always do their homework on the "prospect." They are prepared to answer such questions as:
   a. What is the biggest benefit of my offer to their strongest need?
   b. What do I have to offer that no one else can?
   c. What can I negotiate and which others need approval from superiors?
2. A very special discovery process begins with the first meeting. This is where the negotiator probes to find insights into areas where negotiating can be productive. The prospect's responses will be critical to winning the day.
3. Start building a personal relationship early. Try to use the word "you" far more often than "I." This can be difficult because most people have a tendency to talk about themselves or product more than listening to the other side. But practice makes perfect. People always buy from people they like even if only temporarily.
4. After the prospect has responded "yes, I like what you are offering but have a few changes," is where you put your negotiating hat on and begin to offer alternatives. But, be very careful and follow key steps. For example, if you give in to a change, make sure you take something back from the original proposition. Another point, beware of false objections.
5. Never argue, say no, or lose control of your emotions. Keep in mind that your changes are always related back to what the other side needs and/or wants. Phrase your alternatives in terms of why this is good for the other side.

> "You need to convince the other party that you have what they want."

Negotiating skills can be used face-to-face as well as over the telephone. It is a little more challenging via the phone but definitely not impossible to be a consistent winner. With phone situations the negotiator should learn the skills of being an active listener.

Great negotiators are well-liked by most everyone and usually much more successful than their peers.

Rick Wemmers, *CSP is a Nationally Recognized Business Development Expert Showing Companies How to "Jump-Start" Revenue Growth Popular Business Presentations. Visit his website at www.Wemmers.com*

LABCAST Be sure to attend Rick Wemmer's Lab Manager Academy webinar, "Customer-Centered Negotiating," on Wednesday, May 7 (or afterward at www.labmanager.com/negotiating, to watch the archived video).

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CULTURE CONFIDENTIAL

By Mark A. Lanfear

As a manager in a lab environment, have you ever thought about changing jobs? Have you ever wanted a better opportunity? Have you ever wanted more satisfaction from the work you do every day?

Of course you have. It's only human nature for us all to be constantly searching, especially in our professional lives. It may not mean that we're completely *dissatisfied* with our current position—but isn't there always room for improvement?

This scenario is no different when it comes to your employees. If they're good at what they do and if they're dedicated to the cause, hopefully they will always want to do better—to go above and beyond. Accordingly, within the last year, 44 percent of life sciences professionals have changed employers, according to the Kelly Global Workforce Index 2013 Survey.

Managers must always take this into account. They must always realize that good employees could potentially go elsewhere if a better opportunity strikes.

This makes the issue of workplace culture extremely important. As surveys have proven time and again, happiness at work isn't about just compensation. It takes into account a complex array of factors that run deep, with workplace culture being critical among them.

In fact, the general environment at work can often mean the difference between an employee who wants to stay and an employee who wants to go, regardless of how great the job or the pay. In today's job marketplace, where employees in the sciences in particular are hard to come by, who can afford the risk of losing their best workers?

This is why helping build a strong culture among your employees is a good first step toward ensuring that your workers at least have the opportunity to remain satisfied on the job even if not everything else (such as salary and other tangible workplace aspects) is perfect.

Fortunately, across all industries surveys indicate what the modern worker is looking for in terms of workplace culture, and it's no different in the life sciences. One of the main points for managers to understand from the beginning is that advancements and the desire for progress are inextricably linked. Poor salary and benefits are certainly strong motivators for seeking a new job, but so is a lack of opportunity, and if your workplace is devoid of that, it could threaten to establish a culture where only cyclical, repetitive tasks are important.

So what can you do if these types of tasks really are what your lab is all about? As a manager, you can still help make the workplace more dynamic, because opportunity and progress for workers can come in many varied forms. Are there ways you could better connect your employees to the lab's overall mission? Can you figure out how to more creatively track progress and then offer more meaningful rewards when your employees do an excellent job?

Ultimately, people want meaning from their work, and knowing that this means something to their employer will help create a strong workplace culture where employees feel valued.

Other things to consider on the journey to creating a better workplace culture include getting people into the right jobs (this may seem obvious, but how often have you realized that someone might be a better fit for another area of the lab—but haven't taken the steps to change that?) and giving people the chance to work hard.

Yes, employees actually *do* want to earn their paycheck. After all, who would want to come into work every day with nothing to do? Employees consistently indicate they want on-the-job challenges, which can go a long way in creating a workplace culture where people know that the work they do matters. When people know they are truly responsible for the goals in a lab, they too are helping build a positive culture where the work itself is one of the most important parts of the lab culture.

Building a workplace culture will never be a one-size-fits-all proposition. But if managers are willing to keep learning about their workplace—and keep adapting to employees' needs—then it's a pretty good bet that their best workers will be willing to stay for the long haul.

Mark Lanfear *is a global practice leader for the life science vertical at Kelly Services, a leader in providing workforce solutions. He has operated clinical trials around the world for almost two decades. In addition, Mark is a featured speaker at many life science industry conferences and a writer for life science periodicals. He can be reached at MARL773@kellyservices.com or 248-244-4361.*

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SHIFTING TO GREENER FUELS

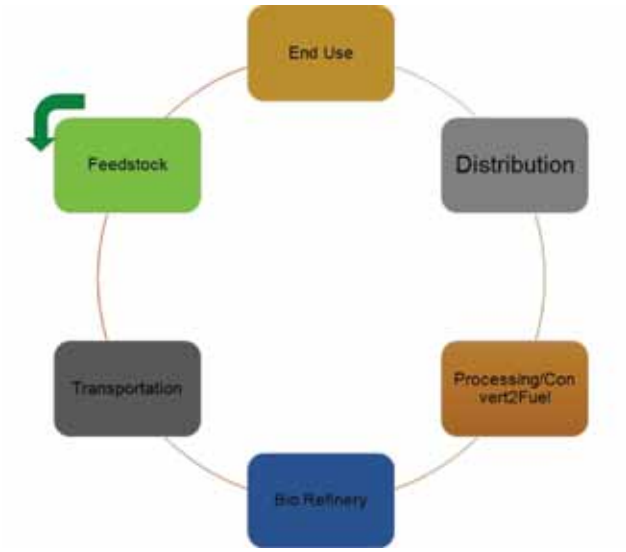
IMPROVING BIOFUEL ECONOMICS USING UPSTREAM INNOVATIONS FOR SAMPLE PREPARATION

by Bobby Chavli and Annette Summers

Renewable energy today is predominantly derived from wood, corn, wind, and water. The majority of these first-generation biofuels are burned, which causes greenhouse gases to be released and adds to carbon emissions.

"Responding to these challenges effectively requires a 'life cycle perspective,'"[1] says Thomas McKone, a senior staff scientist at Lawrence Berkeley National Laboratory.

It takes energy to transform something into a usable form of energy (see Diagram 1). This life cycle perspective attempts to explain the net impact of energy production on the environment—from the source to its final destination with the end user.



▲ *Diagram 1: The major points where carbon is used or created in the biofuel life cycle. Using a life cycle perspective attempts to explain the net environmental impact of a given form of energy as it is produced and then transported to the consumer. To determine the net impact, efficiencies are measured at each major step.*

For example, the U.S. uses almost 3 billion gallons of gas just to transport the fuel it consumes each year. This number may seem large; however, it is only 2 percent of the total 133 billion gallons consumed each year.[2]

Third-generation biofuels

First- and second-generation biofuels come from food sources such as edible corn, and the second generation from a variety of feedstocks such as liganose or municipal waste. Third-generation biofuels are typically microbial, using CO_2 as their feedstock, and are much more carbon neutral.[3]

Depending on the type, biofuels can have a 40 percent more efficient energy balance than fossil fuels. Fuels from second-generation and third-generation fuels can actually have a positive balance.[3] While biofuels make environmental sense, they are still more costly than fossil fuels.

Second-generation biofuels eliminate the foods versus fuels land-use controversies of the first generation because they are produced from agriculture and forestry residue or inedible by-products. Input materials cost considerably less than first-generation fuels. Still, these fuels cost about 70 percent more to produce because extra steps in the production process are inefficient.[4]

Searching for innovation

One critical way to lower production costs for second-generation fuels is to improve industrial microbes, enzymes, and batch chemistry.

Better industrial yeast strains are needed to transform cellulose to glucose through an amylase breakdown step. This step alone accounts for more than half of the total hydrolysis process cost.[5] This step is inefficient and costly because the current strains of industrial

yeast have limited success when breaking down the dominant sugar types in second-generation biomass. Typically, industrially engineered yeasts are ten to 100 times less effective at digesting xylose than when digesting glucose in first-generation crops.

Testing and optimizing yeast strains is a time-consuming and difficult business. Yeasts need to be carefully monitored through their initial growth phase, called "doubling time," and then monitored as the xylose is produced. Cells are grown in high-density cultures to maximize productivity by volume, and the medium is composed of highly concentrated sugars and enzymes.

Cell density is monitored regularly using photometric analysis so it can be maintained at specific OD660 measurements. Doubling time for a yeast culture is typically two to three days, while xylose production can peak between days four and six of the culture and may need to be sustained for longer to get the appropriate yield.

Sampling rapidly happens on the yeast culture's schedule and not within the lab workday constraints. Adding complexity, the reagents often need to be added or changed outside work hours. Experiments are conducted in triplicate to ensure reproducibility and statistical rigor; sampling and testing assays rapidly can ramp to hundreds of aliquots.

Process innovation can ease brute-force screening

Process innovation can improve this long protocol and enable labs to conduct enough assays to efficiently screen promising new strains. Because of the challenges of strain optimization, many second-generation biofuel projects have languished in the recesses of university campuses and federal laboratories—until recently.

A genomics lab at the State University of Campinas in Brazil chose to automate yeast strain optimization testing. Using automation, scientists working there more accurately and efficiently screened yeast strains that could be used in second-generation biofuel refineries. The automation greatly assists brute-force cloning and screening clonal populations.

"With automation I can get accurate and reproducible results that simply would not be possible with standard means," says Pedro Tezei, a State University of Campinas researcher (see video).[6]

At the State University at Campinas, the engineered yeast strains were grown and screened to find the most productive organism. The experiments monitored yeast strain activity over four to eight days.

Flexible automation platform made it possible

Using automation, they could collect samples and measure at any time during the multiday protocol. The core lab developed an end-to-end workflow that starts with yeast inoculation, grows the cell population to the appropriate density, and measures the population's productivity over time. They achieved this with the Hamilton Microlab® STAR liquid handler.

Automation can make difficult protocols easy. For each core lab working on strain optimization for biofuels, hundreds of smaller labs are optimizing strains for other synthetic biology applications. These labs can benefit from

early automation to make their processes more robust and ready for scale-up.

Why a robust process matters for scaling up

As researchers scale up bioreactor production, small changes in nutrients, pH, and temperature can influence yield in subtle ways. Careful and frequent testing is needed to maintain consistency and quality. An automated protocol can save months of chasing down false leads and not knowing what parameters have changed and when.

Conclusion and future trends

Automation will be a key piece of the puzzle to improve the efficiency of microorganism screens, sample during cell growth, and analyze cell production output. Without this information taken at reliable intervals—with reliable chain-of-custody data,

The Hamilton Microlab® STAR liquid handling robot. The machine's ability to handle multiple types of labware, from tubes to microplates, was critical in allowing State University at Campinas researchers to automate their complex workflow. The vertical storage of tips and plates on deck means a minimal impact on lab space and eliminates hands-on steps, making the workflow a 24/7 procedure that could be monitored remotely through the LIMS.

understanding how these strains grow, and defining the optimal growth conditions—setting parameters for the bioreactors within biorefineries will be greatly hindered.

However, automation alone will not guide second- and third-generation biofuels to supplant fossil fuels or first-generation biofuels. A few trends are likely to occur.

Biofuels will be niche contributors to worldwide energy consumption. Road maps for the U.S. and the EU both predict that renewables will contribute about 15 percent of our energy diet until 2030 and beyond.[7, 8, 9] To incentivize a switch to more carbon-neutral renewables, policy will be informed by life cycle sustainability assessment metrics.

New companies and technologies will be commercialized to support the new biofuel ecosystem. Policymakers and entrepreneurs alike are conducting gap analyses to understand what technological building blocks are readily available and what is still needed.

Best practices will be pollinated from the agrochemical and petrochemical businesses. Early partners for biorefineries will come from the existing infrastructure of the agrochemical and petrochemical businesses. Already, states such as Minnesota are finding that existing grain co-ops and commercial refineries are extending their business by adding biofuel services.

Automation that scales from the research lab to the pilot lab will be in demand as production inputs are validated. To maximize the return on their automation investment, researchers would be wise to choose a flexible liquid-handling platform that can automate clone selection to microbial screening and reagent mix optimization to pilot scale-up.

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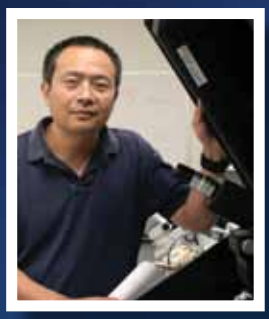


Nongjian Tao, PhD

ASK THE EXPERT

INNOVATIONS IN IMAGING AND MICROSCOPY

by Tanuja Koppal, PhD

Nongjian Tao, PhD, director of the Center for Bioelectronics and Biosensors at Arizona State University's Biodesign Institute and professor in the School of Electrical, Computer, and Energy Engineering, talks to contributing editor Tanuja Koppal, PhD, about a new technique called plasmonic-based electrochemical microscopy (P-ECM) developed in his lab for imaging localized chemical reactions from single nanoparticles. He talks about the advantages of this technique when compared to conventional optical microscopy and scanning electrochemical microscopy (SECM) and its potential uses in diverse areas.

Q: Can you give us some details about your institution and your laboratory?

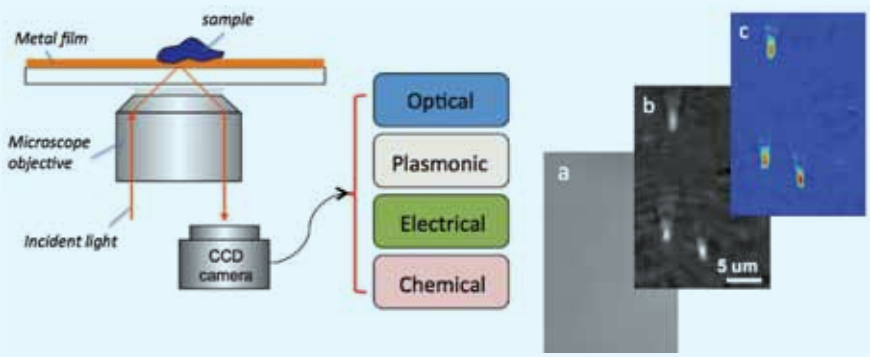
A: The Biodesign Institute at Arizona State University is focused on use-inspired research. It has 12 centers, each covering a very broad spectrum of research areas, from infectious diseases to developing new detection technologies. My lab is in the Center for Bioelectronics and Biosensors, which focuses on developing new detection technologies.

We have nearly 40 researchers—who include 15 PhDs who are faculty, research professionals, and postdoctoral fellows—and about 25 graduate students. All of them come from very diverse academic backgrounds. I have a background in physics and electrical engineering, and others come from chemical engineering, bioengineering, mechanical engineering, material science, computer science, and chemistry. It's all cross-disciplinary research, and so we need people with different academic backgrounds to solve a particular problem. In order to build a new detection technology, we need concepts from physics, we need to build the device with help from mechanical and electrical engineers, we need computer science people who can write the software code and chemists to modify the surfaces for detection, and we need people with a biomedical background to help us with the applications.

Q: How do the new detection technologies that you are developing help fill existing gaps?

A: We are very interested in imaging technology because it tells us not only that something is happening but also where it is happening. It gives you the spatial location that is extremely important, especially in biology, when you are studying cells and tissues. Just like with DNA and protein microarrays, where the homogenous surface can be divided into individual elements, with imaging you can measure each individual element on the sample surface simultaneously to get a high-throughput (HT) detection technology.

We are particularly interested in developing techniques that can give chemical information such as chemical reactivity and charge, which are different from a conventional imaging approach. Most of the traditional imaging and microscopy techniques provide information about the morphology of samples. Optical microscopy, for instance, provides very limited chemical information and does not tell you what it is that you can see. Fluorescence microscopy is also a very powerful technique, but using labels has its own problems, since labels can change the properties of a molecule. Moreover, fluorescence emission tends to be weak, and so you need to accumulate a large amount of signal, which takes time. Often with fluorescence you cannot get a fast dynamic detection process that takes just microseconds. Hence, we are focusing on developing label-free detection technologies that are faster and noninvasive for the study of biological samples.



Multifunctional plasmonic imaging. *Left: Experimental setup. Incident light is directed onto a glass slide-supported metal film via a high numerical objective(21) or a prism (not shown here), and the reflected beam is detected with a CCD camera. At a proper incident angle, surface plasmons, or collective motion of free electrons in the metal film, are excited, which is referred to as surface plasmon resonance (SPR), creating an evanesce wave (near field) near the surface of the metal film. The interaction of the near field and sample on the surface creates a plasmonic image. The sensitive dependence of the plasmonic image on the local refractive index near the metal film and surface charge density of the metal film has led us to develop morphology, chemical reaction and electrical impedance imaging capabilities. In addition, the setup is compatible with conventional bright field and fluorescence imaging, allowing one to combine strengths of different imaging principles into a single setup. Right: Bright field (a), plasmonic (b), and electrical impedance (c) images of 3 viruses. Note that the contrast of the bright field image is too low to reveal the viruses.*

Dr. Nongjian Tao is the director of the Center for Bioelectronics and Biosensors at the Biodesign Institute at Arizona State University. He joined the ASU faculty as a professor of electrical engineering and an affiliated professor of chemistry and biochemistry in August 2001. Before that, he worked as an assistant and an associate professor at Florida International University. He has patents, has published more than 200 refereed journal articles, and has given more than 200 invited and keynote talks worldwide. He is an elected fellow of AAAS and the American Physical Society. His current research interest includes mobile health devices, chemical and biosensors, molecular electronics, and nanoelectronics.

Q: Can you talk about this label-free approach and where it can be used?

A: We have developed techniques to detect electrochemical reactions. The best-known example of an electrochemical detector is the glucose sensor (glucometer). However, traditional electrochemical methods do not tell us the location of the current generated. To get around this problem, Professor Allen Bard at University of Texas in Austin invented the scanning electrochemical microscope (SECM). He used a microelectrode to scan the entire surface of the sample to map the localized electrochemical current.

What we have created is a different approach called plasmonic-based electrochemical microscopy, or P-ECM, where we use visible light instead of a microelectrode to scan the sample surface. However, visible light is not so sensitive to most electrochemical reactions. So we combined it with surface plasmon resonance (SPR), which is very sensitive to electrochemical reactions. We use light to excite SPR on the surface of an electrode (we use gold-coated electrodes), and that gives rise to a large SPR signal. We image this signal on the electrode surface, and that gives us information about the localized electrochemical reaction taking place in the sample. (See accompanying figure and caption.) The conventional SECM approach scans the surface line by line using a microelectrode, whereas with light you can look at the entire surface almost simultaneously. This enables us to perform measurements in a microsecond time scale. Also, using light instead of a mechanical device makes the technique noninvasive and does not destroy the sample surface.

Q: What are the current limitations of P-ECM? What improvements are you working on?

A: We have demonstrated how we can image localized electrochemical reactions using this technique. We are now looking to expand it to plasmonic-based electrochemical impedance microscopy (P-EIM). Impedance is another quantity that is very useful to characterize samples. It measures how different parts of a sample show charge response to changes in the electrical field. We have used this to study ion channel activity in cells.

In summary, what we are providing is a technology platform, and people can certainly use it for different applications. It's a new imaging approach that provides capabilities to look at localized chemical reactions and charge distribution, and it can also be used to study localized molecular binding processes. For instance, we have studied membrane protein binding activity while the proteins are still in the lipid environment, in the cell. Traditionally you have to extract membrane proteins from the lipid environment in the cell in order to study them. This takes a lot of work and effort, and, more important, when you extract the protein its structure and function can change. With P-ECM we can image the cell response and look at the localized binding events at the organelle level, such as in the mitochondria. We are looking to achieve higher sensitivity and higher spatial resolution using this technique. We are also coupling this technique with fluorescence, bright-field, and atomic force microscopy and looking to commercialize it as well.

Q: What do you need in terms of samples and expertise to work with this technique?

A: It's very similar to conventional optical microscopy. The only difference is that we coat the microscope cover slide with a thin layer of gold film because we need to excite the free electrons from the surface, using light to give rise to a SPR signal. If you are familiar with optical microscopy, then you can work with this technique too. The gold-coated slides can be purchased from commercial vendors, or if you have an evaporator you can coat them yourself. You need standard cell culture protocols for working with cell lines and primary cells; [you] load the cells onto the gold film, and that's all there is. You will need to load new software for image processing, and that may take some time to learn.

Q: What are some of the applications beyond life sciences?

A: This is a wonderful technique to characterize the catalytic reactions and chemical properties of nanomaterials. We have used this technique to detect trace amounts of chemicals, specifically explosive chemicals that collect on a surface. We were able to image the chemical reactions of a few particles of trinitrotoluene (TNT) on a fingertip using this technique, although we could not see those particles with an optical microscope. We are trying to make this technique faster, better, and more accurate to look at other diverse applications.

SampleManager LIMS Delivers a Complete Informatics Solution for Method Execution, Laboratory and Data Management

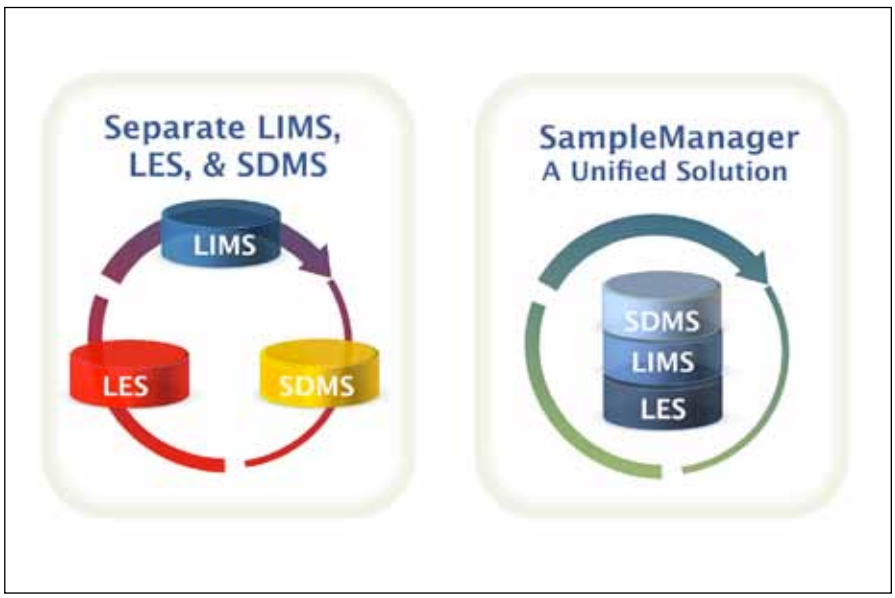
By Trish Meek, Thermo Fisher Scientific

Analytical and QA/QC labs, under ever-increasing pressure to improve time to market, ensure compliance and realize cost savings, now have an all-inclusive informatics solution that gives them complete control over their methods and Standard Operating Procedures (SOPs) without having to purchase, integrate and validate software from multiple vendors.

The new Thermo Scientific Lab Execution System (LES) is web-based, built on and fully integrated with the Thermo Scientific enterprise-level Lab Information Management System (LIMS) platform, allowing the LES functionality to be accessed from the LIMS or from any web browser.

Combined with the instrument integration capabilities of Thermo Scientific Integration Manager, and the raw data storage and retrieval capabilities of the company's SDMS (Data Manager), the new LES expands Thermo Fisher's growing informatics platform, and offers customers the most comprehensive paperless lab solution available today.

The LES offers a number of embedded, feature-rich capabilities, enabling lab managers and scientists across all industries to:

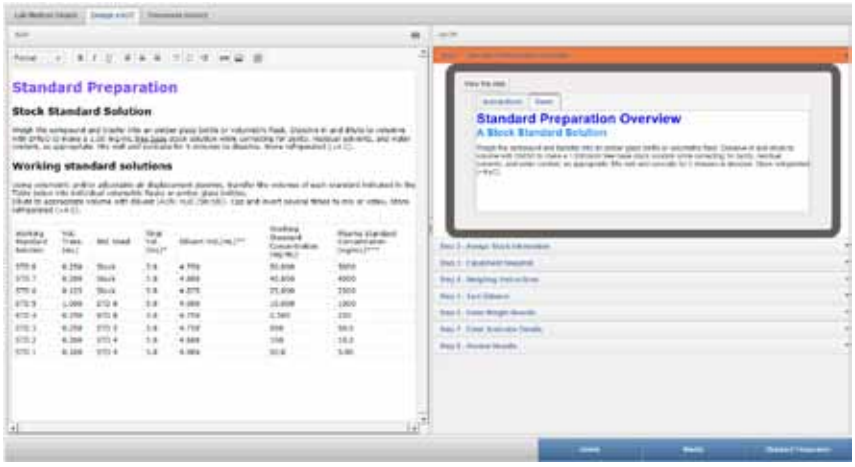


New SampleManager LIMS delivers a complete laboratory informatics solution, with LIMS, SDMS and LES combined for an end-to-end lab workflow.

- Achieve full instrument integration, including managing their own methods and workflow
- Retrieve and archive any kind of raw scientific data
- Export the results across the organization in the format required by the recipient

"Our customers are increasingly searching for opportunities to streamline laboratory processes and come closer to a true paperless lab. Doing this takes cost out of the workflow and other SOPs, allowing lab personnel to focus on an improved process and more revenue-generating activities," says Sanjay Khunger, Vice President and General Manager, Informatics, for Thermo Fisher. "Our goal is to help our customers achieve a truly integrated lab environment. A comprehensive informatics solution is one of the most critical investments any business can make if they are moving towards a truly integrated and connected enterprise."

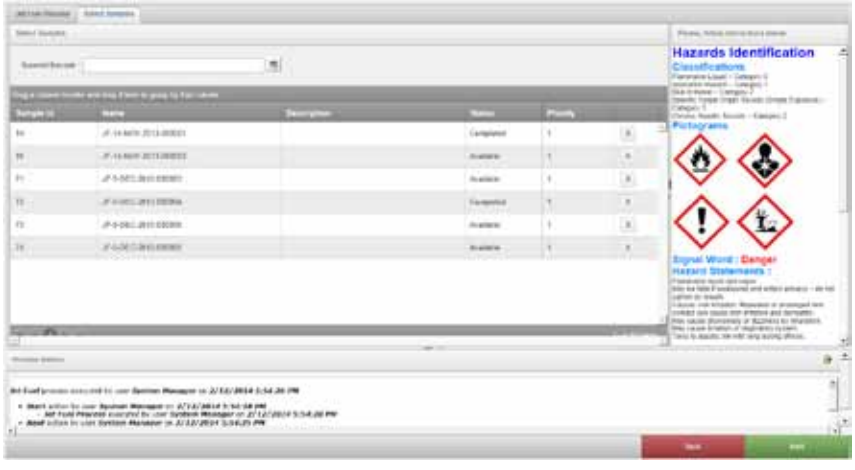
"Our customers are increasingly searching for opportunities to streamline laboratory processes and come closer to a true paperless lab."



SOPs and methods can be broken down into logical steps to guide analysts through the procedure.

Process history provides a detailed description of every activity that has occurred against an SOP or method and their status.

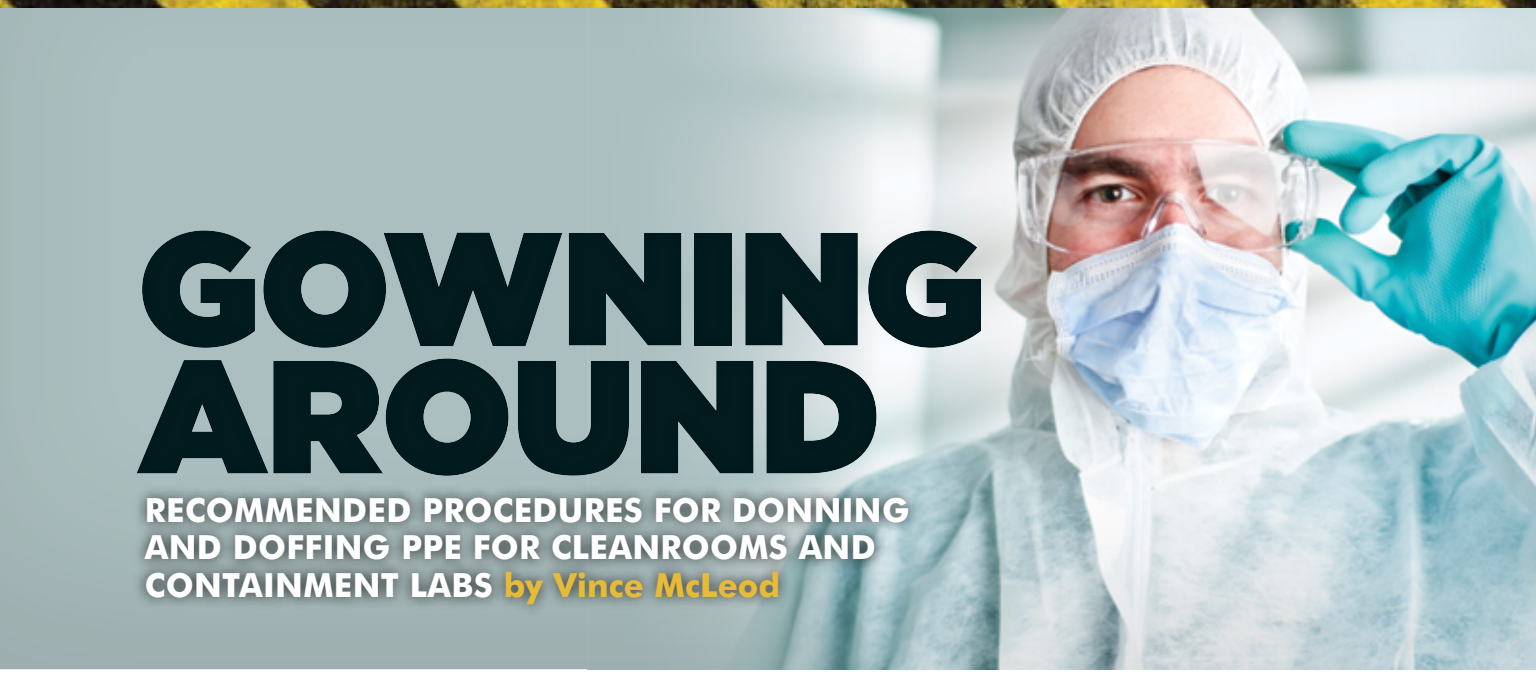
Instructions and illustrations demonstrate proper analytical techniques.



Training records and instrument calibration records ensure that only trained analysts and calibrated instrumentation is used.

Hazard warnings embedded into the SOP remind analysts of necessary safety procedures.

Trish Meek is the Director of Product Strategy for the Informatics business at Thermo Fisher Scientific. To learn more about our Lab Execution System or SampleManager LIMS, visit www.thermoscientific.com/LES or email us at marketing.informatics@thermofisher.com.



GOWNING AROUND

RECOMMENDED PROCEDURES FOR DONNING AND DOFFING PPE FOR CLEANROOMS AND CONTAINMENT LABS by Vince McLeod

Biosafety level-rated research labs are becoming more prevalent in a world focused on genetic and cancer research, pharmaceutical production, and disease treatment. These specialized containment spaces are found in a diverse array of clinical, diagnostic, production, and research facilities. And they are becoming increasingly sophisticated as rapid changes in research equipment, handling protocols, and technology force facility designs to adapt. As safety guys working at a large public university that includes a medical school, a dental school, a veterinary school, animal research colonies, biomedical and cancer research facilities, and a nanotechnology research facility, we are presented with many opportunities to encounter every type of containment laboratory and cleanroom. One thing they all have in common is the need to properly gown up prior to entry and to de-gown before exiting. The exact personal protective equipment required is strictly dependent on the type of containment area and the research work that is ongoing. Rather than discuss specific protocols for the different types of containment areas, we want to provide a generic procedure that can be tailored to fit almost any containment lab or cleanroom, both sterile and non-sterile.

> "The exact personal protective equipment required is strictly dependent on the type of containment area and the research work that is ongoing."

General setup of containment labs

Containment laboratories are constructed so that the room itself is a secondary containment barrier.[1] That is, the lab ventilation is kept at a slightly negative pressure relative to the adjacent areas. In other words, an inward directional airflow is established by exhausting more air than is supplied. This prevents any contaminates from spills or releases from migrating into surrounding rooms. The laboratory exhaust should be vented directly to the outside air, with no recirculation. Depending on the research and materials in use, many times the exhaust air must also be filtered, usually with high-efficiency particulate air (HEPA) filters.[1]

Ideally, separate areas are provided for entry and gowning-in verses de-gowning and exit, although many facilities use a single access for entry and exit. In any event, the ingress/egress point(s) should be part of a two-stage process: a pre-gowning area where the process is started, followed by the gowning or PPE donning room. In an ideal facility, exit is via a separate de-gowning room, then to a final clearance and exit. Air flow is strictly controlled in these areas to fully contain any contaminates.

A few pre-gowning precautions

The following actions and items should receive consideration prior to beginning the process of entering or using a cleanroom or containment lab.

- **Minimize the use of makeup, hair gel, body lotions, and personal skin care products, as these can potentially introduce contaminates.**

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SAFETY TIP

USE WARNING SIGNS TO DESIGNATE PARTICULAR HAZARDS

By James. A. Kaufman

The use of warning signs to designate particular hazards is not just a good idea. It's the law. The OSHA Laboratory Standard 29CFR1910.1450 requires that those areas in which particularly hazardous substances (select carcinogens, reproductive toxins, and highly toxic substances) are used be clearly designated. The OSHA Hazard Communication Standard requires the labeling of hazardous chemicals in the workplace.

Hazard labeling should not be limited to chemical hazards. Mechanical, biological, physical, noise, radiation, hi/low pressure, electrical, and stress hazards should all be clearly indicated with appropriate signs.

Good signs should go beyond hazards and extend to the facilities and equipment we use to deal with these hazards: emergency equipment and emergency facilities. OSHA regulations require the emergency equipment be identified with prominent signs.

Take a good careful look at your labels and see if they can't be improved. Can you make it easier to recognize the hazard and the means of dealing with it? Are cabinets for corrosive storage clearly labeled? Are the circuit breakers in all your electric panels clearly labeled? Do preserved specimens have the identity of the preservative and appropriate hazard warnings on the labels?

Kaufman, James A., Laboratory Safety Guidelines - Expanded Edition, The Laboratory Safety Institute, www.labsafetyinstitute.org.

- **Users should not smoke within forty-five minutes of entering, especially cleanrooms, as it is well documented that smokers shed particulates for much longer than thirty minutes after smoking.**
- **Remove extraneous street clothing such as sunglasses, hat, jacket, etc., before entering the antechamber in order to simplify the process and minimize actions.**
- **Plan out the work in advance so all materials, tools, solutions, etc., are on hand and ready to minimize traffic and the number of entries/exits.**

A recommended gowning procedure

The following procedure is meant to provide a generic order for donning PPE items for a basic- level containment lab or cleanroom. The recommended sequence is designed to help control contamination when donning and removing standard containment/cleanroom PPE. Not every apparel item is needed in all cases. Check your facility's procedures. If you are dealing with highly infectious or toxic agents or working in a highly sterile lab (pharmaceutical preparations, an FDA-regulated lab, etc.), then additional steps and much stricter protocols will be necessary. [2]

Covering up

- **Don bouffant cap and beard cover and make sure all hair is covered.**
- **Don shoe covers, tucking in all laces, tassels, etc.**
- **Select, inspect, clean, and then don safety glasses.**
- **Don gowning gloves (usually required for sterile environs).**
- **Don face mask (N95, N100, etc.), and bend nosepiece to fit snugly on bridge of nose.**
- **Don hood (if separate and required, usually a part of a coverall gown) and secure face and neck seals.**
- **Don coverall gown. Make sure gown does not touch the floor by gathering leg and arm cuffs first and releasing one at a time. See the Sterile Preparations Manual for a good description of this process.[2] If a separate hood is used, tuck shoulder panels inside and under the gown before zipping up.**
- **Don boot/shoe covers and pull over outside of gown legs.**
- **Don the second pair of gloves and stretch them over gown sleeve cuffs.**

You are now ready to enter the cleanroom or containment lab. Upon completion of your work, exiting the containment area is generally the reverse of the above steps. However, there are a few things to consider and remember, so we will list the steps in full.

De-gowning and exiting

- **Remove boot/shoe covers and, if wearing two pairs of gloves, discard the outer pair of gloves. If only one pair of gloves is worn, it should be removed last. If boot covers will be reused, store in a separate proper container.**
- **Remove the coverall gown. If the gown will be reused, hang in approved and controlled area; otherwise, discard.**
- **Remove eyewear and place it in proper storage container.**
- **Remove hood and follow same steps as for the gown if it is to be reused.**
- **Exit gowning room and enter antechamber.**
- **Remove and discard face mask.**
- **Remove and discard bouffant cap.**
- **Remove and discard shoe covers.**
- **Remove and discard inner pair of gloves (if applicable).**

Final words

Work in containment labs and cleanrooms is very serious business. Failure to follow protocols could potentially put you, your coworkers, and others in danger or at risk. Contamination could cause loss of many hours of research and possibly ruin the product, incurring huge financial losses. The PPE requirements are used for good reason. Be patient and properly gown in and out every time you enter a containment area. And remember—safety first!

References:

1. *Biosafety in Microbiological and Biomedical Laboratories, 5th Edition*, Center for Disease Control, US Department of Health. Atlanta, GA. 2009. http://www.cdc.gov/biosafety/publications/bmbl5/
2. *Manual for Sterile Preparations*. Pharmaceutical Services Division, Ministry of Health, Malaysia. November 2013. http://www.pharmacy.gov.my/v2/en/documents/manual-sterile-preparations.html

***Vince McLeod** is an industrial hygienist certified by the American Board of Industrial Hygiene and the senior industrial hygienist in the University of Florida's Environmental Health and Safety Division. He has 25 years of occupational health and safety experience at the University of Florida, and he specializes in conducting exposure assessments and health hazard evaluations for the university's 3,000-plus research laboratories.*

EVAPORATORS

CAPTURING THE REQUIRED CONTROL AND MAINTAINING IT DEPENDS ON THE RIGHT PLATFORM AND CARE

by Mike May, PhD

Learning to use evaporation starts very early in chemistry. For students, the process takes a very simple approach, maybe just putting a solution in a beaker over a flame and waiting. That technique, though, doesn't provide the sophistication, control, or throughput that advanced techniques require. Consequently, scientists can use dedicated evaporators.

At the U.S. National Institutes of Health's Chemical Genomics Center, analytical chemistry team leader William Leister needs throughput and flexibility in evaporation. For one thing, he uses a wide range of containers: test tubes of various sizes, in racks that hold different numbers of test tubes as well as 96-well plates. Consequently, he says that he needs an evaporator that provides "flexibility of rack configurations." He adds, "For our needs, the ability to control each side of our evaporator independently is very important."

Keep it rotating

"Rotary evaporation is a staple in chemistry labs, like using a hot plate or overhead stirrer," says Jim Dawson, president of Heidolph North America (Elk Grove Village, IL). He adds that chemists get very particular about this device. "How it's set up and used is very personal," he says.

To keep this device working right, says Dawson, you "need to use the right vacuum pump with the appropriate vacuum control for the application." That control, though, gets very application-specific. As Dawson explains, "Sometimes you need precise vacuum control, but sometimes a basic manual knob is enough." Beyond that, the required care involves the seals, glass joints, and tubing. Those pieces must be maintained to keep the desired level of vacuum during evaporations.

In buying a new rotary evaporator, Dawson encourages customers to consider the safety and ease-of-use features. After that, he says that you should look for the level of control that you need. To confirm what that is, and to keep a device operating effectively as long as possible, Dawson says, "I can't stress enough the value of face-to-face support—helping the customer with the purchase, setting up the instrument, and offering support through the lifetime of the device."

Controlling contamination

Today's evaporators often handle multiple samples at once, but each must be processed without being impacted by the others. So Jim Jacso, director of sales and engineering at Glas-Col (Terre Haute, IN), says that scientists must make sure that there's no cross-contamination. That requires careful control of the airflow. "Slow airflow at first prevents cross-contamination," Jacso says.

A user must also keep a system in excellent condition. To do that, Jacso emphasizes keeping the needles clean. "If holes are plugged up in the needles," he says, "you get wells that aren't drying down." In processes that involve acids, the needles can get corroded and plugged. Some systems use stainless-steel needles; others use polytetrafluoroethylene. "Choose the proper needles depending on what you are doing," Jacso says.

> "There is an evaporator for just about everyone."

If a system includes a regulator, as many do, it must be maintained as well. "Make sure that it's up to speed and functional," Jacso says.

The world of evaporators moved beyond a beaker over a flame long ago, and today's options can get overwhelming. "You can get ones that shake, heat, heat a gas," Jacso explains. "You can also get programmable evaporators." He adds, "There is an evaporator for just about everyone. You can spend under $1,000 and up to $20,000."

***Mike May** is a freelance writer and editor living in Ohio. You may reach him at mike@techtyper.com.*

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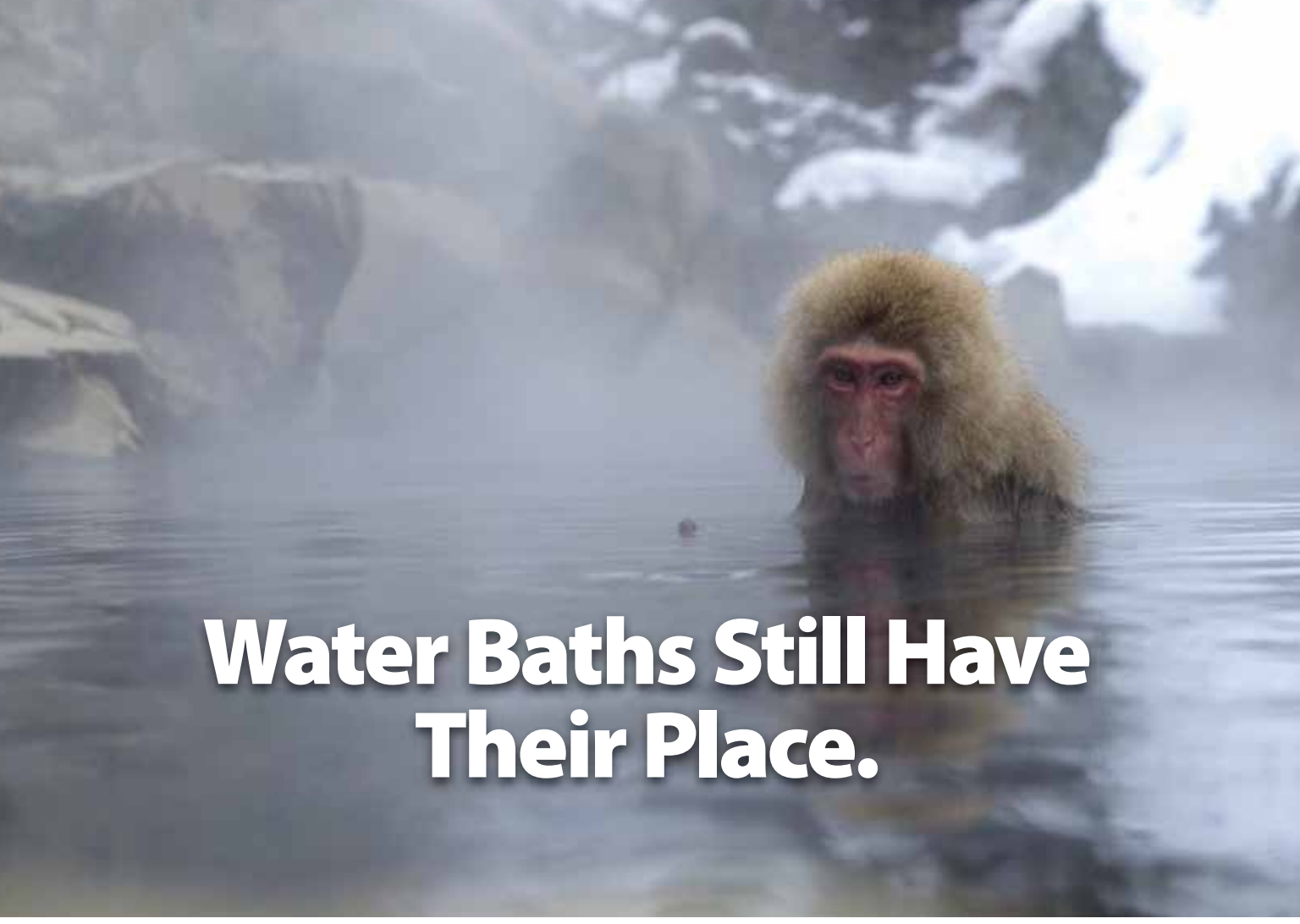

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MICROPLATE HANDLERS

STREAMLINING WORKFLOWS, CONNECTING OPERATIONS

by Angelo DePalma, PhD

Microplate handlers are the robotic "glue" that unifies operations around a microplate workflow. The evolution of robotics and software has caused a "democratization" of lab automation in general, and microplate handlers in particular.

Eric Matthews, Midwest sales manager at BMG LABTECH (Cary, NC), notes that the commoditization of plate handlers has led to greater visibility for companies specializing in dedicated microplate handlers, as opposed to large robotic systems. Matthews mentions companies like Caliper (a PerkinElmer company) and Hudson Robotics in this regard.

The same technologic and economic factors are allowing vendors like Stäubli and HiRes Biosolutions, which manufacture industrial-scale robots, to enter laboratory and research markets. "Laboratories are using Stäubli robotic arms in many interesting ways," Matthews says. Additionally, these players are teaming with vendors of industrial automation software to create ultra-fast microplate-centered automation systems that, according to Matthews, "practically eliminate all workflow bottlenecks."

Timothy Sherrill, program manager of integrated solutions at Beckman Coulter Life Sciences, describes this trend as "automation pushing out into the lab. Vendors are combining applications with hardware to provide a better out-of-the-box experience for end users, while requiring less training."

Improved capabilities

Since serving the needs of resource-rich labs is not an issue, vendors of microplate handlers must now focus on the needs of labs with limited financial and human resources that need automation. Since both high- and low-end systems have become easier to use, both dedicated and large automated systems allow labs to take on microplate-based automation tasks that once required automation specialists.

"More and more systems from companies like Hudson and Caliper are going into core labs at universities. Labs can acquire these plate handlers, put them into a fume hood, and perform many tasks without a lot of automation expertise," Matthews tells *Lab Manager*.

There has also been a retrenchment of sorts within industries that comprised the traditional market for plate handling. Pharmaceutical companies are screening a fraction of the compounds they tested during the late 1990s and early 2000s, for example. This shift, from "the power of big numbers" to more focused screening, has been a boon to less sophisticated plate-handling systems. Those that shuttle microplates between a stacker and one device, say, a reader or washer, can handle a formidable share of workflows.

"Stackers now have greater functionality," Matthews adds. "Ours is just a plate feeder, but others can move from a washer to a handler. And that one step, two-instrument integration, solves about 90 percent of the problems for many core facilities. Not every lab needs a traditional enclosure with fifteen different things going on inside."

Until about five years ago, sophisticated systems dominated. Today, the trend is toward using smaller, safer robots designed for laboratory use. Beckman Coulter Life Sciences, for example, has moved from the lab-focused ORCA (Optimized Robot for Chemical Analysis), to an industrial arm and now to the Precise Automation PF400, a device that operates alongside workers without the need for a safety barrier.

> "Both high- and low-end systems have become easier to use."

"Automation vendors now have platforms that address most common laboratory liquid-handling requirements with more that can be done on the deck of the instrument," notes Sherrill. When a laboratory's workflow goes beyond these stand-alone capabilities, adding one or more accessories (thermocycler, centrifuge, plate washer, plate sealer, etc.) is easily accomplished. "Software to handle these systems has progressed with an increased focus on data management."

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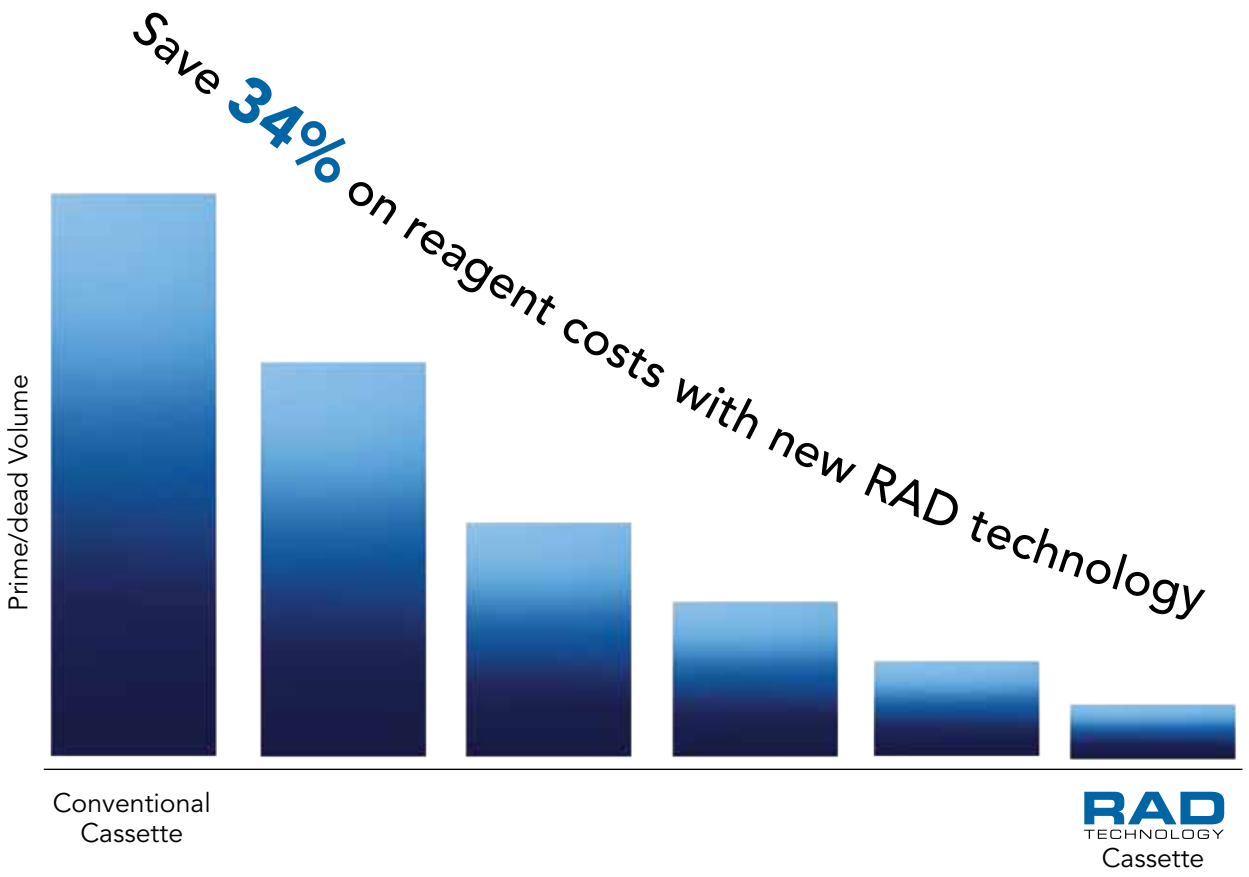

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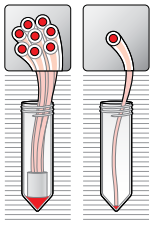

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Range of needs

Markets for microplate handlers are characterized by a huge range of needs, from simple handlers and stackers that streamline simple workflows, to room-sized, multimillion-dollar setups. BioTek Instruments (Winooski, VT) serves the more straightforward low- to mid-range need for automation. With the capacity for up to 75 microplates, the company's BioStack line of plate stackers enables automation to single microplate washers, dispenser, or readers.

In late 2013, BioTek expanded its BioStack Microplate Stacker line with the BioStack 4, the first BioTek stacker capable of handling plates with lids. BioTek also added products for cell imaging and washing/dispensing.

"Until now, labs that worked with lidded plates had to move up to a full-featured microplate handler, which raises acquisition costs up to the forty to fifty thousand dollar region," says Jason Greene, BioTek product marketing manager. "BioStack 4 works with standard plate lids, so users don't need to purchase the consumable from us," Greene adds.

The device has the capability of de-lidding the plate, delivering it to a plate washer, then re-lidding and delivering to storage. Or, in the case of contamination-sensitive cells, plates can retain their lids during a reading operation.

Lidded microplate operation is indicated for many cell-based operations (culturing, screening, or cell-based assays) or processes where evaporation may be an issue. Living cells are prone to contamination by adventitious organisms. Lidding allows investigators to aspirate and replenish media with confidence. Evaporation can result in overly high readings, for example, or loss of critical working volumes. "There's not a lot of volume in most microplate wells to begin with," Greene observes. Microplate handlers lacking lidding/de-lidding capability must rely on the tenuous "seal" created by stacking plates on top of each other.

> "Today, the trend is toward using smaller, safer robots designed for laboratory use."

BioTek's focus on low- to mid-range automation does not strictly limit the company to those markets. When a big-budget customer wishes to automate an entire assay, BioTek turns to one of its more than 20 partners, such as Hamilton Company, HighRes Biosolutions, or Thermo Fisher Scientific. "Their robot ties all those operations together, but our components are part of that process," Greene says.

BioTek's partnering activity is not unique among automation companies of modest size. To facilitate those collaborations, the company maintains a privilege-based FTP website, its Automation Integrators' Site, dedicated to automation partnerships. BioTek constantly updates the site with solid model drawings, software, and programmer documentation, to facilitate integration of its instruments with larger automation systems. BioTek is also involved in SiLA (Standardization in Laboratory Automation), an organization dedicated to interoperability of automation components and systems.

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MICROWAVE DIGESTERS

CONSIDER YOUR CHEMISTRY FOR TODAY AND TOMORROW FOR HIGHER SAVINGS

by Mike May, PhD

When preparing a sample for analysis that requires high temperature and pressure in an acidic environment, a scientist selects microwave digestion for the process. This attracts scientists from an extraordinarily large range. "Microwave digestion uses are extremely broad," says David Gunn, applications manager at Milestone (Shelton, CT). "It includes processes in the food industry, pharmaceuticals, precious metals, mining—just about anything where you analyze trace metals."

Furthermore, microwave digestion impacts not only what you want to do but also how you want to do it. Bob Lockerman, analytical product manager at CEM Corporation (Matthews, NC), explains, "Microwave digestion is typically used for throughput, when people want to speed up sample preparation."

Stay out of the hood

To keep a microwave digester working properly as long as possible, users should follow a few guidelines. "Keep these systems out of the fume hood and away from corrosives," says Lockerman. "Don't sit it near a bottle of acid." He adds that all manufacturers build these devices so that the air inside the vessel does not get to the electronics, but he adds, "The electronics have to breathe, and they collect air from outside the cavity. If you put the digester in a heavy acid environment, that will affect the electronics."

Maintenance of a microwave digester also includes another step. "Inspect the vessel," Lockerman says. "Look for wear and tear." He mentions that most manufacturers provide specific guidelines for inspecting the vessel. Gunn adds, "Make sure that your chemistry matches up to the specifications of the vessel."

> "Make sure that your chemistry matches up to the specifications of the vessel."

Like any technology, a microwave digester does the job right only when it's used properly. When asked about the most common mistakes in using this device, Lockerman says, "It's putting the vessel together incorrectly." He adds, "The vessel should be simple to put together, so there's less chance to make a mistake."

Another common mistake, says Lockerman, happens when users put in too much sample.

Buying tips

At Exova (Santa Fe Springs, CA), Peter Espinoza, sample prep coordinator for the inorganics group, says, "We analyze every element on the periodic table." Depending on the process, he needs different temperatures. "For really difficult samples, like plastics and polymers," he says, "we use up to 250 degrees and 40 bars of pressure." To keep his systems running properly, he says, "We try to follow the recommendations from the manufacturers, and we have a service plan, so they come out once a year."

Espinoza's comments make a perfect introduction to Gunn's key buying tip: "When shopping for a new microwave digester, make sure that it has the ability to do all of your samples." He adds, "It must cover all of your samples and provide the throughput that you need."

The samples that Gunn describes should be for today and the near future. "Think down the road," he says. "What will I need in the next ten years?" Although that can be difficult to predict, it's worth a try. "If you suddenly go to something more difficult," Gunn says, "you might need a new device."

So when buying a microwave digester today, it helps to think about the chemistries that you might run tomorrow. Considering tomorrow's necessary temperatures and pressures could save you money now and in the future.

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TOC ANALYZERS

GATEKEEPER INSTRUMENTATION FOR WATER QUALITY

by Angelo DePalma, PhD

Total organic carbon (TOC) analyzers present a rapid, efficient measure of the carbon contamination content of public drinking water and ultrapure water for lab operations.

Thermo Fisher Scientific (Waltham, MA) TOC analyzers are integrated into lab water purification systems, rather than sold as stand-alone instruments.

Within that context, TOC analyzers operate either in-line or at-line—a reference to how the sampling is done and where the analysis occurs, notes Julie Foster, product manager for water purification at Thermo Fisher Scientific.

> "The benefit of off-line detection is that the whole cell can be calibrated and tested independently."

For at-line operation, the analyzer extracts a sample periodically and runs the TOC measurement discretely and apart from the water production line. Several vendors offer similar systems. Thermo Fisher's is incorporated into its Barnstead NanoPure brand of water purification systems, which also provides resistivity, conductivity, and temperature measurements.

A less expensive option involves in-line TOC analysis. Here, the conductivity cell exists within the purification path.

"The benefit of off-line detection is that the whole cell can be calibrated and tested independently," Foster says. "And because it's off line, the integrity of feedwater is less important than for in-line measurements. The feedwater can be dirtier." Since in-line TOC monitors water quality during purification, the feedwater must be cleaner.

One may ask why a TOC analyzer is needed at all in systems with UV oxidation, which practically guarantees TOC levels of less than 5 ppb.

"Customers who require accountability or traceability want to see an actual readout that they can record and keep," Foster explains. "This includes operation under Good Laboratory Practices, which always have real-time measurements of TOC and resistivity."

Additionally, laboratories that analyze organic materials at very low levels, say, by liquid chromatography, want assurance that compounds in their feedwater will not show up in their traces or raise the noise level. "If water is impure, the contaminants will show up in those traces,"

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Foster says. Additionally, critical cell culture and electrophoresis work may require documentation of acceptable TOC levels.

Regulatory stimulus

The U.S. Environmental Protection Agency's Disinfectant Byproduct Rule was enacted in stages beginning in the late 1990s, as part of the Clean Water Act. The regulation holds water utilities responsible for characterizing their product for levels of disinfection byproducts (DBPs), which form when disinfectants are used to control microbial pathogens. Over 260 million Americans are exposed to DBPs.

> "Before this rule, online TOC measurement was an anomaly. Now people are seeking us out."

Specifically, the rule tightens compliance monitoring requirements for trihalomethanes (THMs) and haloacetic acids (HAAs), and has been a boon for TOC monitoring, according to W. Gary Engelhart, laboratory products and marketing manager at OI Analytical (College Station, TX).

"Paralleling this, we see increased attention to online TOC, or grab-sampling, to get a better handle on levels of these contaminants in drinking water," Engelhart tells *Lab Manager*. "Before this rule, online TOC measurement was an anomaly. Now people are seeking us out. It has been a tipping point."

The HAA and THM problems are seasonal, arising mostly during warm months when algal or bacterial blooms are most likely and water companies are more inclined to use disinfectants. TOC is not the only way to quantify these compounds. OI's own purge-and-trap system for GC-MS will do the job, and Parker Hannifin sells a dedicated THM analyzer.

Nor are HAAs and THMs the only consequence of bacterial or algal blooms. When microorganisms die, they release compounds that produce disagreeable odors, even in the ppb concentration range.

"Water plants struggle to master these situations," Engelhart says. "TOC is a good indicator of what's coming into the plant."

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SAMPLE PREPARATION FOR HPLC/UHPLC

TURNING SAMPLES INTO RESULTS

by Angelo DePalma, PhD

Most HPLC analyses employ some form of sample preparation, especially with low-concentration analytes in complex mixtures. According to Anil Kurup, senior marketing manager for pharmaceuticals and bioanalysis at Waters (Milford, MA), the type and extent of sample prep depend on the compound(s) under investigation (e.g., small or large molecule), sample matrix, required detection limits, and the instrumentation and detector. The Separation Science website, www.sepscience.com, which is devoted to chemical analysis, expands on some of these considerations.

"Identifying the right sample preparation technique is critical for analyzing nanogram levels of a small-molecule drug with LC/MS from a few microliters of biological sample," Kurup says.

Analysts have many techniques to choose from: dilution, filtration, solid phase extraction, micro chromatography columns, affinity adsorption, enzymatic digestion, and solid phase extraction (SPE), to name a few.

Is UHPLC different?

One of the selling points for UHPLC has been a reduction in run times compared with standard HPLC. Three- to fivefold improvements are easily attainable, and tenfold not unheard of. But improved efficiency has shifted the workflow bottleneck from the run itself to sample prep.

"Users looking to reduce workloads and analysis times, at lower cost, often begin with sample preparation," says Trisa Robarge, sample preparation product manager at Agilent Technologies (Santa Clara, CA). "Clearly, users are looking to reduce the amount of sample prep they do."

A study published by Pall Corporation (http://goo.gl/GVBV7w) clearly demonstrates the value of 0.2-micron filtration in UHPLC. It compares injection of polymeric microspheres under three conditions: unfiltered, 0.45-micron filtration, and 0.20-micron filtration. After just 10 and 15 injections, respectively, columns clogged under the first two conditions as back pressures doubled from 2,000 psi to more than 4,000 psi. But back pressures remained constant under the 0.2-micron filtration condition, even after 1,000 injections.

The study concluded that 0.2-micron filtration "prolongs the lifespan of the UHPLC column at least fiftyfold relative to filtration using 0.45 µm syringe filters and over a hundredfold compared to use of unfiltered samples. The cost savings generated by this simple filtration step is thus likely to be very significant."

Not all experts would agree on those cost savings.

According to Kurup, labs operating under GLP (Good Laboratory Practices) will routinely filter all samples, regardless of whether they use HPLC or UHPLC, through a 0.2-micrometer filter. Under these circumstances, UHPLC does not present any additional sample preparation burden. Nor does UPC^2, Waters' trademarked supercritical fluid chromatography (SFC) platform, according to Kurup.

So in the end, "To prep or not to prep?" becomes an economics question for which labs must weigh the time and cost involved in preparation against the cost of a column.

Rapid methods

The simplest sample prep routine involves "dilute and shoot"—simply adding buffer to bring the sample to an appropriate concentration, and injecting. Dilute and shoot has the advantages of speed and being practically free. It works well with pure compounds dissolved in pure HPLC-grade solvents, but many chromatographers avoid it because of the potential column damage.

As Jason Weisenseel, PhD, chromatography technical leader for aftermarkets at PerkinElmer (Orlando, FL), notes, "UHPLC operators need to be careful what they put into their system.

Sample prep takes on even greater significance than in conventional HPLC."

Weisenseel suggests, at the very least, passing samples through a 0.2-micron filter, even when a more thorough cleanup technique such as SPE is employed. "SPE removes particles, but I like to be on the safe side. You can get away without filtering up to a point, but particles will eventually build up within your system."

Along with solid-supported liquid-liquid extraction (SLE), SPE has become a workhorse for HPLC sample prep. "Conventional liquid-liquid extraction is time-consuming and uses a lot of glassware," says Robarge. "The alternative, SLE, operates through the same principle as conventional liquid-liquid extraction, and is appropriate for automation."

Depending on how they are used, SLE and SPE can address both matrix removal and analyte concentration. In ion exchange mode, SPE often removes all interfering matrix and achieves concentration. While SLE is not normally thought of as a concentration technique, depending on the reconstitution volume, analytes may be significantly more concentrated than they were originally.

Another consideration, particularly for biological samples analyzed by LC/MS, is lipid removal. "Lipids and phospholipids cause ion suppression in MS and negatively affect method ruggedness accuracy," Robarge says. Of the lipid-depleting protocols and kits currently marketed, Agilent's CaptivaNDLipids claims to remove particulates as well, according to the company, potentially saving a filtration step while sparing columns.

Lipid depletion is increasingly applied in the analysis of foods and samples outside the life sciences, which has led to various kits for removing this class of interfering species. In late 2013, Waters introduced the new Ostro™ sample preparation plate for removing phospholipids from biological samples. The product was designed to complement SPE. According to the company, Ostro removes 30 times more phospholipids than conventional extraction, and deals with multiple phospholipid subtypes as well.

QuEChERS update

Several preparative methodologies developed for one type of sample and analyte have shown to be useful, with modification, for other, seemingly unrelated workflows. For example, in the decade since its debut, the QuEChERS (quick, easy, cheap, effective, rugged, and safe) method of rapid sample prep for pesticide analysis has become a generalized method for both GC and LC. The technique uses centrifugation or homogenization, accompanied or followed by reagent addition, to render analytes suitable for chromatographic analysis.

Agilent, Waters, Phenomenex, SigmaAldrich, PerkinElmer, Restek, and Thermo Fisher Scientific (among others) sell QuEChERS sample prep kits for analyzing "everything under the sun," according to Robarge. The proliferation of QuEChERS and similar approaches to sample prep leaves end users with more choices than for, say, columns. As a result, chromatographers need to be more cognizant than ever of sample characteristics and purification capabilities.

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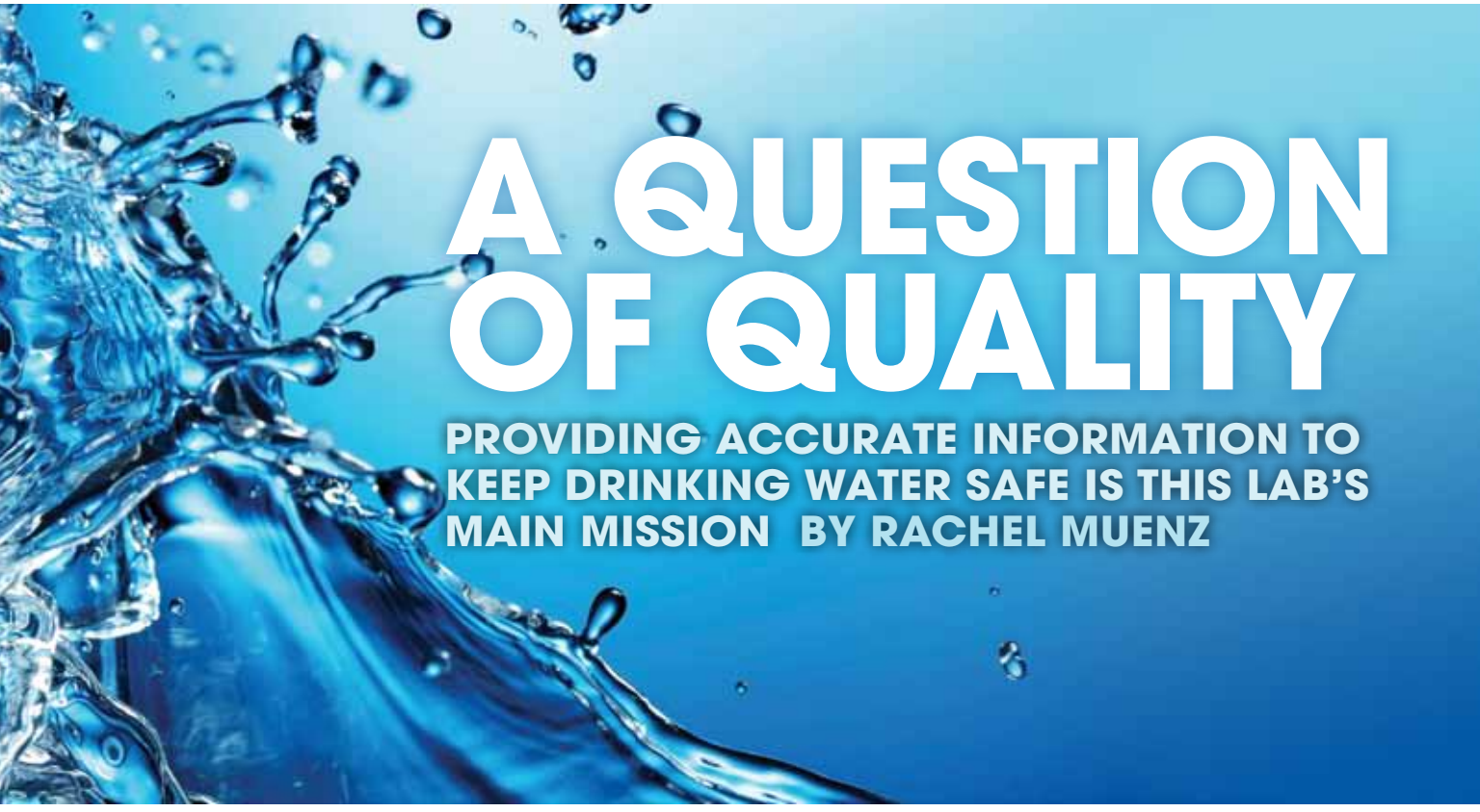
FOR ADDITIONAL RESOURCES ON SAMPLE PREPARATION FOR HPLC/UHPLC, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/SAMPLE-PREP



A QUESTION OF QUALITY

PROVIDING ACCURATE INFORMATION TO KEEP DRINKING WATER SAFE IS THIS LAB'S MAIN MISSION BY RACHEL MUENZ

"Is my water safe to drink?"

Getting the answer to that question is Russell Leu's main goal as section supervisor of the environmental laboratory in the Montana State Department of Public Health & Human Services (DPHHS). The lab's first priority is to ensure that the state's drinking water is safe, analyzing water from public water supply systems, private wells, and other sources for possible contaminants.

All public water supply systems in Montana have to do a certain amount of sampling (depending on their size) to meet regulations, Leu explains.

"It may be something as simple as a bacteria [test] once a quarter, or once a month, or it may be a lot more than just bacteria," Leu says. "There is a lot of chemical analysis testing—pesticides, herbicides, volatile organic compounds, semi-volatile organic compounds, and radiologicals. The big cities have a lot more sampling to do than a small RV park or a bar that handles fewer people."

Individuals who just want to know whether their water is safe can also get their samples tested at the lab and get any questions about their results answered. Leu says providing those answers is one of his favorite parts of the job.

▲ *DPHHS Environmental Laboratory chemist Jill Cohenour concentrates on her work.*

"It can be pretty daunting [for the average person] when you get a number that's 20 parts per billion of this and .05 parts per billion of that," says Leu, who has worked in his current position for almost four years but has over 20 years of analytical chemistry experience. "What does that all mean? The average person needs some help."

The most common tests the lab runs are for total coliform and E. coli, but there are several other contaminants they look for that are particularly common to Montana.

"Because we're a rural state with a lot of farming, nitrate testing is a very important test that we do," Leu says, adding that there's also a lot of mining in Montana. "When you have mines, you sometimes have tailings, and then you have water running through those, and it can pick up some of the heavy metals—arsenic, lead, cadmium, etc.—so [residents] want to know what they are."

On rare occasions, municipalities have emergencies with their water supplies that they need analysis for.

"Once in a while we will get a situation where, say, with a public water supply system, their storage tank has been breached and there is the possibility

that something not so nice was put in it. So then we would test for various possible contaminants in their system," Leu says.

But the environmental lab, part of the state's laboratory services bureau which also includes a clinical lab, isn't the only one looking after Montana's drinking water. Currently, there are 20 out-of-state labs and 18 in-state labs certified to do water testing in Montana, and it's the state laboratory's job to certify them.

"We do on-site audits once every three years for in-state laboratories, and we do the reciprocal certification for out-of-state laboratories, those who are certified by NELAC [National Environmental Laboratory Accreditation Conference] or the EPA [Environmental Protection Agency] or their state certifying authority," Leu says.

In addition to those main duties, the lab also helps the Department of Environmental Quality with many of its summer sampling and monitoring projects and even helps out college professors with some analyses.

"For example, we're doing a mouse blood metal analysis for a researcher at a college," Leu says. "She got a grant to do some testing and wasn't able to do it herself, so she contracted it out to us."

Skills and staffing

Currently, those responsibilities are handled by Leu and his staff of four chemists (they are looking for a fifth). The lab is also part of the Centers for Disease Control and Prevention's Laboratory Response Network (LRN), meaning the lab also has a part-time chemical terrorism coordinator on staff.

"It [the LRN] involves us being proficient in analyzing several possible agents of terrorism, so if there was some sort of contaminated site or act of terrorism where they suspected an agent of terrorism and they identified it, we would be able to analyze those samples," Leu explains.

When hiring staff members, the lab prefers individuals with chemistry degrees, though any sort of science degree paired with analytical laboratory experience is also acceptable, Leu says, adding that three of his chemists have chemistry degrees while the fourth has a microbiology degree and lots of lab experience. Once staff members begin, they receive thorough training that varies depending on what experience they have.

"They're definitely going to have to learn our laboratory information management system [LIMS], because that's where all the customer information and all the test information is put in," Leu says. Along with that training, there is an orientation program that familiarizes new staff with all the state requirements, and the state public health and safety division has a

half-day training program that is specific to the lab. Each test done in the lab is EPA-approved, which means staff have to learn the standard operating procedures and system requirements that go along with those tests.

"You don't just hand them a method and say, 'Start analyzing samples,'" Leu says. "There are demonstrations of capability that they have to perform, there are method detection limit studies that they have to run, and then they have to pass the proficiency test before they are fully qualified to run that method. Otherwise, they would have to work under a senior chemist or one who's certified for that particular method."

The metals analysis section of the laboratory.

Staff are kept busiest during the summer months when the lab is "bombarded with samples," Leu says, but things slow down in the winter. Because of the cyclical nature of their work, the number of samples the lab deals with each month varies greatly.

"All of our big projects probably come from April to October, and then it's just finishing those off. And we get a few standard bacterias that run year-round and a few other small sampling batches," he says. "You either have a lot of samples or you have a few. The winter months are when you do all these demonstrations of capability and method detection limit studies and linear range studies."

Winter is also when the lab, which is certified by EPA Region 8, does a lot of its instrument maintenance.

Looking after the lab

As section supervisor, Leu is responsible for ensuring that samples are being run through in a timely fashion, that the lab meets all the method holding times, and that when the sample is completed and they generate a report, all the QA/QC requirements are being met and the lab is quickly producing legally defensible data. He also makes sure chemists have the supplies and consumables they need, checks backlog reports, and resets priorities when necessary to complete any projects that may have fallen by the wayside.

"There are some tests that take a lot longer than others, and some of them can be done in a matter of minutes," he says. "Some of them are five-day tests. It's a matter of making sure that we meet the method turnaround time."

Leu says he doesn't have to do much to motivate his staff, but he works to keep a positive atmosphere in the lab.

DPHHS Environmental Laboratory supervisor Russell Leu.

"They're pretty much self-motivated, but we try to keep them informed on what future projects are coming up," he says. "We try to use a lot of humor and keep it light in the lab. We want to do serious work here, but we also want to have fun doing it."

Both the environmental and clinical labs are overseen by DPHHS Laboratory Services Bureau chief Ron Paul, who ensures that staff members at both labs are able to do their jobs properly.

"I view my responsibility as ensuring that the folks who work in those laboratories are equipped and have the proper capability to be able to fulfill the goals of those respective laboratories and, hopefully, be able to do their jobs better with my help," says Paul.

As with most laboratories, there's no such thing as an average day in Montana's state environmental lab, apart from reviewing instrument worksheets and generating reports, Leu says.

"A typical day for me is not typical," he says. "Every day when I leave, I usually write down a list of things I want to do the next morning. There's been several days where I haven't gotten to a single one of those."

Many other environmental labs can likely relate to one of the main challenges Leu's lab faces: waiting for new methods to be approved by the EPA.

"We have to use EPA-approved methods and, without being too critical, it takes a long time for a new method to become approved by the EPA," he says. "Just because some latest and greatest technology is out today, we probably wouldn't be using it for years, until the method is set up, validated, and approved by the EPA."

Paul adds that the lab faces financial challenges as well. As a fee-based laboratory, revenues are unpredictable, so they have to be smart with budgeting. "We have to sustain ourselves by being financially sound, keeping an eye on the integrity of our financial status, and ensuring that we're living within our respective budgets," Paul explains. They stick to those budgets and overcome other challenges by making sure they are getting the biggest bang for their buck and by getting input from others in the lab.

> "We try to use a lot of humor and keep it light in the lab. We want to do serious work here, but we also want to have fun doing it."

Past, present, and future

In the past, repetitive tasks and high organic solvent use were issues faced in the environmental field. Automation has taken over those rote tasks, Leu says of major industry changes, and far less solvent is needed for testing. He adds that things are a lot safer. "When I first started out, I worked on a college campus. When we had excess organic solvent, it was put on a steam table and up the stack it went, so the answer to pollution was dilution," he says. "Nowadays, we don't get by with that. You save all your organic solvent, and when you get a certain amount, someone comes and collects it."

For Leu's lab specifically, reporting results is going to get a lot easier as they upgrade to a new LIMS called Element from Promium.

"We had an approximately ten-year old LIMS, but the company went bankrupt, so there was no support for it," he says. "Luckily, we had an in-house IT person who could do a few upgrades, but we were getting left behind as far as reporting out some of the results."

MAIN INSTRUMENTS AND TECHNOLOGIES:

- Promium Element LIMS
- Variety of GC systems that use both electron capture detectors and selective detectors
- LC systems that use UV-Vis and fluorescence
- Post-column derivatization
- LC-MS-MS
- IC
- Inductively coupled plasma
- Coulometric system for doing nutrient analysis
- Microwave digestion
- Ovens and refrigerators

The new LIMS will allow them to scan received paperwork to include in their final reports along with QA/QC requirements, instrument worksheets, and instrument data—tasks they used to have to do by hand.

"The biggest change for us is that our QC/QA is out there. We're able to track it, we're able to graph trends, and see if our spike recoveries, for example, are blowing down, or we have certified reference material," Leu says. "We're able to track our QA/QC a lot better with our new LIMS system."

All of that will help the lab put citizens' minds at ease about their drinking water when something goes wrong, such as with a water system breach where an entire town's water is shut off.

"They bring a sample to you and they want to know right away. So you're working as quickly as you possibly can, knowing that you need to get them those results back, but also knowing that those results have to be accurate results," Paul explains. "You don't want to send out a false positive or a false negative and then have to call back the next day and say, 'Whoops, we made a mistake.' A lot of samples take on a lot more significance when you're talking about a large number of people being affected."

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INSIGHTS ON HPLC AND UHPLC SYSTEMS

SOLID CHOICES FOR CHEMICAL, BIOCHEMICAL ANALYSIS

by Angelo DePalma, PhD

▲ *Nano- to Microscale UPLC System ACQUITY UPLC® M-Class Waters / www.waters.com*

▲ *Reporting System for LC-MS and GC-MS Instruments / Dash Reporting Bruker / www.bruker.com*

▲ *HPLC/UHPLC System / Nexera X2 Shimadzu / www.ssi.shimadzu.com*

The pros and cons of high-performance liquid chromatography (HPLC) compared with ultrahigh performance LC (UHPLC) are by now the stuff of legend.

Cost of ownership has always been a factor in purchasing LC systems, says Bill Foley, senior director, separations product management, at Waters (Milford, MA). But today, as major LC markets become increasingly cost-conscious, lab managers can justify more expensive UHPLC based on value. "More than ever, UHPLC systems are easier to justify from the perspective of cost of ownership."

Perhaps the most tangible, measurable benefit to UHPLC is reduced solvent usage. Labs pay for solvents coming and going; HPLC/UHPLC-grade solvents are expensive to acquire and costly to dispose of. Supplies of acetonitrile, a preferred LC solvent, are back up after the shortages of several years ago, but prices have not fallen in step with rising inventories of the solvent.

According to Foley, labs that invest in new UPLC® (a Waters trademark, versus the generic UHPLC) systems can save 90 percent or more on solvents. Savings are even greater for Waters' supercritical carbon dioxide-based ACQUITY UPC²® systems—what Waters has termed "convergence chromatography."

UPC² systems are identical to UPLC in hardware design. While supercritical chromatography systems have a reputation for extreme operating conditions, pressures are around the same, or lower, as they are for UHPLC.

Throughput and sensitivity are common selling points for UHPLC. Run times are significantly shorter, resulting in fivefold or higher raw throughput. Yet real-world improvements vary according to several factors. One is instrument location. Users who in the past could access an HPLC on the next bench may now have to walk down the hall to use or check on the availability of the replacement UHPLC.

Another factor relates to whether the UHPLC replaces HPLCs dedicated to one specific method. This would not normally be problematic when both instruments employ the same column and mobile phase. But sometimes they don't, and users can be picky about how colleagues maintain the instrument.

Waters therefore takes a conservative position on how many HPLCs a UHPLC can replace, so while run times may be shorter by a factor of five or more, the company's official stance is that one UHPLC can replace two HPLCs and, under ideal circumstances, possibly three.

Not on pressure, particle size alone

During the early days of HPLC, the "P" in the abbreviation stood for "pressure" but eventually gave way to "performance." Perhaps this historical fact

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Answers for infrastructure and cities.

and UHPLC's use of very high pressures led to the mistaken belief that UHPLC's superior performance was solely a result of pressure (and small particle size stationary phases).

Not true. As Jason Weisenseel, PhD, chromatography technical leader for aftermarkets at Perkin Elmer (Orlando, FL), notes, a major factor in UHPLC's effectiveness lies in the super-low system dead volume, which produces tighter bands. "When they're tighter they're taller as well, and sensitivity rises," Weisenseel observes.

Weisenseel relates that during the 1980s and 1990s, as HPLC systems became more robust, users became complacent about sample preparation. But the advent of Waters' UPLC in 2004 required users to rethink sample prep. "Operators must be more careful of sample and mobile phase cleanliness than they need to be with HPLC."

Columns are the component most susceptible to damage through particle buildup. "Injecting an untreated, nasty matrix can clog columns irreversibly. Tubing is susceptible as well," Weisenseel says.

While some UHPLC workflows can withstand "dilute and shoot," more complex samples such as plasma and serum do better when filtered through 0.2-micron membranes or subjected to solid-phase extraction (SPE).

Ade Kujore, marketing specialist at Cecil Instruments (Cambridge, UK), provides some perspective on the HPLC-UHPLC decision. "UHPLC involves more stringent and prolonged sample preparation and often more frequent maintenance and servicing." UHPLC systems are more expensive, and while these systems are faster, labs are not always prepared for processing the data UHPLC generates. "Superficially porous particle columns, together with column heaters/chillers, may negate the need for UHPLC in some instances," he adds.

Sample and mobile phase preparation do not involve high-level engineering, but they do take time and require judgment, training, and skill levels somewhat higher than for HPLC. So while UHPLC does provide higher throughput and sensitivity, sample prep must be factored into any time and cost analysis.

Mass detection has been viewed as a way to avoid some types of sample preparation while augmenting sensitivity. Phillip DeLand, global LC business manager at Bruker (Fremont, CA), notes the historic banter between chromatography and MS, where chromatographers view MS as just another detector and mass spectroscopists see LC as merely a fancy injection device. But clearly the synergy between the two platforms creates analytical value greater than the sum of its parts.

Bruker does not sell UHPLCs as stand-alone instruments but only integrated with its core MS instruments. Its major analytical markets are environmental, food testing, and life sciences proteomics.

"In those areas, we see a common theme in reducing detection limits within a variety of matrices, where interferences exist or with low-concentration analytes," DeLand says. The most significant boost to sensitivity occurs in the interface between the LC and the MS, most commonly with the gentle electrospray ionization technique. Bruker has developed an ion source, Captive Spray, which gets more of the analyte into the MS's ion optics. This builds on previous efforts to increase ionization efficiency through addition of a solvent that enhances ionization by adjusting the charged state of the analyte, which in turn allows more efficient charge transfer during the electrospray operation.

STRETCHING CAPABILITIES

Automation

HPLC automation is mostly limited to pre-analysis, which falls within the realm of general lab operations. Yet the speed and throughput of modern LC systems have shifted the workflow bottlenecks from the chromatography run to sample preparation, to the point where labs contemplating high-throughput operation need to study automation possibilities.

One consideration involves vial or microplate handling just prior to auto injection. Conventional plate stackers can store dozens of plates at the proper temperature, feed them to the injection component, and return them to storage. Waters' Sample Organizer product, for example, stores and delivers up to 20 plates.

Very high throughput labs, or those that live and die by consistency of results, must consider a more comprehensive automation of sample preparation that includes dispensing or liquid handling, temperature control, filtration, dilution, solid phase extraction, and sample container shaking or washing. One could even imagine workflows where microplate reading might antecede injection into an LC.

"An ideal system would clean up the sample throughout the workflow without user intervention," Foley says. "This frees scientists for other tasks and eliminates human error."

Regarding automation, Kujore suggests that purchasers look into systems that allow automation on the lab's

▲ *HPLC Autosampler*
HPLC Autosampler
HTA / www.hta-it.com

terms—when and to the degree that is needed and not as an expensive add-on at the time of purchase.

Reliability of various automation components is a primary concern, according to Kujore. "The last thing you want after leaving for a long weekend is worrying if your robotics are doing what they're supposed to do." Users should also factor in acquisition and maintenance costs. "If you find yourself with a negative payback—such as routinely devoting extra time and resources to use, set up, and maintain and automate—you'll wonder if you actually need it."

Two-dimensional LC

UHPLC systems have significantly improved separations and peak capacities relative to HPLC, but the need exists for even higher performance. Improvements may be possible by applying even higher pressures to even smaller stationary phase particles, but the resulting physical demands on instrumentation—back pressures—increase exponentially as particle sizes shrink.

One elegant work-around, says Dr. Michael Frank, Agilent's senior director, global marketing, liquid phase separation business (Waldbronn, Germany), is two-dimensional LC (2DLC). The technique involves subjecting each peak in the first dimension to separation in a second, orthogonal dimension, for instance, reverse phase followed by ion exchange. Thus, compounds that coelute by virtue of affinity to C18 will separate based on charge.

Any complex sample or samples with difficult-to-separate components are candidates. Life science separations, which often involve complex samples and/or low-concentration analytes, come immediately to mind, as do clinical and bioprocessing samples. Even small molecule drug assays containing structural isomers, closely related metabolites, or coeluting impurities are often difficult to separate through one-dimensional LC.

2DLC is gaining traction in nontraditional HPLC industries as well. Today, the technique quantifies small differences in beer samples and helps the Chinese herbal medicine industry standardize their formulations. It can also characterize samples from hydrocarbon and polymer processing, where components differ only slightly. "Some of these separations are achievable only through 2DLC," Frank says. "Having two different columns or two different mobile phases operating during one run tremendously increases your chances of separating compounds of interest."

2DLC reduces somewhat the need for high-end MS detection, provided peaks are well characterized in both dimensions, for example, samples containing five compounds that separate easily. A single-quad MS detector may suffice for providing confirmatory mass assignment when analyzing a pharmaceutical active ingredient that includes ten to 15 impurities.

For protein digests, however, MS increases the likelihood of obtaining the most information from each injection, Frank says. "2DLC theoretically multiplies the peak capacities of the two individual separations. MS provides additional peak capacity—not in the retention time dimension but in a separated mass dimension. MS/MS adds two mass-selective peak capacities, and with ion mobility you can increase peak capacity to the power of five, all in one run."

▲ *LC-MS/MS Columns / Raptor™ ARC-18 Restek / www.restek.com*

The advantages of 2DLC come at a cost. As with the migration from HPLC to UHPLC, 2DLC adds complexity to the chromatographic workflow. "There's no such thing as a free lunch," Frank comments. With UHPLC the prices are somewhat higher maintenance and more extensive sample preparation. For 2DLC the principal downside is system complexity—the need for an additional pump and column. On the plus side, because 2DLC operates at normal system pressures, the system is under reduced stress relative to UHPLC.

Paradoxically, run times under 2DLC are not disadvantages when all factors are considered. Runs on complex samples may be lengthy under HPLC and even under UHPLC. According to Frank, 2DLC greatly reduces method development times. "Overall, if you have to develop a completely new method [under HPLC/UHPLC] until all components in a sample are identified, 2DLC would decrease overall work times."

CARE AND MAINTENANCE

Of all the components in an HPLC system, pumps require the most care and maintenance. Kujore advises against allowing gases into the pump, which makes online or off-line degassing of all mobile phases a must. "When a pump has been unused for eight hours or more, before switching it on, check that no air bubbles are visible within the mobile phase tubing. If there are, first purge each pump according to the manufacturer's instructions." In addition, when changing the contents of the mobile phase container, operators should prime all pumps before switching them on.

Another way to protect the system is by filtering all mobile phases and components before introducing them to the system. Users should consider an in-line, 0.45-micron mobile phase filter and a smaller-pore filter for samples.

Acetonitrile, which remains decidedly unkind to solvent budgets, is equally problematic for check valve seals, as it tends to cause sticking. Kujore therefore recommends priming with water or methanol after using an acetonitrile mobile phase. Operators should also note other pump-unfriendly solvents, per the user manual, and mobile phase components that are incompatible with normal or reverse phase columns.

Remember that pump back pressure increases as guard columns become fouled. One key to longer analytical column life is a regular change of the guard column. "Frequent pump back pressures of greater than 33 MPa at flow rates of less than 1.4 ml/minute in columns shorter than 25 cm are cause for concern," Kujore advises.

When buffer salts are present in mobile phases, operators should not allow them to precipitate out of solution, which will cause pump parts to stick. One technique during downtime is to circulate buffer through the pumps at a low flow rate, such as 0.2 ml/minute. "Never let the pump lie unused for more than, say, twenty minutes, if the mobile phases contain buffer salts," Kujore cautions.

▲ *Preparative SFC System / Prep-2088 / JASCO / www.jascoinc.com*

Finally, after using the buffer, flush the system with 15 percent methanol in water for two hours and back-flush pump pistons, either manually or automatically, after using buffers with very high salt content.

Is SFC special?

Despite SFC's reputation as an exotic form of LC, care and maintenance are amazingly similar to what users might expect of standard LC. The back-pressure regulator incorporated into SFC systems is the only major difference. Additional maintenance relative to HPLC involves checking these back-pressure seals and seats.

"Aside from that additional component, SFC systems are virtually identical to HPLC, in terms of both maintenance

and component longevity," says D.J. Tognarelli, chromatography product specialist at JASCO (Easton, MD).

If anything, column lifetime tends to be longer in SFC because supercritical CO_2-based mobile phases, even with the addition of cosolvents, tend to be gentler than typical HPLC solvents. Also absent are problems related to running HPLC with salt buffers that increase the likelihood of clogging or salt precipitation.

▲ *HPLC/UHPLC Columns for Glycan Analysis / GlycanPac AXR-1 Thermo Fisher Scientific / www.thermoscientific.com*

"An ideal system would clean up the sample throughout the workflow without user intervention."

Pressures employed in HPLC and SFC are virtually identical, Tognarelli adds. "In our SFC systems, the cosolvent pump is an HPLC pump, so the pressures are not meaningfully different." The only pressure difference is in the flow cell, which in HPLC operates at low pressure. In SFC the flow cell is maintained at high pressure. "But this does not affect maintenance."

UHPLC pressures, by contrast, are significantly higher than for SFC or HPLC and the source of some maintenance issues. JASCO SFC systems operate at about 500 bar maximum pressure, whereas UHPLC may go as high as 1,300 bar, which subjects seals and valves to at least twice the stress of SFC or HPLC.

PURCHASE CONSIDERATIONS

Potential purchasers of LC systems need to do their homework. Those on the fence regarding HPLC or UHPLC should refer to the opening section of this article.

It is not unusual for labs to send one or more group members to one of the larger instrumentation or automation trade shows specifically for purposes of "kicking the tires."

Generically speaking, purchase decisions should be made under the assumption that the instrument will be in service for around eight years, possibly longer.

That is why Kujore's list of factors to consider are heavily based on cost of ownership:

- Cost and ability to implement accessories and components.
- Ease of routine maintenance, such as the cleaning of pump check valves, mobile phase switchovers, column changes, flow cell changes, lamp changes, and the ability to physically access system components.
- Software ease of use and functionality: Will there be a long, steep learning curve? Can your laboratory afford for staff to take time off from their normal duties to attend training sessions?
- Reliability, continuity, efficiency, and competence of support, whether from the manufacturer or a third-party support organization.
- System reliability, longevity, and the availability of spare parts and optional accessories.
- Cost of authorized repairs and service.
- The cost of special consumables: Can you use ordinary consumables, or are you restricted to those from one specific manufacturer? What happens if that manufacturer for any reason ceases to supply the necessary consumables or will supply them only under a severe increase in pricing and/or terms and conditions?
- Flexibility and choice of analytical columns.
- Detector specifications such as low drift, noise, and stray light.
- Pump specifications such as low pump pulsation and speedy and accurate gradient mixing.
- Autosampler specifications such as carryover, injection precision, numbers of injections, and availability of accessories.
- Column heater/chiller specifications such as compartment size, temperature ranges, speed of temperature changes, and the accuracy and stability of required temperatures.

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TECHNOLOGYNEWS

asm2014 | EB2014

This month we highlight vendors who will be exhibiting at the **114th general meeting of the American Society for Microbiology (asm2014)** and **Experimental Biology (EB 2014)**. Experimental Biology is an annual multidisciplinary, scientific meeting comprised of over 14,000 scientists and exhibitors representing six sponsoring societies and multiple guest societies. It takes place April 26-30 at the San Diego Convention Center. asm2014, which takes place at the Boston Convention & Exhibition Center May 17-20, will showcase the central role of microbes in the biosphere.

ANALYTICAL

Industrial FT-NIR Spectrometer

MB3600-CH70 Polyol Analyzer

- Intended for chemical industry laboratories that perform a large number of daily measurements for QA/QC analysis or at-line process support
- Particularly adapted for applications in the fields of polyols and polyurethanes
- Maintenance-free bench analyzer enables fast determination of several quality properties in liquid chemicals
- Features a set of pre-loaded calibration models with operator interface for immediate OH value determination

ABB www.abb.com

Isotope Ratio Mass Spectrometer

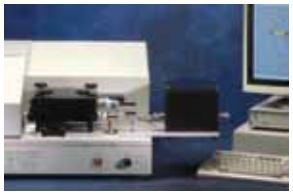
Isoprime VisION

- Simplifies the analysis of light element stable isotopes (carbon, nitrogen, sulfur, oxygen and hydrogen) within a broad range of disciplines
- Can interface to an elemental analyzer or gas chromatograph for analyses within the fields of geochemistry, ecology, climate change, petrochemicals, agriculture, forensics, pharmaceuticals and environmental remediation
- Includes user-friendly ionOS software which has several new, built-in features

Elementar Americas
www.elementar-americas.com

Elemental Analyzer

Model 440



- Manual version now available
- Determines percentage levels of carbon, hydrogen and nitrogen (CHN) quickly, easily and reliably across a wide range of sample types
- Offers labs running smaller numbers of samples a no-compromise entry point into high performance CHN analysis
- Horizontal furnace design enables easy removal of sample residue between each material analysis, thereby eliminating the possibility of contamination

Exeter Analytical www.eai1.com

Source for Dart MS

DART®-QS Source

- Provides a protective environment for Direct Analysis in Real Time (DART) mass spectrometry of a range of materials
- Allows both qualitative and quantitative results to be obtained in as little as 10 seconds per sample, providing rapid feedback, and alleviating backlogs
- Allows automated direct sample analysis of up to 12 samples with disposable QuickStrip™ Sample Cards

IonSense www.ionsense.com

PRODUCT SPOTLIGHT

BIOLOGICS BREAKTHROUGH

NEW INSTRUMENT LINKS CE TECHNOLOGY TO MASS SPECTROMETRY TO HELP BIOPHARMA SCIENTISTS

Drug development will get a boost with the release of AB Sciex's new CESI 8000 system for biologics characterization at Pittcon 2014. The system uses a breakthrough technology called CESI-MS which will allow biopharmaceutical scientists to more accurately predict efficacy, reduce the time to market for new therapeutics, and proactively detect potential issues before they lead to expensive product recalls.

"With CESI-MS, we are establishing a new benchmark of improved system performance for routine biologics analysis in a way that allows CESI to be easily integrated into existing workflows in biopharmaceutical laboratories," said Jeff Chapman, director of the CE business within SCIEX Separations, a part of AB Sciex. "This is innovation delivered to help save more lives and address the unmet needs of our customers in biopharma."

CESI marks a novel combination of capillary electrophoresis (CE) and electrospray ionization (ESI) technologies. The CESI-MS workflow includes the industry's first commercially available ultra-low-flow separation and ESI module for biologics, along with a high-performance, high-resolution, accurate mass instrument that is ideal for biopharmaceutical development—the fastest-growing segment of the drug discovery and development sector.

The instrument also uses a single approach that increases efficiency and productivity, to provide orthogonal and/or superior results compared to dual-method liquid chromatography / mass spectrometry-based approaches.

"The new CESI system complements our AB Sciex 'quantitation by design' approach, which puts the power of highly accurate quantitative analysis of large molecules into the hands of biopharma scientists," said Joe Fox, senior director of the pharmaceutical business at AB Sciex.

That power will help lead to drugs with fewer side effects and new clinical tests for patients.

For more information, visit www.sciex.com/cesi

Ammonia Analyzer

AT-2000

- Measures ammonium-nitrogen (NH4-N) swiftly, accurately and easily and can be used by non-experts
- Features a wide measurement range from low to high end with accurate measurement and is not interfered by turbidity or color of the sample
- Requires only a small volume of sample (0.1mL, 1mL or 10mL) and calibration is not needed prior to the sample run

JM Science www.jmscience.com

LC-MS/MS Columns

Raptor™ ARC-18

- Offer a well-balanced retention profile without the drawbacks of using an ordinary C18 in the harsh, acidic mobile phases needed for mass spectrometry
- Even after extended use in these low-pH (≤ 2.0) conditions, the sterically protected ARC-18 offers consistent retention, peak shape, and response for charged bases, neutral acids, small polar compounds, and more

Restek www.restek.com

Benchtop Spectrometers

Epsilon 3^{X}

- Equipped with 50 kV excitation and the latest high-resolution silicon drift detector enabling analysis of elements from sodium up to americium
- Epsilon 3^{XLE} is configured with the even more powerful SDDUltra silicon drift detector that makes analysis of ultra-light elements like carbon, nitrogen and oxygen possible
- Provide highly accurate and precise, fully traceable data

PANalytical www.panalytical.com

HPLC/UHPLC Columns for Glycan Analysis

GlycanPac AXR-1

asm BOOTH 725

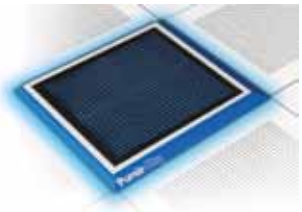
- Offers extremely high-resolution separations based on charge, isomerism, and size
- Designed to facilitate both high resolution glycan profile characterization and quantification
- Help users achieve greater resolution of glycans using HPLC, providing easier profile characterization
- Also designed for excellent resolution of labeled and unlabeled glycans, and are compatible with fluorescence and mass spectrometry detection methods

Thermo Fisher Scientific www.thermoscientific.com

BASIC LAB

Ceiling Mounted Air Filtration Units

Purair SKY



- Designed to protect laboratory personnel and the environment in areas where hazardous substances are handled
- Features a dynamic filtration chamber with a sliding filter clamp that allows for simple, quick filter changes
- Come with an epoxy coated steel support frame with LED lighting and wall mounted controls
- Two models are available

Air Science www.airscience.com

Four-channel Peristaltic Pump

Ismatec®

- Allows users to individually control the flow of each channel from the keypad or via computer
- Each channel also offers bidirectional flow for even more versatility
- Micropump delivers continuous pumping or precision dispensing up to 35 mL/min
- Independent channel calibration minimizes tube-to-tube differences, resulting in high calibration accuracy
- Easy-to-use tubing cassettes enable fast changeovers

Cole-Parmer www.coleparmer.com

Gas Distribution & Management System

544 Series IntelliSwitch IIv

- Automatically switches between two high-pressure, high-flow gases to provide interchangeable service and continuous supply
- Offers reliable high-flow, high-pressure switching in demanding applications and environments
- Proprietary economization software virtually eliminates liquid cylinder vent loss and substantially reduces residual return
- Web server allows for remote monitoring and e-mail notification of events to users

CONCOA www.concoa.com

Microfluidic System

Telos

- For high throughput droplet, particle, and flow product generation
- Benefits a wide range of applications including: DNA, cell and bead encapsulation and screening, emulsion and foam generation, microparticle and nanoparticle synthesis and micro-reaction engineering
- Clamp Module at the heart of the system holds a 2 Reagent Chip with 7 microfluidic channels

Dolomite www.dolomite-microfluidics.com

Ammonia & Cyanide Collection System

SimpleDist®

- Allows users to perform cyanide and ammonia distillations following established US EPA and *Standard Methods* methodology
- Design replaces much of the fragile glassware used in other systems with disposable collection traps and other consumables, reducing labor associated with maintenance and clean up
- Only glassware required is the boiling tube

Environmental Express www.envexp.com

Handheld Serial Pipette

Repeater M4

asm BOOTH 1101

- Designed to minimize the time and effort required for precise and highly accurate repeat dispensing tasks
- Works with nine sizes of Eppendorf Combitips advanced® and a built-in sensor detects the Combitips automatically, showing the tip volume
- Can dispense volumes from 1 µL to 10 mL and completes as many as 100 operations without refill

Eppendorf www.eppendorfna.com

Non-Destructive Evaporation Technology

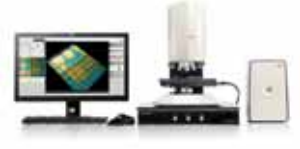
eXalt

- Enables a wide range of solvents and multiple actives to be evaporated all at the same slow rate, and under the same conditions, giving the user excellent control of the crystallization process
- Achieved using a special holder which allows the unit to be configured to slow the evaporation rate of each solvent
- eXalt holders can accept up to 24 different samples

Genevac www.genevac.com

3D Surface Metrology Solution

DCM8



- Is a combined confocal and interferometric optical profiler and provides the benefits of both technologies: high definition confocal microscopy for high lateral resolution and interferometry to reach sub-nanometer vertical resolution
- Features lateral resolution up to 140 nm via confocal microscopy and vertical resolution of up to 0.1 nm with interferometry
- Easy to set up and use

Leica www.leica-microsystems.com

Gas Adsorption Sample Preparation Device

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- Provides high-throughput sample preparation with six independently controlled ports
- Preprogrammed ramp rates and temperatures allow for quick startup
- Allows users to create SOP methods through customizable degassing protocols with Windows software
- Programmable pressure threshold can suspend the temperature ramp if the outgassing pressure exceeds the amount specified
- Status indicators at each port allow instant identification of completed sample degas routines

Micromeritics www.micromeritics.com

Light Source

DH-mini

- Compact, high-intensity source for spectroscopy combines deuterium and tungsten halogen sources in a single optical path
- Produces stable output across the UV-VIS-NIR from 200-2500 nm
- Suited to demanding applications in the quality control and life science industries, especially fiber probe-based measurements where light throughput is a challenge, and absorbance measurements of high optical density solutions

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Manual Pipettes

Ovation® M

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- Combine the ergonomic performance of VistaLab's Ovation design, with a conventional analog volume setting capability
- Contoured shape and adjustable hook means a custom fit for every user in the laboratory
- Unique design promotes ergonomically-correct posture during pipetting, such as neutral forearm and wrist positions, which allow muscle groups to function freely without restriction or stress

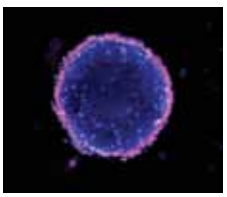
VistaLab www.vistalab.com

CELL CULTURE

Low Adhesion Plates and Dishes

EB Lipidure®-Coat

BOOTH 1423



- Shown in cited research to be one of the most effective tools for state-of-the-art 3D spheroid cell culture
- Available in 384-well format optimized for drug screening or other high throughput applications
- High biocompatibility of the coating on these plates and dishes means cells will not adhere to the surface
- Different well-shapes are available for 96-well plates

AMSBIO www.amsbio.com

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- Expand the volume range measurable with Artel's line of DMSO (dimethyl sulfoxide) products
- For use with the company's MVS® Multichannel Verification System and Liquid Handler Performance Verification Service
- Enable users to accurately calibrate and verify their liquid handlers when dispensing DMSO-based solutions
- The Artel reagents now cover all volumes less than 10 µL

Artel www.artel-usa.com

Antibody Labeling Kits

ReadiLink

BOOTH 136 (at Experimental Bio)

asm BOOTH 607 (at asm2014)

- Provide a simple antibody conjugation solution for labeling microscale amounts (50–100 µg) of antibody
- Suited for researchers interested in labeling their own antibodies for flow cytometry and cell sorting applications
- Allow researchers to label their antibodies in two easy steps
- Protocol takes only 70 minutes, and the labels are as bright and photostable as traditional dyes

Bio-Rad www.bio-rad.com

Certified Solutions of Phenethylamines

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- 14 new certified solutions of phenethylamines now available
- Suitable for numerous applications in GC/MS or LC-MS/MS testing from urine drug monitoring and forensic testing to clinical toxicology analysis
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Cerilliant www.cerilliant.com

DNA-enrichment kits

PointMan™

- Provides reliable and extremely sensitive detection of cancer-related mutations
- Fully compatible with industry standard instruments and DNA extraction methods
- Highly specific and efficient in amplifying the target sequence, while simultaneously suppressing amplification of the wild-type
- Detect mutations for cancer biomarkers including: BRAF, KRAS, EGFR, NRAS and JAK2

EKF Diagnostics www.ekfdiagnostics.com

High Sensitivity ELISA Kit

Amp'd™ HSP70

BOOTH 222

- Enables detection of both baseline and upregulated levels of Hsp70 (Hsp72) and relies on small amounts of starting sample
- Features greatly improved sensitivity enabling detection of both baseline and upregulated/stressed level of Hsp70 (Hsp72)
- Can be used to quantify human, mouse and rat Hsp70 (Hsp72) in serum and plasma samples

Enzo Life Sciences www.enzolifesciences.com

Kits and Reagents for Gene-Editing

GENASSIST™

- Enable easier, robust implementation of CRISPR and rAAV gene editing experiments
- Comprise both off-the-shelf reagents for using CRISPR editing technology and a unique kit combination of these reagents to allow customers to generate their own CRISPR-ready cell lines that constitutively express Cas9-nickase
- Horizon is also launching a new service for the design, manufacture and validation of CRISPR RNA guides

Horizon Discovery www.horizondiscovery.com

LAB AUTOMATION

Benchtop Decapping, Capping, & ID Devices

LabElite™

BOOTH 1515 (Hamilton Company)

- Offer laboratories an easy and efficient way to automatically process and track samples while ensuring sample integrity
- Quickly process all common labware types, providing a flexible solution for optimizing workflows
- Three models are available to meet a user's application, throughput and sample tracking needs: the LabElite I.D. Capper™, LabElite DeCapper™, and LabElite I.D. Reader™

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Nanoliter Pipetting Arm

MultiChannel Arm™ (MCA) 384

- Offers higher productivity to automated liquid handling processes in pharmaceutical and biotechnology applications
- Can be mounted onto Tecan's Freedom EVO® 100, 150 or 200 liquid handling workstations
- Increases the efficiency and speed of pipetting processes for higher throughput as well as delivering a greater level of flexibility
- Quickly switches from one tip array to another

Tecan www.tecan.com

PCR Software Wizard

TouchTools™ PCR Wizard

- An easy-to-use Freedom EVOware® add-on offering straightforward automation of PCR reaction setup on Freedom EVO® platforms
- Simplifies the set-up of applications— including end-point, real-time and multiplex PCR, sequencing, genotyping and gene expression, as well as pathogen and mutagenesis detection
- Helps reduce training time and costs
- Allows users to quickly and easily optimize 96- and 384-well PCR plate layouts

Tecan www.tecan.com

LIFE SCIENCE

Genetically Characterized FFPE Tissue Samples

EB CancerSeq™

BOOTH 1423

- Available as tissue slides and whole blocks, samples are delivered with the mutation and variation data for 48 cancer-related genes including BRAF, KRAS, EGFR, ALK and TP53
- Provide researchers with an excellent medium for applications including validation of cancer marker mutation related drug candidates, companion diagnostic assay development, and much more
- Available from several tumor tissue types

AMSBIO www.amsbio.com

Particle Sizing and Counting Analyzer

Multisizer 4e COULTER COUNTER

- Features a new 10-micron aperture that enables users to obtain accurate count, size and mass distribution for particles and cells ranging from 0.2 to 1,600 microns
- Digital Pulse Processing provides high-resolution analysis in as many as 400 channels
- Delivers dynamic size measurements in real time
- Compliant with 21 CFR Part 11

Beckman Coulter www.beckmancoulter.com

Flow Cytometer

EB guava easyCyte™ 12

BOOTH 229 (at Experimental Bio 2014)

asm BOOTH 924 (at asm2014)

- Gives users a simple benchtop method for multicolor flow cytometry
- Provides 12 simultaneous detection parameters, including 10 fluorescent colors
- Significantly increases the analytical power of flow cytometry
- Consumes less sample and generates less waste
- Easier to maintain than traditional systems, allowing researchers to save time and money while conducting comprehensive cell analysis

EMD Millipore www.emdmillipore.com

Biobanking Tubes

Cryo.s

- Provide a solution for high-throughput sample storage in automated storage systems
- Feature a 30% reduction in height as compared to standard cryo tubes, allowing for an optimized utilization of available space in deep freezers and liquid nitrogen tanks
- Available in volumes of 300 µl, 600 µl and 1000 µl and are supplied in automation-friendly cryo racks

Greiner Bio-One www.greinerbioone.com

384-well Reagent Reservoirs

asm BOOTH 1029

- Fully compatible with all liquid handling systems including the VIAFLO 384 handheld multichannel electronic pipette
- 384 individual pyramidal indentations in each reagent reservoir allow maximum liquid recovery when using a VIAFLO 384 electronic pipette as well as other platforms
- Are both economically and environmentally friendly because users can reuse the reservoir base and dispose of the reservoir inserts

INTEGRA www.integra-biosciences.com

LIMS & SOFTWARE

Scalable Informatics Platform

ACD/Spectrus Platform

- Enables organizations to apply chemical context to their spectroscopy, spectrometry, and chromatography content
- Makes it easier than ever for organizations to manage unified analytical data from multiple techniques and instruments, and combine it with chemical and structural information, in a vendor-agnostic homogeneous environment
- Now includes performance enhancements to the informatics technology and key updates to the web platform

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NGS Data Analysis Software

SureCall version 2.0

BOOTH 210

- Features compatibility with SureSelect custom target-enrichment and Human All Exon panels
- Enables clinical researchers to transform raw NGS data into insightful analyses without requiring advanced bioinformatics training or laboratory infrastructure
- Allows users to easily identify copy number changes and somatic mutations in tumors when comparing them to normal sample analyses and de-novo mutations with trio analysis

Agilent www.agilent.com

PRODUCT SPOTLIGHT

ID ME

NEW SOFTWARE ALLOWS QUICK, ACCURATE IDENTIFICATION OF UNKNOWN SPECTRA

BOOTH 136 (at Experimental Bio 2014)

BOOTH 607 (at asm2014)

This year's Pittcon in Chicago, Illinois saw the addition of two new tools for researchers working to identify unknown spectra as Bio-Rad announced the release of KnowItAll® ATR/IR ID Expert™ and Raman ID Expert™ solutions for spectral identification.

Both software options provide fast, accurate answers to scientists identifying unknown infrared and Raman spectra, whether they're experts or technicians with little or no spectroscopy training.

"The spectral intelligence built into KnowItAll ATR/IR ID Expert combined with the world's largest spectral reference collection provides the highest level of expertise to any scientist, whether a novice or power user," said Gregory M. Banik, PhD, Bio-Rad general manager of informatics.

The software can also perform super-fast automatic searches, another feature which is great for non-experts and experts alike, Banik added.

All the user needs to do is open an unknown spectrum and the software automatically performs single and multiple component searches as well as functional group analyses simultaneously. The software then summarizes the results on one screen to give a complete view of all possibilities for the unknown spectrum.

If there are problems with the user's query spectrum, ID Expert can identify these issues and suggest ways to fix them. Banik used the example of a bad baseline spectrum during Bio-Rad's press conference at Pittcon.

"A novice user may not know it's a bad baseline," he said. "A novice user may not know what a bad baseline is." The software will let them know, and, once the user has identified the unknown spectrum, a PDF report can be generated with one click.

For more information, visit http://www.knowitall.com

LIMS

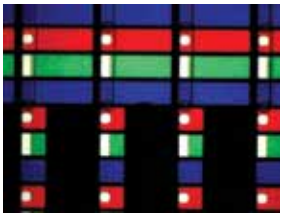
Matrix Gemini

- Now includes a facility for the automation of quality control samples and how they are grouped together
- Enhancement of the existing 'runsheet' function provides the ability to create runsheet templates and automatically build runsheets from those templates as well as performing standard QC calculations
- Allows different types of runsheet to be defined, among other improvements

Autoscribe www.autoscribe.co.uk

Film Thickness Measurement Software

FilmPro™



- Designed to plug-in to CRAIC Technology's microspectrophotometers and their controlling Lambdafire™ software
- Allows the user to measure the thickness of thin films rapidly and non-destructively
- Able to analyze films of many materials on both transparent and opaque substrates
- Enables the user to determine thin film thickness on everything from semiconductors, MEMS devices, disk drives to flat panel displays

CRAIC www.microspectra.com

Web-based Technical Tool

Material Selector Tool

- Designed to assist in identifying appropriate filtration materials by physical attributes
- Enables users to select up to 10 filter media characteristics as applicable to their filtration product or process
- Once the selections are made, the Material Selector instantly returns the suggested material choice
- The latest addition to I.W. Tremont's array of web-based tools

I.W. Tremont www.iwtremont.com

SUPPLIES & CONSUMABLES

High-Performance, Computer Printable Lab Labels

CILS-9100

- Allows users to print variable data (barcodes, batch numbers etc.) from their laser, inkjet or thermal transfer printers
- CILS computer printable surface coatings ensure ultra-clear, durable printed data
- Remain permanent during refrigeration & freezer storage (down to -196ºC), multiple freeze thaw cycles & liquid nitrogen, autoclave & sterilization cycles, and laboratory solvents

CILS www.cils-international.com

Alexa Fluor® conjugated secondary antibodies for fluorescent western blotting

Fluorescent western blotting is a powerful imaging technique which facilitates accurate protein quantification and multi-color analysis. At Abcam, we listened to the demands of our customers, and generated high quality Alexa Fluor® 680/790 conjugated secondaries, to a large number of target species, for fluorescent western blotting. As a result of this diversity and minimal spectral overlap of Alexa Fluor® 680 and 790, the reagents are ideal for multi-color analysis; furthermore customers can be reassured of the quality as Abcam publishes QC data for each individual product within the range.

The popularity of fluorescent western blotting is growing and presents many advantages over the traditional method of using horseradish peroxidase, chemiluminescence and film. Fluorescent western blotting involves secondary antibodies being conjugated to fluorescent dyes, rather than enzymes, and therefore circumvents the need for film and chemiluminescence.

Other advantages of fluorescent western blotting:

- Standard western blotting is semi-quantitative whereas fluorescent detection is quantitative, and covers a broad dynamic range. For instance, during signal transduction research, quantitative analysis is important for protein expression, stability, and turnover. All can be accurately detected and quantified using fluorescent detection.
- Fluorescent detection facilitates simultaneous multi-color analysis on one blot, which avoids the need for stripping and re-probing. Moreover, fluorescent detection is perfect for analyzing two different proteins which migrate at the same molecular weight.
- The fluorescent signal is more stable than chemiluminescence, as a result blots can be stored and imaged at a later date.

Quality and performance with Alexa Fluor® 680/790 secondaries

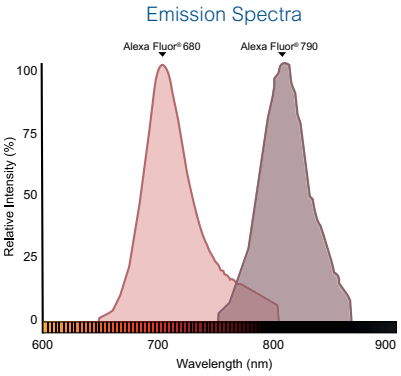
Quality and performance of labeled secondary antibodies is crucial for fluorescent western blotting, the reagents must be optimized for signal: noise ratios. Furthermore, if the number of fluorescent molecules per secondary (F:P ratio) is too low (under labeled) the signal will be weak; if the F:P is too high (over labeled), the signal will also be weak due to the inactivation of the fluorescent dye as a result of Förster resonance energy transfer (FRET).

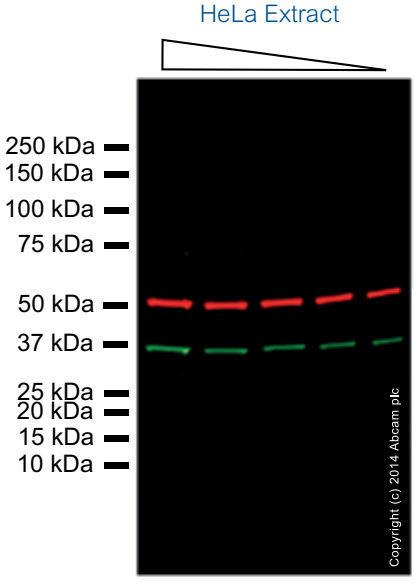
We have generated a range of Alexa Fluor® 680/790 secondary antibodies which have been manufactured and validated for fluorescent western blotting in Abcam's laboratories – ensuring quality and performance. The F:P ratios have been optimized to overcome problems highlighted above. Furthermore:

- We have developed a broad portfolio of Alexa Fluor® 680/790 labeled secondary antibodies to facilitate multi-color fluorescent western blotting.
- Due to minimal-spectral overlap of the Alexa Fluor® 680 and 790, two color analysis is even easier.
- To ensure quality and performance – each individual product within the range is validated in fluorescent western blotting, and for clarity, the corresponding QC data published.

To learn more, please visit,
www.abcam.com/fluorescent-wb

Alexa Fluor® is a registered trademark of Life Technologies. Alexa Fluor® dye conjugates contain(s) technology licensed to Abcam by Life Technologies.





▲*Figure legend - multi-color analysis using Abcam's Alexa Fluor® 680 (red) and 790 (green) secondary antibodies. Decreasing amounts of HeLa extract demonstrate staining of GAPDH (primary antibody ab83956 + anti-chicken Alexa Fluor® 790 - green, ab175787) and alpha tubulin (primary antibody 18251 + anti-rabbit Alexa Fluor® 680 - red, ab 175773).*

ARE YOU IN THE MARKET FOR A... CO_2 INCUBATOR?

CO_2 incubators are designed to copy a cell's natural environment with a relative humidity of around 95 percent, a temperature of 37°C and a pH of 7.2 to 7.5. They are most common in biology labs performing tissue or cell culture and are used in any process where cells need to be cultured for a few hours or many weeks or where cells need to be expanded or maintained.

Types of CO_2 incubators used by survey respondents

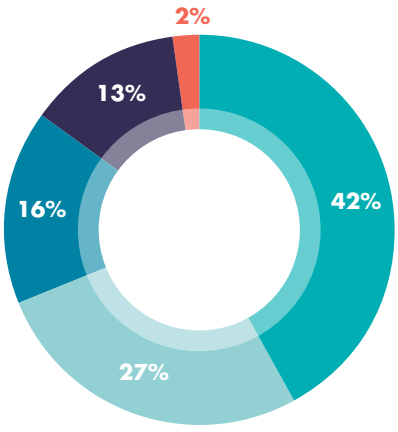
Water Jacketed	54%
Air Jacketed	30%
Direct Heat	14%
Other	1%

Primary purpose for CO_2 incubators as indicated by survey respondents.

Research	68%
Clinical	22%
In Vitro Fertilization	4%
Quality Control	3%
Other	3%

Nearly 27% of respondents plan on purchasing a CO_2 incubator in the next year. The reasons for these purchases are as follows

- Replacement of aging model
- Addition to existing systems, increase capacity
- Setting up a new lab
- First time purchase of a CO_2 incubator
- Other



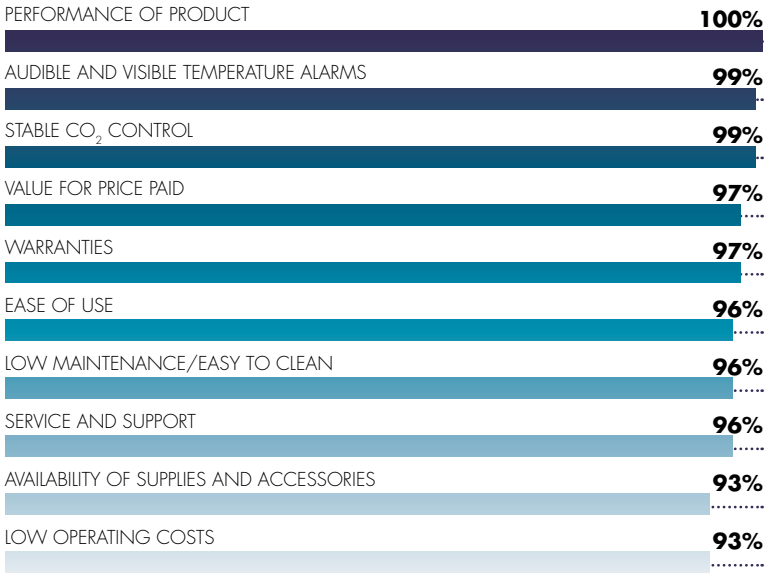
TOP 6 QUESTIONS

You Should Ask When Buying a CO_2 Incubator

1. What measures have been taken in the design to avoid contamination and what features are included to remove contamination?
2. How does the CO_2 sensor contribute to optimal cell growth?
3. How does the humidity contribute to optimal cell growth?
4. Ask for the uniformity and accuracy data versus asking for a water jacket or air jacket.
5. Do you need O_2 control to simulate the environment for your experiment accurately?
6. Calculate the total cost of ownership on the product over one year including product price, install, regular cleaning labor, material like HEPA filter, etc.

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a CO_2 incubator

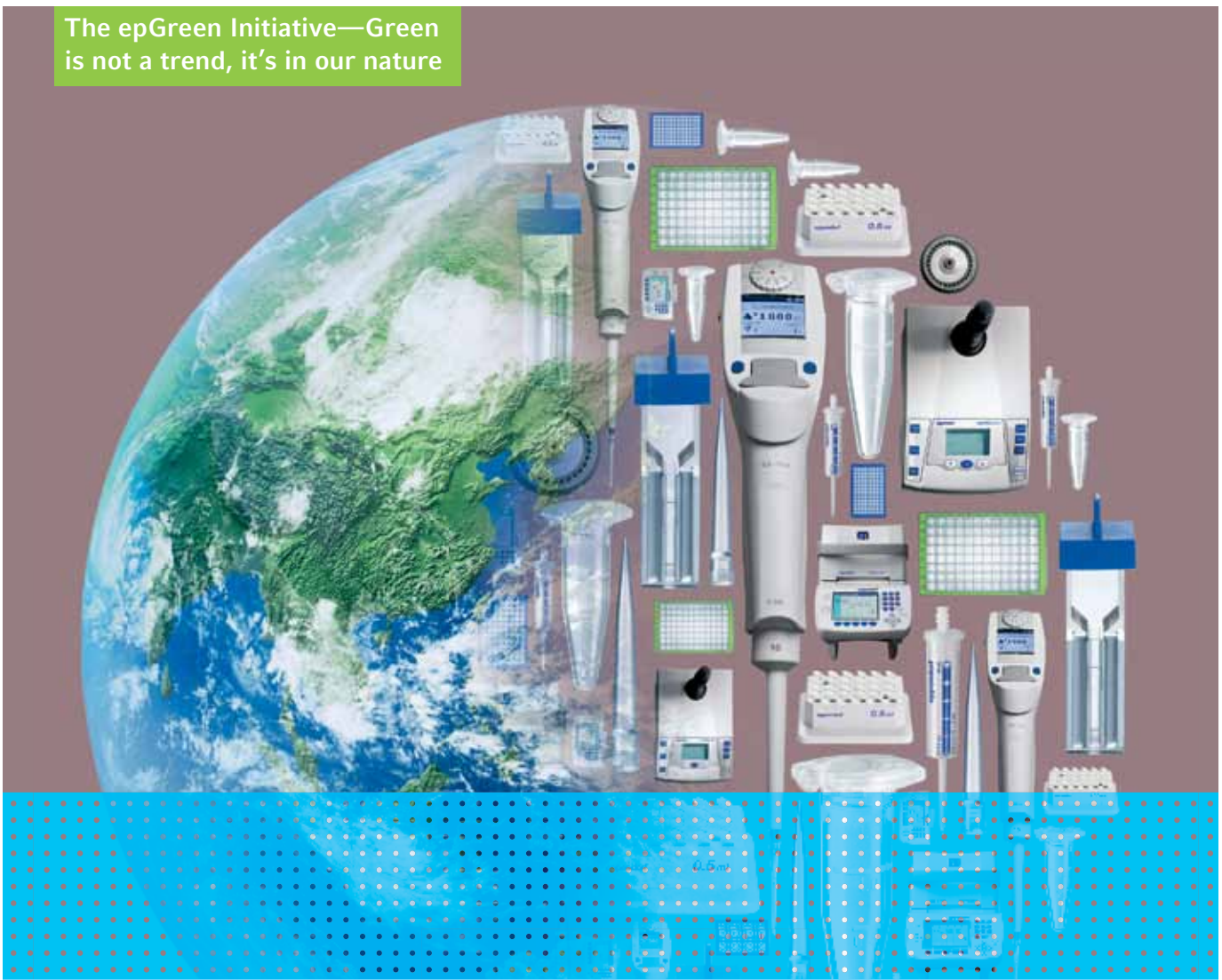


Completed Surveys: 222

For more information on CO_2 incubators, including useful articles and a list of manufacturers, visit www.labmanager.com/incubators

eppendorf

The epGreen Initiative—Green is not a trend, it's in our nature



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Our goal with epGreen is to constantly reduce the environmental impact of our business operations and products. Get peace-of-mind with Eppendorf products that ensure the safety of your lab and your environment. Visit our website for more epGreen initiatives.

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ARE YOU IN THE MARKET FOR A...

LABORATORY MILL OR GRINDER?

In a laboratory, most materials required for sampling are, in practice, nonhomogeneous mixtures. The best method of obtaining a small representative sample of the nonuniform whole is to take a quantity of the material large enough to be compositionally representative and reduce it to a fine homogeneous powder. For this purpose, a laboratory mill/ grinder is usually used.

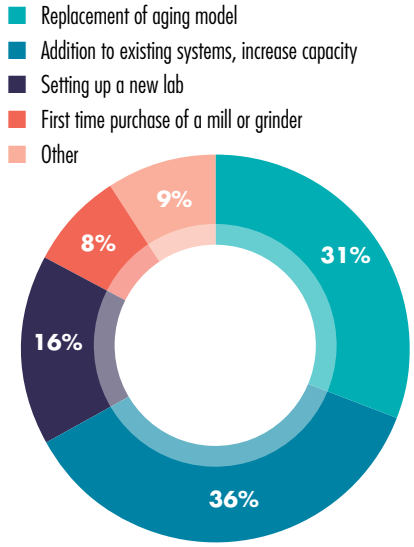
Types of mills and grinders used by survey respondents

Grinding Mill	20%
Ball Mill	13%
Rotor Mill	13%
Mortar Grinder	11%
Mixer Mill	10%
Cutting Mill	8%
Disc Mill	6%
Jaw Crusher	6%
Knife Mill	6%
CryoMill	4%
Other: (Please specify)	3%

Primary purpose for a mill or grinder as indicated by survey respondents.

Research	47%
Processing	24%
Quality Control	23%
Clinical and Diagnostic	3%
Other	3%

Nearly 26% of respondents plan on purchasing a laboratory mill or grinder in the next year. The reasons for these purchases are as follows



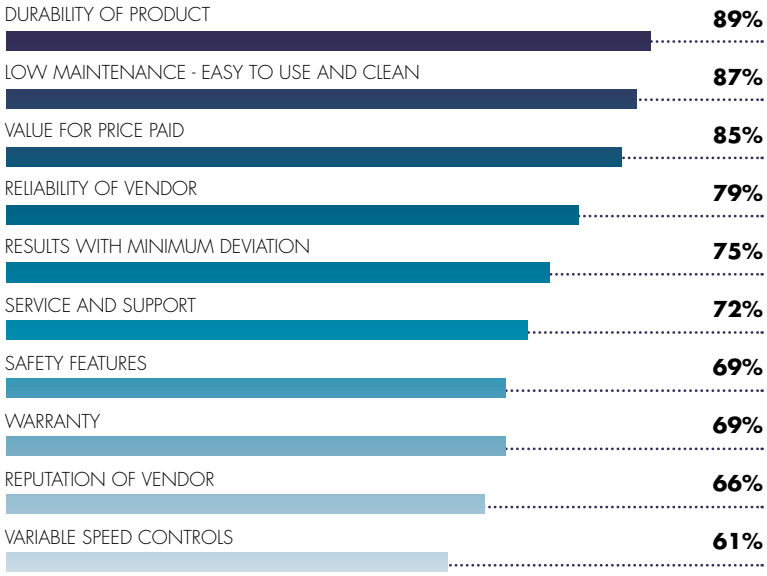
TOP 5 QUESTIONS

You Should Ask When Buying a Mill or Grinder

1. Will the mill/grinder be used for wet or dry milling?
2. For dry milling, ask how finely the material needs to be ground and what are the properties of the material? Rotor beater, disc, and mortar mills, for example, are best for mid-range grinding (final fineness of ~0.01-0.1 mm).
3. For wet milling, ask what capacity of grinder you will need. Bead mills are usually best for small capacity applications while rotor-stator homogenizers should be considered for larger scale applications. For very large scale applications, industrial-scale mills are probably the best fit.
4. How important is preventing cross contamination? Bead mills are likely a good choice if you don't want any risk of contamination.
5. Based on the materials you will be milling, how long does the miller or grinder typically last? How much do replacement parts cost and how easy are they to get? What level of support/warranties does the company offer?

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a mill or grinder



Completed Surveys: 191

For more information on mills and grinders, including useful articles and a list of manufacturers, visit www.labmanager.com/mills-and-grinders

ARE YOU IN THE MARKET FOR A... HOMOGENIZER?

Turning a sample into a suspension—the essence of homogenizing—occurs in a wide range of laboratory applications. In life science and clinical research, scientists often homogenize tissue samples for various analytical studies.

Types of homogenizers used by survey respondents

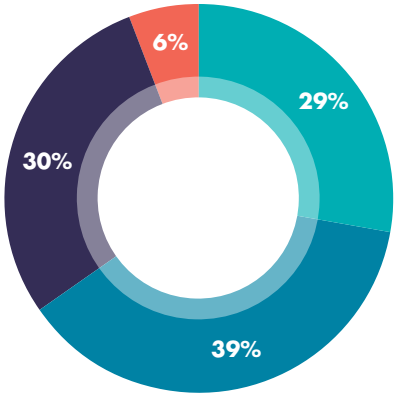
Rotor-stator	41%
Ultrasonic	30%
Bead mill	17%
Fluidized bed	7%
Other	6%

Primary purpose for homogenizers as indicated by survey respondents

Research	66%
Processing	15%
Quality Control	8%
Clinical and diagnostics	7%
Other	5%

Nearly 32% of respondents plan on purchasing a homogenizer in the next year. The reasons for these purchases are as follows

- Replacement of aging model
- Addition to existing systems, increase capacity
- Setting up a new lab
- First time purchase of a homogenizer



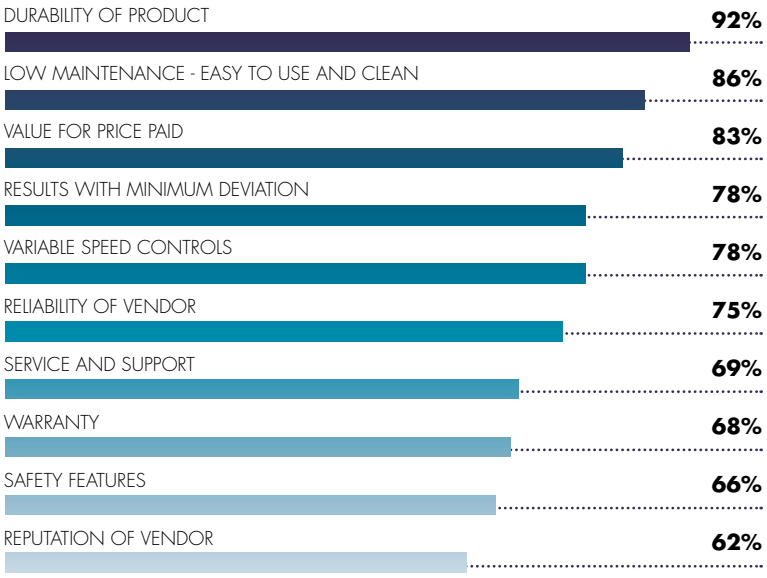
TOP 6 QUESTIONS

You Should Ask When Buying a Homogenizer

1. How does this homogenizer differ from the competition? What makes it superior in quality and cost effective for the scientist?
2. What accessories are necessary to run the unit? Are there pre-assembled bead kits to use that will simplify the homogenization process?
3. Does the company offer demo units for the scientist to test out?
4. Does the company offer application and technical phone support before/after the product purchase?
5. Ask about replacements in case the product parts break down with use.
6. Finally, ask about cost of the purchase, installation charges and warranty extension costs.

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a homogenizer



Completed Surveys: 219

For more information on homogenizers, including useful articles and a list of manufacturers, visit www.labmanager.com/homogenizers

BATHS & CHILLERS

DON'T FORGET TO CLEAN YOUR AIR AND FLUID FILTERS!

by Rachel Muenz

Because baths and chillers are such a basic piece of laboratory equipment, it's easy to put them in a corner and forget about them. But, as with other instruments, maintaining your bath or chiller is extremely important.

"Very often people don't think that chillers and baths are the most important things in the world and probably they aren't," says Dirk Frese, director of sales and marketing at Julabo (Allentown, PA). "But if they [users] have a process relying on temperature control, [chillers and baths] become really crucial."

He adds that a poorly maintained unit could take down a pharmaceutical manufacturer's setup, for example, possibly leading to the loss of millions of dollars in drugs.

Luckily, the most important part of caring for your chiller or bath is simply keeping the unit clean, whether that's cleaning the air and fluid filters or the condenser. Surprisingly, cleaning is something many users fail to do.

"Maintaining clean fluid, at the right level is crucial to product performance," says Kelly Gibbons, marketing coordinator at Polyscience (Niles, IL). "Additionally, it is important to note that some fluids may lose their heat transfer properties and become less efficient over time."

How often users should check their unit for problems depends on the applications they are using it for.

"We recommend that filters and water level are inspected weekly; however, in a harsh environment, it may be necessary to check more frequently," Gibbons says.

Frese adds that users should also vacuum their condenser at least once a week in a manufacturing setting, but in a cleaner lab setting, they can likely get by with cleaning a couple of times a year.

Placement of the chiller or bath is also important and is another common mistake users make. Julabo units, for example suck in air in the front and pump it out the back, so they need enough space at the back to vent properly, whereas Polyscience units require enough space on both sides to vent.

"Having enough room in the back to allow that hot air to escape and not circulate back into the unit is key," explains Ernie Stark, Julabo's inside sales manager.

Ambient temperature in the location is also important.

"Ambient temperature should not exceed manufacturer recommendations so the unit can perform to specification," Gibbons says, adding that maintenance aspects like physical location only need to be checked every six months or so.

Apart from dust in the air filters and on the condenser, there are several other signs that you should probably do maintenance, including dirty fluid and/or algae in the circulation fluid and loss of cooling performance, the experts say. As well as color change and turbidity, small black globules in the fluid are another sign it needs to be changed, Stark adds.

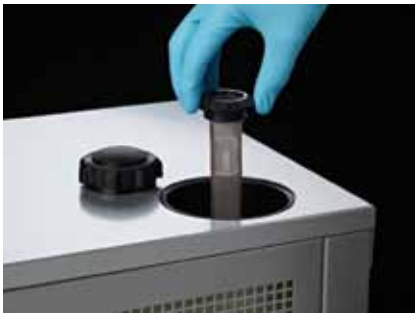
"If they have it [chiller or bath] connected to a reactor, and it's a clear glass reactor, they'll see these little black spots," Stark explains. "And of course their performance will go way down so they should know something is wrong."

Gibbons adds users should make sure to refill the reservoir with a fluid that meets their application requirements.

"These mistakes can be avoided by setting and adhering to the maintenance schedule and consulting the manual, especially when it comes to things like compatible fluids," she says.

Though they may seem unimportant, doing annual maintenance on your chiller or bath is imperative to meeting your lab's objectives.

"It's easy to forget or put maintenance off until 'tomorrow,' but too often we see units come in for repair in very poor condition due to lack of maintenance," Gibbons says. "They end up being scrapped because of catastrophic failure due to a lack of preventive maintenance."



▲ Remembering to keep the fluid filters clean is a key part of bath and chiller maintenance.

MAINTENANCE PROGRAM OPTIONS:

- Not all manufacturers offer such programs, but many have options that range from basic care to more extensive service
- Extended warranties are important considerations, especially for those who expect rough use of their chiller or bath

IMPORTANT RESOURCES TO CONSULT:

- The operator's/service manual
- The manufacturer—service technicians, customer service and sales reps

▼ Many manufacturers offer preventive maintenance programs which can range from basic to more extensive plans.

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EASY OIL CHANGES FOR ALL ROTARY VANE AND HYBRID VACUUM PUMPS

Problem: Rotary vane, or oil-based, vacuum pumps, are a common piece of equipment found in most labs. A vacuum pump is an accessory used with equipment such as freeze dryers, vacuum concentrators, glove boxes, and vacuum ovens. Just as in your car, the oil in a rotary vane pump needs to be changed periodically in order to run at its optimum. The ramifications of not doing regular oil changes is poor vacuum and seizing up the pump's internal components, which can destroy an expensive pump.

Oil changes can be time consuming and can take a pump out of circulation for hours or days at a time. This causes bottlenecks in the lab, which means loss of research time and productivity. And let's talk about the mess—when the drain port is removed, oil flows out of the pump by gravity and onto the floor if a container has not been put into place to catch it; which means solvent cleanup duty is required to prevent any injury from slipping and falling.

Time between oil changes varies from "*What's an oil change?*" to an SOP of changing oil once a month or after each use. Typically when the oil in the vacuum pump site glass looks dirty, it's time for an oil change. This is dependent upon the application and the solvents and processes being used.

Solution: With a product like Labconco's new PrimeMate™ Oil Change System, messy oil changes are a thing of the past. In as little as 13 minutes, the system drains dirty oil from the pump and refills it with clean oil. The pump never leaves the lab or is disconnected from the equipment. Waste oil is held in a closed 1-gallon container for proper disposal dependent on state and company regulations. After setting up such a system, oil changes can be done with two flips of a switch. No oil dripping onto your hands or the floor.

To prepare the pump for an oil change, remove the drain port from the vacuum pump and install the coupler included with the PrimeMate. If multiple pumps will be in the oil change rotation, accessory couplers are available. Once the coupler is installed, there is no need to remove it. Using the quick disconnect fitting, snap the system's hose to the coupler and the pump oil is ready to be changed. Toggle the switch to drain. A peristaltic pump built into the PrimeMate starts draining the oil into a 1-gallon waste container. Once the pump is empty, flip the toggle to fill. Clean oil is pumped back into the pump. When the pump is full, toggle the switch to "off" and the oil change is complete. Disconnect the hose from the system and the pump is ready for the next run.

An accessory battery pack and cart allow the PrimeMate to be used on pumps in multiple locations on one change. The battery pack can run up to eight hours on a full charge and up to 32 oil changes can be done on one charge.

For more information, please go to: www.labconco.com

▲ *Labconco PrimeMate Oil Change System shown with vacuum pump.*

Need To Reduce Energy Costs? Siemens Helps Laboratories Take Control.

When Wayne State University's team began Phase II of its Chemistry building renovation, it was stumped by a seemingly simple question. Use a single blade damper terminal or a Venturi air valve technology to control its laboratory ventilation and exhaust system?

They had used both technologies in separate, previous projects. And while the scope of each project was the same, they found a huge disparity in costs. That led to a full-blown independent review of the two technologies. They chose the Siemens single-blade damper air terminal.

That choice provided Wayne State with significant energy savings. It also provided an example of the critical nature every detail has in a laboratory's efforts to improve efficiency.

"Laboratories are among the biggest energy consumers in any facility," says Franco Atassi – Director of Life Science Solutions from the Building Technologies division of Siemens Industry, Inc. "Whether in a university, healthcare or corporate setting, they conform to a set of safety codes and standards; need specific ventilation rates using a non-circulated supply of fresh air; require precise environmental control, and demand high thermal load due to heat emitting lab equipment. These special requirements help drive energy costs in labs to be three- to eight- times greater than the average office building."

A leading expert in critical environments, Siemens understands how every detail impacts long-term energy savings and efficiency. It's the only building automation systems provider with a complete package of laboratory controls. Its approach to laboratory energy solutions are built around four core competencies:

- Assessment and Benchmarking
- Technical Solutions
- Information Management
- Service Solutions

Assessment

During its qualification assessments, Siemens evaluates both energy usage and overall compliance and benchmarks against the latest codes and standards. In addition to identifying potential energy improvements, Siemens finds ways to use existing equipment more efficiently.

Technical Solutions

Increasing energy efficiency is where Siemens technology excels. In laboratories, ventilation and cooling can account for two-thirds of energy use. Siemens employs a host of technologies and Facility Improvement Measures – FIMs, to make these processes more efficient. A typical solution may include variable air volume controls, occupancy monitoring, low flow/high performance fume hoods, sash management, thermal load decoupling, and a combination of other technologies.

Information Management

Siemens helps various facility users and operators manage their data and use what's relevant to their needs. Siemens helps laboratories monitor conditions, including energy consumption, with its Energy Monitoring and Control (EMC) tool. EMC pulls data from throughout a laboratory. It offers seven specific reports including overall energy consumption updates, room environment summaries, fume hood performance and air volume drivers. Laboratory managers also use its reports and data archiving to meet documentation requirements for ventilation system performance.

Service Solutions

Proper service is critical to ensure energy efficiency and compliance within a laboratory environment. Siemens provides its clients with expert service professionals well versed in building technologies and laboratory regulations. As a result, services offered help ensure both long-term optimum system performance and continuous regulatory and accreditation compliance.

Once considered improbable, Siemens is making laboratories energy efficient. Its solutions are in use at university research laboratories, pharmaceutical manufacturers, and even at one forensic lab that achieved LEED™ certification, a designation of environmentally friendly building design given by the United States Green Building Council.

Siemens laboratory technologies and services are available from any of its100 branch offices nationwide. To learn more about Siemens solutions for energy efficient laboratories, go to: **usa.siemens.com/lifesciences.**

SIEMENS

PROFILES

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Arizona Instrument LLC, an ISO 9001:2008 company, is the manufacturer of the Computrac® Moisture, Solids, Ash and Jerome® Mercury and Hydrogen Sulfide analyzers. The Jerome® J505 Mercury Vapor Analyzer, a high quality, robust Atomic Fluorescence Spectrophotometer, is used for determining mercury in ambient air and water. This hand-held instrument offers a sample button on the handle as well as a touch pad interface and an easy to use menu structure, allowing users to input unique testing locations and sampling cycles. The Jerome® line also includes instruments using gold film sensor technology to accurately detecting H2S as low as 3ppb and Hg vapor as low as 0.5μg/m3. Test data can be downloaded using the USB port and statistically analyzed using the instrument.

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FOR THE ONES WHO GET IT DONE

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DID YOU NOTICE AN AD IN THIS MONTH'S ISSUE THAT SEEMED UNUSUAL OR UNBELIEVABLE? IF NOT, YOU MAY WANT TO LOOK AGAIN. SOMEWHERE IN THIS ISSUE IS A HIDDEN FAKE AD. IF YOU FIND IT, SEND THE NAME OF OUR FICTITIOUS COMPANY TO **FAKEAD@LABMANAGER.COM** FOR A CHANCE TO WIN AN AMAZON GIFT CARD.

CONGRATULATIONS TO LAST MONTH'S WINNER: PENNY C. FROM MINNESOTA

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PRE-OWNED EQUIPMENT MARKETPLACE

PARTING POINTS

Takeaways from this month's issue:

GROWING GREEN

Laboratories can be one of the largest users of electricity and water at an institution. They are also among the largest consumers of materials and generators of hazardous waste. Labs can create a green program through:

- Self-evaluation that lab personnel can use to assess how green their lab is
- A recognition program for meeting green goals
- Maintaining an accurate inventory of chemicals and supplies
- Setting ultralow freezers at higher temperatures if they don't need to be at -86

10

20

BUILDING A STRONG LAB CULTURE

The responsibilities of a lab manager are to lead and manage the lab in the midst of team dynamics. In a weak lab culture, team members have low productivity, are confused about their assignments, complain about other team members, and show a lack of involvement. Creating a good environment involves:

- Selecting the right team members
- Communicating the lab's main goals at the outset
- Setting an infrastructure
- Promoting collaboration and acknowledging contribution

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ASK THE EXPERT – INNOVATIONS IN IMAGING & MICROSCOPY

Nongjian Tao, PhD, director of the Center for Bioelectronics and Biosensors at Arizona State University's Biodesign Institute and professor in the School of Electrical, Computer and Energy Engineering, discusses a new technique being developed in his lab, focusing on:

- What is needed to build the new detection technology
- How the new technique will benefit his lab
- The limits of the technology
- What is needed in terms of samples and expertise to work with the technology

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PERSPECTIVE ON: AN ENVIRONMENTAL LAB

The Environmental Laboratory of the Montana Department of Public Health and Human Services is all about ensuring safe drinking water for the state. Environmental lab section supervisor Russell Leu and lab services bureau chief Ron Paul discuss:

- The variety of testing the lab is responsible for
- How rewarding providing information to the public is
- The challenges of government regulations and uncertain budgets
- Major changes in technology and solvent disposal over the years

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INSIGHTS ON HPLC/UHPLC

The pros and cons of high-performance liquid chromatography (HPLC) compared with ultrahigh performance LC (UHPLC) are by now the stuff of legend. Things users should consider when deciding between these technologies include:

- Cost of ownership
- Instrument location
- Sensitivity and throughput
- Automation and care and maintenance

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