MAGAZINE
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Run Your Lab Like a Business

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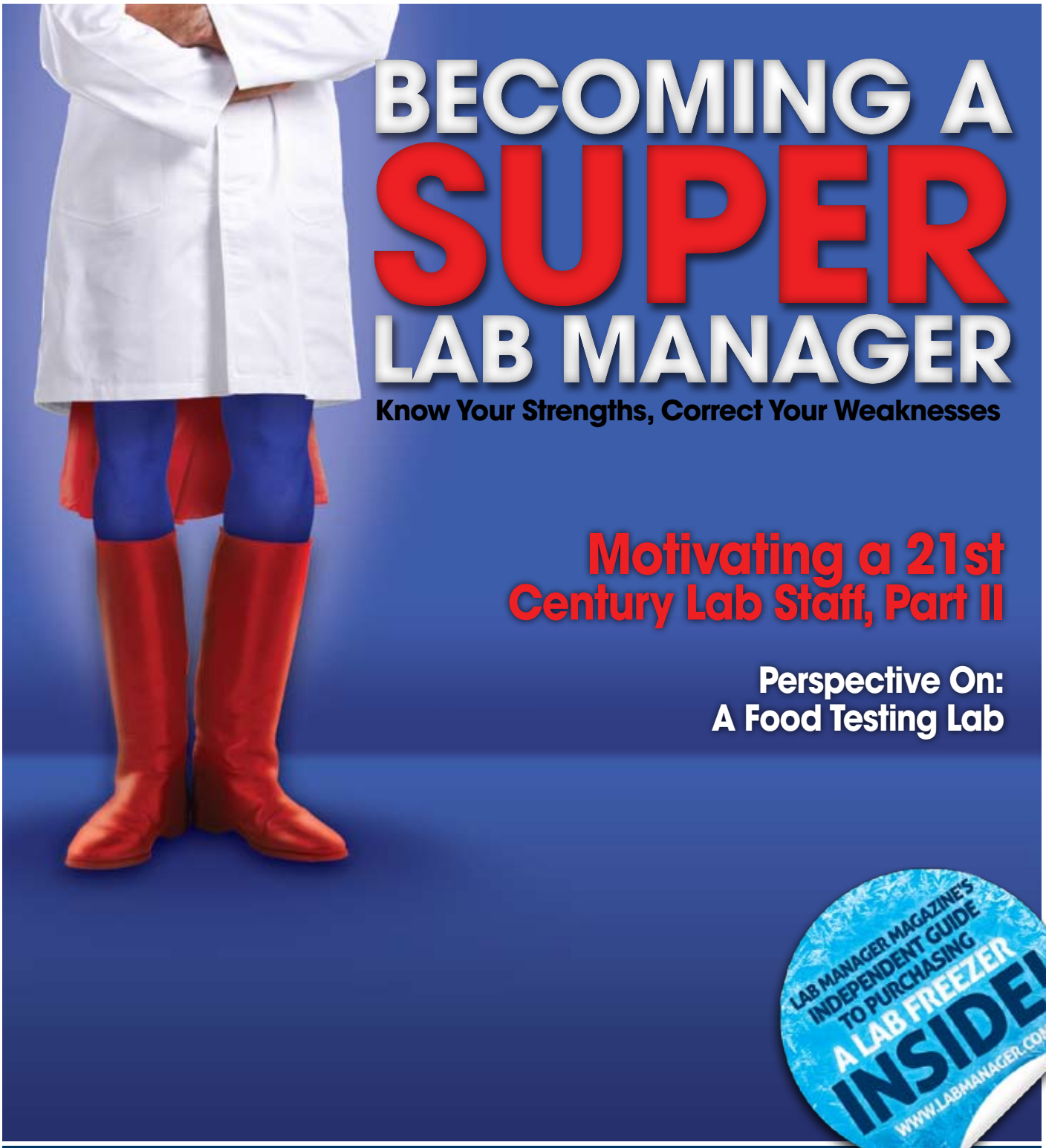

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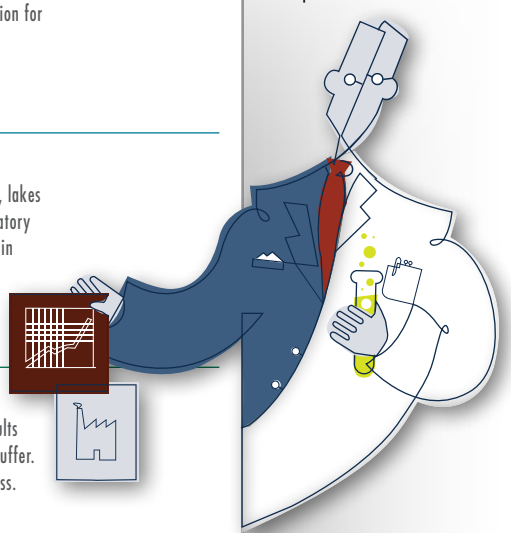


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Running Your Lab Like a Business

The unique mission of *Lab Manager Magazine* is to help you do what we say in our tagline—"Run your lab like a business." While we knew that management skills and business acumen were important to you, our recent Business Management Survey confirmed just how true that is and how even more important it has become in these cost-cutting times.

Richard Daub's cover story this month starts by presenting key results from the survey but takes off from there to provide first-hand accounts of the business and management challenges many of you face. Based on one-on-one interviews with a number of you, Daub delivers some helpful information on how to acknowledge the management skills you lack and then do something to correct it, thus hopefully becoming a "super" lab manager (blue tights optional). An interesting take away from the article is the shared belief among many of you that managing a lab will not get easier or be done better until communication between upper management and research departments improves.

While lab management remains ever changing and ever challenging, as we wind up 2009 we at *Lab Manager* believe our mission is more important than ever and are committed to remain true to the task of providing the best information available specific to your management and business needs.

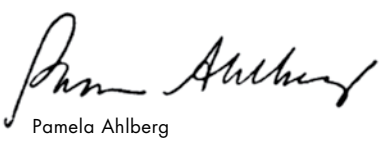
Which brings us to 2010... As I've mentioned in past editor's notes, we are very excited about our new "Ask the Expert" feature for 2010. If you visit the website you will find a page for posting questions for each month's "expert" to answer. Please visit www.labmanager.com soon to add your questions. The topic for January's expert is: Designing an eco-friendly lab. Other web-related news is that we have introduced two blogs on the site. In one blog, entitled "Lab Management Matters," contributing writer John Borchardt will discuss current issues and topics in lab management. The second blog, authored by myself, will cover other areas of interest. Our hope is that both of these blogs will become very interactive and provide a voice for you, our readers.

Speaking of your voices... Based on a survey we sent out in late November, which many of you took part in, the January issue will include an article discussing Pittcon 2010—your history with the conference, reasons for attending (equipment shopping, networking, short courses or job seeking) and tactics for getting the most out of it. This article segues nicely to our February/March issue where we will feature a dedicated section showcasing new Pittcon product offerings for 2010, a time-lined history of the conference, as well as a guide to "Must See New Products" at the show.

So there's a lot on our plate for 2010 that we're excited about. And with new, more interactive tools, we look forward to growing our relationship with you and better understanding your research and management challenges.

In the meantime, we at *Lab Manager Magazine* wish you a joyful holiday season and a very happy New Year.

Happy Holidays!



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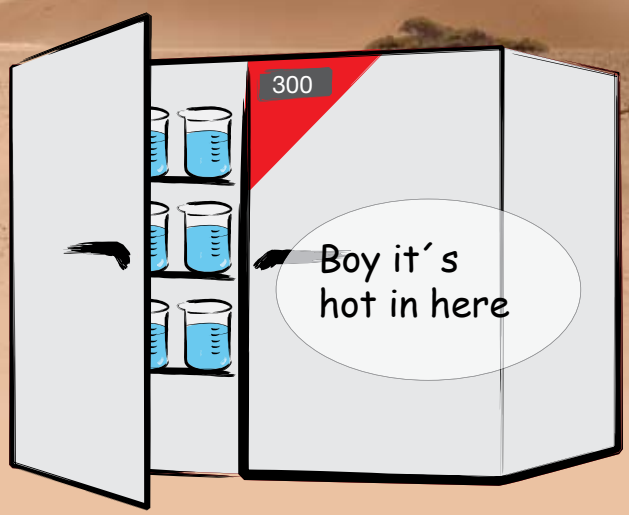

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BECOMING A SUPER LAB MANAGER

Communication breakdown between upper management and research staffs present greatest challenge by Richard Daub

There is hardly a company in the world that hasn't been affected by the downturn of the global economy, and we have now reached the point where—*Gasp!*— even science is taking a backseat to the bottom line.

"Laboratories are first and foremost businesses."

While the common battle cry these days from upper management to their managers has been to "Do more with less!" the majority of the laboratory managers who participated in *Lab Manager Magazine*'s recent Business Management survey indicated that their upper management teams have not been very clear in communicating the direction of their organizations to them.

The condition of the economy not only has impacted how many organizations are trying to achieve their goals, in many instances it has actually changed the goals themselves. If these changes are not communicated from the executive level to the management level, managers are left to tell their staffs that they just don't know where the company is headed or to tell them nothing at all. Either way, in an economy still cutting jobs by the hundreds of thousands per month, it has become a daunting task to maintain, let alone elevate, the delicate morale of employees who may be more concerned about job security than actually doing their jobs.

Gone are the days of laboratories being need-based establishments. Today, laboratories are first and foremost businesses that are often backed by investors who expect results sooner rather than later. This is probably why more than 70 percent of the participants in the survey indicated that today there is a greater need to take a more business-like approach in the lab compared to two or three years ago, and also why more than 65 percent said that they think their management responsibilities will increase over the next one to two years.

Of the business management skills these managers planned to make an effort to improve upon in the coming year, communication was the overriding theme. They told us that they wanted to improve the level of communication with their staffs, but they also said that upper

Please rate the level of challenge you face in your lab and organization from the following:

	Most Challenging	Challenging	Less Challenging	Not Challenging	Don't Know
Tighter timeframes for delivering research results	14.77%	62.50%	10.23%	4.55%	7.95%
Greater cost constraints	38.89%	48.89%	7.78%	3.33%	1.11%
Pressure to increase overall research productivity	15.73%	60.67%	19.10%	3.37%	1.12%
Attracting and retaining quality staff	23.08%	48.35%	20.88%	5.49%	2.20%
More and stronger competition	10.00%	44.44%	23.33%	16.67%	5.56%
Finding or creating new revenue streams/markets	21.11%	44.44%	16.67%	8.89%	8.89%
Pressure to bring new products to market	18.89%	35.56%	18.89%	17.78%	8.89%
Working within regulatory guidelines	21.11%	34.44%	26.67%	12.22%	5.56%
Obtaining research grants	24.18%	26.37%	7.69%	31.87%	9.89%
Funding new equipment/technologies	40.66%	38.46%	8.79%	8.79%	3.30%
Management support of research initiatives	10.99%	38.46%	28.57%	19.78%	2.20%
Government restrictions on research	5.56%	21.11%	21.11%	38.89%	13.33%
Technology transfer	6.67%	34.44%	31.11%	18.89%	8.89%
Staff training	10.00%	52.22%	30.00%	7.78%	0.00%
Integrating new technologies into current research	10.99%	59.34%	19.78%	7.69%	2.20%
Mergers/acquisitions of research organizations	3.30%	17.58%	28.57%	34.07%	16.48%
Maintaining environmental health & safety standards	6.59%	49.45%	25.27%	16.48%	2.20%

Table 1. Laboratory challenges rated by category.

From the following list of business management approaches, rate the effectiveness each has on increasing innovation and improving timely completion of research projects.

	Very Effective	Effective	Less Effective	Not Effective	Don't Know
Share information about your organization's practices and procedures to all staff members	26.74%	56.98%	6.98%	2.33%	6.98%
Share your organization's mission, vision and/or values statements with staff members	29.33%	54.67%	10.67%	5.33%	0.00%
Share your organization's strategic goals and group goals with staff members	32.00%	54.67%	9.33%	2.67%	1.33%
Provide clear performance expectations	41.33%	45.33%	6.67%	4.00%	2.67%
Provide timely and specific feedback on staff performance	27.03%	52.70%	16.22%	2.70%	1.35%
Assign project managers to oversee research projects	20.00%	44.00%	20.00%	9.33%	6.67%
Give employees opportunities to enhance their knowledge, learn new jobs, and expand their abilities	29.33%	58.67%	9.33%	1.33%	1.33%
Focus on specific business issues	14.67%	34.67%	32.00%	12.00%	6.67%
Welcome collaboration on ideas	32.88%	50.68%	13.70%	2.74%	0.00%
Define specific objectives and goals	41.89%	45.95%	9.46%	1.35%	1.35%
Remind staffers of the objectives and goals during the research process	24.66%	52.05%	19.18%	4.11%	0.00%
Establish clear criteria for evaluating results	37.84%	43.24%	13.51%	4.05%	1.35%
Set project milestones	29.73%	47.30%	14.86%	6.76%	1.35%
Track progress against milestones	30.14%	42.47%	17.81%	8.22%	1.37%
Ongoing communication with staff members, sponsors and stakeholders	29.17%	50.00%	16.67%	1.39%	2.78%
Calculate and measure Return on Investment (ROI)	12.33%	30.14%	23.29%	20.55%	13.70%

Table 2. Business management approaches rated by effectiveness.

management must do a better job of communicating with them. Knowing the goals of the company and understanding the direction in which it is headed is necessary to establish and manage the expectations they have of their staffs and to assure them that their jobs are safe, so that they can focus on their work and be productive.

Not only is it important for managers to know what to expect from their employees, it may be even more important for employees to know what is expected from them by their managers and their companies. An overwhelming 84 percent of the participants in the survey indicated that sharing the organization's mission and goals increases innovation among staff members and improves the accuracy and timely completion of research projects. This is why communication at all levels is so important. The lab manager must be the bridge that connects the mission and goals being established by upper management with the employees whose jobs are to achieve those goals.

"When people really understand what the mission of the strategy is, they can focus more on the work that they're doing and they perform better," says Dr. Scott D. Hanton, one of two section managers in the global analytical sciences department at Air Products and Chemicals in Allentown, Pennsylvania. "They can see that connection between what they're trying to accomplish in the laboratory and how that benefits the business."

"The workforce appreciates being in the loop," says Dr. George Lucier, a laboratory analytical manager with the Battelle Memorial Institute who is stationed at the Tooele Chemical Agent Disposal Facility in Utah. "It helps them become engaged in their work so they're not just there running sample after sample. They have a better idea of what the big picture is, and they feel as if they are stakeholders in that bigger picture."

If upper management does not clearly define its expectations, it is difficult for managers to justify the importance of the work being done in the lab. When workers don't understand how their individual jobs contribute to the

Please check the management skills you use and rate their effectiveness in making you a better manager.

	Very Effective	Effective	Somewhat Effective	Not Very Effective	Not Using
Open and honest communication with staff and management	58.43%	37.08%	4.49%	0.00%	0.00%
Listen to and accept constructive feedback	42.05%	48.86%	9.09%	0.00%	0.00%
Demonstrate confidence and enthusiasm	39.08%	42.53%	18.39%	0.00%	0.00%
Be a good listener	44.32%	43.18%	11.36%	1.14%	0.00%
Articulate clearly what's important to the success of the organization and to employees	34.09%	46.59%	18.18%	1.14%	0.00%
Empower staff to take ownership; get involved; make positive contributions to the organization	44.32%	36.36%	12.50%	3.41%	3.41%
Make sure employee behavior is aligned with company strategy	14.77%	47.73%	27.27%	3.41%	6.82%
Help employees understand their role in making the company a success	19.32%	46.59%	28.41%	2.27%	3.41%
Provide employees with the resources they need: equipment, technology, training, mentoring and coaching.	35.63%	49.43%	13.79%	1.15%	0.00%
Be approachable and visible	45.45%	39.77%	13.64%	1.14%	0.00%
Encourage creativity, innovation and fun	36.78%	40.23%	17.24%	1.15%	4.60%
Develop operating plans and financial budgets	14.94%	35.63%	28.74%	11.49%	9.20%
Have a clear vision for the lab	35.23%	37.50%	18.18%	4.55%	4.55%

Table 3. Practiced management skills rated by effectiveness.

Please check all the steps you've taken to motivate staff and rate their effectiveness.

	Very Effective	Effective	Somewhat Effective	Not Very Effective
Reaffirm the mission, objectives, goals	20.45%	42.05%	32.95%	4.55%
Do something unexpected such as ordering pizza for lunch	20.00%	43.53%	24.71%	11.76%
More one-on-one communication	31.82%	56.82%	10.23%	1.14%
Recognize jobs well done with bonus payout	26.92%	37.18%	26.92%	8.97%
Promote and increase salary for jobs well done	25.93%	39.51%	24.69%	9.88%
Provide autonomy on projects	24.42%	52.33%	19.77%	3.49%
Hold staff members more accountable for their performance	30.23%	50.00%	13.95%	5.81%
Offer staff members challenging assignments	29.07%	51.16%	15.12%	4.65%

Table 4. Steps taken to motivate staff rated by effectiveness.

success of the organization, it can have a negative impact on their morale. And morale is highly infectious.

"What I try to do more than anything else is to make every person on the staff feel like his or her contributions are really important," Dr. Hanton says. "I try to ensure that the work employees are trying to do is challenging to them, is important to the business, and is recognized by somebody who cares. If I have a person who is challenged and is doing something the business cares about and his or her role is recognized in it, then I have greater morale among my staff."

"Sharing the organization's mission and goals increases innovation among staff members."

An informed workforce can also result in greater overall efficiency, according to Dr. Judy Guy-Caffey, manager of analytical services with TETRA Technologies in Conroe, Texas.

"Because you know what the primary goals are and where you should be moving, you don't waste a lot of time on things that are extraneous or not necessarily conducive to meeting those goals," she says.

Beyond communicating the goals of the organization to the staff, more than 80 percent of the survey participants indicated that empowering their staffs to take ownership and getting them involved in making positive contributions to the organization is an effective way to make themselves better managers.

"Without ownership, people are just doing things because they are being told to," says Dr. James F. Hoffman, a 31-year veteran at Marathon Petroleum Company in Catlettsburg, Kentucky, and current manager of the refining, analytical, and development department. "They would much rather understand what's going on, why and how and what their role is, and how they can influence things. So it's much more important to give them ownership."

"From the manager's perspective, I don't think you can really do it all yourself anyway," Dr. Guy-Caffey says. "If you're not delegating and empowering people in your group to take responsibility for various projects, then you're probably not able to get everything done that needs to get done on every single project."

Dr. Hanton believes that empowering employees makes managers look better.

"The more that people are empowered, the more they can make their own decisions," he says. "They make decisions faster, which leads to better performance in the department. I can improve my management skills if I can give my staff the right information that empowers them to make good decisions fast, because that moves everything along faster and that's what the whole business world needs now. Everything is focused on speed."

With ownership comes accountability. More than 80 percent of the participants indicated that holding staff accountable for their performance is an effective way to motivate them.

"If they realize that their success is dependent upon their performance, they are more focused," Dr. Hoffman says.

"If I'm holding everyone accountable, everyone is going to work harder and take more pride in his or her work,"

Please rate yourself on the following management skills.

	Excellent	Good	Fair	Poor
Open and honest communication with staff and management	39.08%	54.02%	6.90%	0.00%
Listen to and accept constructive feedback	38.37%	53.49%	8.14%	0.00%
Demonstrate confidence and enthusiasm	43.68%	44.83%	10.34%	1.15%
Be a good listener	42.53%	45.98%	10.34%	1.15%
Articulate clearly what's important to the success of the organization and to employees	18.82%	57.65%	22.35%	1.18%
Empower staff to take ownership; get involved; make positive contributions to the organization	37.93%	40.23%	19.54%	2.30%
Make sure employee behavior is aligned with company strategy	17.24%	50.57%	27.59%	4.60%
Help employees understand their role in making the company a success	24.42%	48.84%	24.42%	2.33%
Provide employees with the resources they need: equipment, technology, training, mentoring and coaching.	22.99%	52.87%	17.24%	6.90%
Be approachable and visible	62.79%	34.88%	1.16%	1.16%
Encourage creativity, innovation and fun	36.47%	45.88%	15.29%	2.35%
Develop operating plans and financial budgets	25.88%	37.65%	29.41%	7.06%
Have a clear vision for the lab	33.72%	39.53%	23.26%	3.49%

Table 5. Management skills rating.

Please check the following resources you are currently using or plan to use to gain management skills.

	Have used	Currently using	Plan to use	No Specific Plans
Formal eductional programs from Universities and Colleges	54.14%	21.79%	21.79%	2.27%
Learn from colleagues	21.83%	71.26%	3.45%	3.46%
Read professional magazines related to business management	20.53%	69.77%	6.98%	2.73%
Seminars/workshops	36.92%	40.23%	19.54%	3.31%
Online resources	23.14%	62.07%	13.79%	1.00%
On-the-job training	24.61%	67.05%	6.82%	1.52%

Table 6. Resources used to gain management skills.

says Dr. Hanton. "We have to give workers an effective guide as to what they're supposed to do and then let them do it."

While accountability is an effective means of motivation, many managers believe it is also a necessary shield against resentment toward those who are not performing up to standard.

"Not holding the staff accountable demoralizes the rest of the workforce when they see somebody they feel should have been held accountable for something and that person wasn't," Dr. Lucier says.

Accountability and empowerment are even greater motivators than pay raises, according to Dr. Kenneth Jensen, a laboratory consultant in Parker, Colorado, who spent 35 years as the superintendent of technology services in the U.S. Air Force.

"Give them goals to achieve and rewards for those goals, but they have to be meaningful rewards that will make their jobs easier or are going to benefit them in some way other than monetarily," he says. "If you give them a monetary increase, they learn to live with that in six weeks."

"While some businesses have the ability to reduce costs by modifying their operating procedures, laboratories typically do not."

That being said, most companies are not currently in a secure enough financial position to be attempting to motivate their employees with pay raises. In fact, many labs are attempting to find ways to increase productivity without offering their usual annual salary increases, and some are even trying to do so while lowering their payrolls.

If done tactfully, companies can actually use payroll reduction as a powerful motivator. By having all the employees take a small reduction in pay to avoid potential layoffs, employees may feel as if they are making a direct contribution to the success of the company by doing their part to help weather the storm. They may also have a stronger sense of urgency to perform at a higher level.

However, if cutbacks and staff reductions are made without thorough explanations from upper management as to their relation to the success of the company, upper management risks destroying the morale and productivity of their staffs. Without proper communication from upper management, managers are left in the precarious position of trying to convince their staffs that the company is not in danger, even if they aren't so sure of it themselves. Managers must be able to convince their staffs that their jobs are secure and that the

"The contemporary lab manager has to have the proper mixture of scientific knowledge and business acumen—and not necessarily in that order."

reductions being made are for the good of the company and not just for the sake of saving money. This is a challenging task for managers in any industry, but, for someone who has spent most of his or her career doing science in the lab where conditions can be controlled and results hypothesized, dealing with the unpredictability and often incomprehensible nature of human beings can be a vexing experience.

"It can be a little bit overwhelming," says Dr. Guy-Caffey. "In the scientific field, it seems as if people are moving up through the ranks by starting out as scientists who have all the scientific background you could want but not necessarily a lot [of background] in the way of business. One area of difficulty is not having much experience interacting with upper management. Then they may not have a lot of experience in actually supervising people. And if you don't have any financial experience, it can be a difficult transition if you have to start doing budgeting or costing and things like that."

While some businesses have the ability to reduce costs by modifying their operating procedures, laboratories typically do not. Procedures must strictly be adhered to, specific equipment and supplies must be used, and safety cannot be compromised. Today's lab managers must possess a knack for thrift and a keen awareness of how every item and activity is impacting the bottom line. They must also be prepared for the eventuality that upper management will suddenly slash their budgets and tell them to figure it out for themselves.

"It's all about efficiency now so that you can minimize your overhead and minimize the cost for the customer," says Dr. Lucier.

"But you still have that pressure to get projects completed and get new things out there to help the company's bottom line," says Dr. Guy-Caffey. "You really have to be on top of things as far as still trying to get as much done as you can on projects without going over budget."

"As a lab manager, I can't afford to do long-term, academic-style science," Dr. Hanton says. "I have to focus on the needs of the business, and that means being more streamlined in our activities, being more focused on the deliverables of the business, and really being a clear partner with the business to solve the problems that they've got today."

"Years ago it was, 'Let's do it scientifically correct, and we'll get paid for it no matter what,'" Dr. Jensen says. "Now you need to be aware of the business side of it and accept the fact that some things cannot progress, because you're not going to be able to pay for them. Even so, you need to make a marked effort to perform everything scientifically and analytically correct."

Perhaps the most telling revelation of this survey is that the contemporary lab manager has to have the proper mixture of scientific knowledge and business acumen—and not necessarily in that order. Now more than ever, the greatest challenge is not merely to achieve a scientifically relevant result, but to achieve one that is within budget, on schedule, and—most important—profitable.

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MOTIVATING A 21ST CENTURY LAB STAFF, PART II

LAB MANAGERS NEED TO ADJUST THEIR MANAGEMENT STYLE TO TAKE GENERATIONAL DIFFERENCES INTO ACCOUNT

by Ronald B. Pickett

In part one of this article (November, 2009), I discussed the role of the organizational climate in motivating lab scientists and the importance of understanding individual characteristics. In part two we will consider the difference in age cohorts. A cohort is a group of people who share a common characteristic or experience within a defined period (e.g., are born, leave school, lose their job, are exposed to a drug or a vaccine, etc.).

"The Generation X mentality reflects a shift from a manufacturing economy to a service economy."

Age cohorts: New findings in cross-generational motivation

Over the past several years a number of distinct differences have been found among various age groups. These are more pronounced than the obvious differences such as those under 40 will probably have childcare issues and those over 55 will be looking at retirement options and parent care. It has to do with the way the world in which we were raised shaped our group personalities. Those of us with parents who were young adults during the Great Depression know that their attitude about money and investing is very different from ours. Kids who grew up with their hands on a keyboard or a gaming device and think that *USA Today* is a journalistic icon are different from people who are terrified to plug in their computers and don't trust anything less authoritative than *The New York Times* (although now, none of the media giants retains its patina of journalistic excellence and impartiality).

These group characteristics lead to some helpful generalizations about motivation. An article in the July-August 2009 *Harvard Business Review* updates and expands some of the generational cohort models. The substance is that baby boomers (those born 1946 through 1964) and Generation Ys (those born 1979 through 1994) have a lot in common. Since many of you are from the baby boom age cohort, this is may be good news. Here are some of the common characteristics:

They want to contribute to society through their labor, seek flexible working arrangements, value social connections and loyalty to a company, and prize other rewards of employment over monetary compensation.

More from the portrait of baby boomers

They expect to work beyond age 65, and 14 percent say that they don't think they will ever retire. They report needing to stay in the work force three to four years longer than they did six months ago. More than half of boomers volunteer time to advance environmental, cultural, or other causes. They prize flexibility and autonomy in their jobs. They have needy family members from two generations: elderly parents and dependent children.

"Members of Generation X work to live rather than live to work."

More from the portrait of Generation Y

They are very ambitious, but they want both to remain faithful to the workplace and have a wide range of new experiences. They are comfortable in a multicultural environment. They are committed to healing the planet, and they believe that it is important to work in a green, environmental workplace. They also want to network and expect others, including bosses, to be accessible.

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The "odd" generation

An interesting side note to this research is that the "different" group is Generation X, those between the ages of about 35 and 50!

Generation X is comprised of the 44 to 50 million Americans born between 1965 and 1980. They are the product of a severe decline in the birth rate that followed the baby boom, and make up a much smaller group than both the previous and following generations.

This relatively small cohort makes up an important middle segment in most laboratories. So managers need to adjust their management style to take their generational differences into account, and not see them as weird or strange or unmotivated. For example, Gen Xers rate high compensation as very important. Here are a few common characteristics of Generation X.

They tend to be individualistic, independent, resourceful, and self-sufficient. In the workplace, Generation Xers value freedom and responsibility. You may have noticed that many in this generation display a "casual disdain for authority and structured work hours." They dislike being micromanaged and strongly prefer a hands-off management philosophy.

"Consider [a] cohorts' characteristics when developing new policies, rewards, and recognition."

The Generation X mentality reflects a shift from a manufacturing economy to a service economy. They are the first generation to grow up surrounded by computers, and technology has been an integral part of their lives. As a result, they are quite comfortable in the high-tech environment of laboratories and are anxious to adopt new technology and make modifications to the equipment in use.

Since many Gen Xers lived through tough economic times in the 1980s and saw their baby boomer parents lose long-held positions, they are less committed to one employer and more willing to change jobs to get ahead than previous generations. They adapt well to change and are tolerant of alternative lifestyles. Generation Xers are ambitious and eager to learn new skills but want to accomplish things on their own terms. As the economy improves, they may be more likely to look outside the organization for new positions than either baby boomers or Gen Yers.

Unlike previous generations, members of Generation

TIPS FOR MOTIVATING YOUR STAFF

1. Check the climate—are people excited, happy, and supportive of each other?
2. Manage the climate!
3. Know what is important to each employee.
4. Make sure your company policies are fair and equitable.
5. Don't permit one "bad apple" to ruin the barrel.
6. Involve your staff in projects and in the decisions that will affect them.
7. Change people's jobs or keep them the same—this is totally dependent on the individual.
8. Reward exemplary behavior.
9. Make expectations explicit.
10. Hire the right people, people who will fit in with the group.
11. Find out what your colleagues are doing that is working for them.
12. Set and maintain high standards.
13. Keep at it!

Two seemingly contrasting ideas have evolved: The need to set a climate that will be motivating for the entire group, and the need to recognize the unique characteristics of each individual. However, that dichotomy is the essential truth of motivating a work group.

KEY POINTS FOR MANAGERS:

1. The motivation of the staff is one of the core responsibilities of managers. I see people all the time who have left a company because of a climate that was stifling their individuality.
2. Create a climate that fosters innovation, rewards productivity, and engenders excitement.
3. Maintaining a high level of motivation isn't something that is done once and forgotten; it has to be constantly reviewed and renewed.
4. It's not only the motivation of the staff that is important; managers have to keep their own level of motivation and energy high. You can't expect your people to be enthusiastic and excited if you are bored or scared.

(If you want a lighthearted treatment of this topic, visit http://www.motivation123.com/.)

X work to live rather than live to work. As a group, they appreciate fun in the workplace and prefer a work hard/play hard environment.

Key points for lab managers: Stress the social contribution of your work, be accessible to your staff, focus on outcomes over processes, encourage curiosity, and emphasize "green."

As a manager, it makes sense to understand the age cohorts that comprise your work group. Consider the cohorts' characteristics when developing new policies, rewards, and recognition.

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A YEAR IN REVIEW—LOOKING BACK AND PLANNING AHEAD

SCIENTISTS PLANT SEEDS FOR FUTURE OPPORTUNITIES

During the past year, scientists around the country have encountered various challenges, including an unpredictable world economy, thousands of job losses, and pharmaceutical megamergers. There cannot possibly be a pot of gold at the end of this rainbow, can there? Think again. Many scientists, faced with unemployment and other challenges, have not only survived but thrived as well.

"Scientists with vast experiences across different industries may stand out from the crowd."

Hardworking, talented scientists have withstood diverse economic issues to transform negative situations into positive growth opportunities within the industry. As scientists continue to plant seeds for future opportunities, they are able to contribute their past experiences and talents to an industry that refuses to succumb despite the challenging conditions of an uncertain economy.

Pharmaceutical megamergers create new opportunities despite job losses

In 2009, six premier pharmaceutical companies merged. Each of the three megamergers led to significant job losses, forcing highly experienced scientists to pursue other opportunities or to change their career goals. Many displaced scientists became entrepreneurs and created their own companies, using their past work and educational experiences, as well as industry knowledge, to achieve success.

Other scientists relocated and accepted positions in other industries in order to expand their skill sets and acquire challenging roles. Typically, career changes allow individuals to develop innovative skills that help them succeed in their new positions while becoming more marketable to employers. Scientists with vast experience across different industries may stand out from the crowd once the economy improves and hiring picks up. While the megamergers of the past year did create job losses, they also helped individuals seek new challenges and positions, forcing them to transform negative situations into opportunities for growth.

American Recovery and Reinvestment Act of 2009 creates hope for researchers and developers

This past year, Congress created an economic stimulus appropriations bill that is expected to provide $21.5 billion in federal research and development funding well into the future:[1] $18 billion will be allocated for the continuation of scientific research and development in the nation, while $3.5 billion will likely be used for improving and creating research and development facilities and capital equipment.[2]

Through the recent creation of the economic stimulus bill, scientific organizations and facilities across the country have, in the past few months, gained renewed hope. Despite the constant economic struggles of the nation, scientists and researchers will still have ample opportunities to continue to research and develop cures and solutions for the various diseases, medical complications, and maladies that affect the quality of life of thousands of people every year.

According to the American Association for the Advancement of Science (AAAS),[3] the National Institutes of Health is expected to receive $10.4 billion for future research projects, while the Department of Energy will likely receive $2.5 billion for energy research and development. As research continues well into 2010, the scientific community will be able to develop diverse and innovative solutions in order to restore hope to millions of people who are diagnosed with various types of diseases each year.

Alternative energy creates positions for science professionals

In the last decade, the alternative energy industry has been thriving and has created thousands of new positions for scientists around the country amid the unpredictable conditions of the national economy. According to a Pew Charitable Trusts study,[4] from 1998 to 2007, the number of alternative energy jobs in the United States grew two-and-a-half times faster than traditional jobs. The nonprofit organization also found that the industry had created nearly 770,000 American jobs by 2007.

In the meantime, various organizations such as Apollo Alliance (an environmental coalition headquartered in San Francisco) and Challenger, Gray & Christmas (an outplacement consulting firm headquartered in Chicago) have predicted that the alternative energy industry will

continue to create thousands of new positions during the next decade,[5,6] as national and worldwide organizations implement "environmentally friendly" strategies.

Today, the alternative energy sources of solar, wind turbines and biofuels have attracted numerous scientists around the country from various types of industries. Scientists have been particularly sought after in order to use their backgrounds and knowledge to positively contribute to the high demand for alternative energies in the future.

While many industries continue to lay off workers, the future of alternative energy is becoming brighter with each passing year—leading scientists to pursue new careers that will provide them with not only secure positions, but opportunities to display their talents and plant seeds of hope for the future as well.

As thousands of jobs have been created in alternative energy in the last decade, the future appears bright within the industry. There are no signs that opportunities will decrease anytime soon. Not only is the industry creating jobs for current workers, but colleges and universities around the nation are also preparing future scientific leaders for careers in the field.

Across the country, well-respected colleges and universities have begun offering bachelor's and master's degrees in renewable or alternative energy. The Oregon Institute of Technology was the first educational institution in the country to offer a four-year undergraduate program in renewable-energy systems. Since then, the following respected public and private universities, among others, have followed in the institute's footsteps by creating alternative or renewable energy degree programs that will prepare highly talented students for successful futures in the industry.[7]

- Arizona State University
- University of Wisconsin—Madison
- Washington State University
- Illinois State University
- John Brown University

During the past 12 months, scientists around the country have endured an unpredictable national economy as well as continued job losses and pharmaceutical megamergers. Throughout the year, scientists learned that they could truly adapt to all sorts of adversities in order to continue to pursue their dreams within the scientific community.

Some scientists have become entrepreneurs, while others have found opportunities in the field of alternative energy or have continued their research and development careers with help from the American Recovery and Reinvestment Act. Meanwhile, others have just begun their careers after obtaining a degree in renewable energy. Each of these young scientists is eager to positively impact the scientific community well into the future.

Through it all, individuals have continuously contributed their talents to the scientific community in order to plant seeds for future opportunities.

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LOCATION, LOCATION, LOCATION

FACTORS TO CONSIDER WHEN DECIDING WHERE TO ESTABLISH A NEW LABORATORY

by John K. Borchardt, Ph.D.

Companies have long located their R&D laboratories in accordance with two philosophies. The first is that of the central research laboratory at which scientists perform research in all areas of current or future interest to the company. The second is that of smaller, scattered labs located at production facilities. More recently, global companies have used a third approach, locating some R&D labs in or near major markets whose product needs and preferences differ significantly from those of the firm's native country. Another approach gaining popularity is to locate laboratories in areas that are hot spots for specific technologies. This is most obviously the case in biotechnology, as pharmaceutical companies locate labs in stimulating intellectual environments for biotech such as Boston and San Diego.

"Teamwork between researchers, design engineers and marketing staff is facilitated by... geographic proximity."

Photo 1. Bristol-Myers Squibb Laboratory (New Brunswick, NJ).
Photograph courtesy of Bristol-Myers Squibb Corporation.

The central laboratory

Large laboratories are often architectural statements representing the image of the laboratory operator (Photo 1). The central laboratory is often located in close proximity to company headquarters. Both large companies, such as DuPont (Photo 2) and Dow, and small firms have used this approach in choosing laboratory locations. Teamwork between researchers, design engineers and marketing staff is facilitated by this geographic proximity.[1] This teamwork can reduce product development time and facilitate coordination of product or process development. This reduces development costs. In addition, frequent interaction between marketing and R&D personnel helps to ensure that products are well designed and meet important customer needs.

Having R&D centralized in a single facility makes it easier to justify, establish and maintain expensive services such as laboratory instrumentation, laboratory information management systems, and services such as machine and glassblowing shops. A large laboratory gives a company the critical mass to maintain a significant presence in the local scientific community through participation in the local ACS section and in other local science and engineering societies, as well as representation in local university outside speaker programs. This visibility can make it easier to hire scientists, technicians and summer interns locally.

A variant of this approach is to locate the laboratory and the plant on the same site. Doing so can reduce operating costs for the two facilities by combining utilities and other services. Also, the lab and the plant can share analytical services. Lab personnel are immediately available for plant trials or to test new manufacturing processes. Should plant operating problems arise, laboratory personnel are readily available to help solve them.

Smaller, scattered R&D labs

These labs are often located in or adjacent to company production facilities. The advantages are the same as for having central laboratories located on a production site. Modern telecommunications capabilities may be weakening the argument for this approach to choosing laboratory sites.

In today's cost-conscious environment, companies purchasing businesses that include R&D operations may not wish to spend the funds required to relocate researchers and their equipment from their current location to a facility operated by the buyer. Often the former owner of the business will rent lab facilities to the buyer of the business.

Such was the case at Goodyear's Akron, Ohio laboratory when the firm sold its PET business to Shell Chemical. When Union Carbide purchased Shell Chemical's U.S. polypropylene business, it leased space in Shell's Westhollow Technology Center. The lease was acquired by Dow Chemical when the firm acquired Union Carbide. More recently, the purchasers of Shell's resins, elastomers and specialty surfactants businesses leased the space used by the businesses they had acquired. A downside is that the hosting company may decide that the lab space is needed for its own requirements and may not renew a tenant's lease.

"[Locating] the laboratory and the plant on the same site...can reduce operating costs."

Photo 2. DuPont Experimental Station (Wilmington, DE).
Photograph courtesy of E. I. du Pont de Nemours and Company.

Renting the laboratories used by the purchased business can have several advantages for the buyer. The first is avoiding problems associated with obtaining environmental emissions permits. A second is avoiding personnel relocation costs. A third is improved personnel retention after the purchase. Researchers are less likely to leave a new employer if relocation and the attendant disruption of their personal and family lives are not involved in the change of employment. A fourth is that laboratory services such as machine shops, glassblowing shops and analytical services may still be available to the tenant occupying space in a large laboratory. Making these arrangements when located in a separate, independent facility can be time consuming. Finally, while corporate secrecy must be maintained, exposure of researchers, particularly those hired after the sale, to corporate cultures different from those of their own employer can be healthy and lead to improved ways of doing things.

The last is also an advantage to the former owner of the business renting out laboratory space. Use of on-site services by tenants can also enable the laboratory owner to keep the level of total work done by these services at a level adequate to justify their existence. Sometimes this enables the laboratory owner to maintain analytical chemistry expertise that would otherwise be needed only occasionally. Most important, by keeping laboratories occupied and bringing in rental income, the laboratory owner is able to offset overhead costs for the firm's own continuing R&D operations.

Smaller companies may set up a small lab in an existing building in an office park. This avoids the costs of constructing a new building. However, if the park does not contain other laboratories, emissions permitting may be a time-consuming and, for a small company, expensive issue.

Overseas laboratories

With many U.S. markets reaching saturation, locating production facilities in regions with rapidly growing markets, such as some Asian countries, makes sense for global chemical and pharmaceutical companies (Photo 3). There may also be labor cost advantages. As global firms locate production facilities in other countries to better penetrate their markets, the need to understand these markets and develop products tailored to them becomes increasingly important. Staffing laboratories located in other countries with their own nationals can facilitate this.

Photo 3. AstraZeneca Bangalore Laboratory (India).
Photograph courtesy of AstraZeneca International.

Research in many fields of science and technology has become internationally competitive. Accessing and understanding the most advanced research in other countries can be difficult without R&D bases in those countries.[1] Communication and understanding are also more difficult unless laboratory managers hire foreign nationals who speak the language and have a deep understanding of the culture.

With access to electronic communications and pushed

by globalization, many employers of scientists have been building laboratories around the globe. Some firms with global operations, such as Procter & Gamble and Unilever, have long done this. For example, drug firm Bristol-Myers Squibb currently operates nine laboratories in five countries. Companies such as Exxon-Mobil, Royal Dutch Shell and Dow that have built world-scale production plants in Asia also have built new laboratories there.

Kuemmerle suggests that the optimal size for a new foreign R&D facility during the start-up phase is usually 30 to 40 employees.[1] He suggests that the best size is about 235 employees, including support staff, when the laboratory is fully established. If the laboratory is too large, its culture can become too self-centered or too anonymous, resulting in researchers becoming isolated. However, many overseas laboratories are substantially larger than the limit recommended by Kuemmerle.

"Drug firm Bristol-Myers Squibb currently operates nine laboratories in five countries."

If the foreign R&D center is too small, the resulting lack of critical mass produces an environment in which there is little cross-fertilization of ideas among researchers. A small R&D site sometimes does not command as high a level of respect in the neighboring scientific community as does a large laboratory. As a result, researchers in small laboratories have a harder time gaining access to informal networks that provide opportunities for an exchange of knowledge. (One way to counter this problem is to have an active program of researchers publishing their results, attending local college and university outside speaker programs, and volunteering as speakers themselves.)

As a result of outsourcing, many pharmaceutical companies are funding R&D in biotechnology and combinatorial chemistry laboratories. The most common scenario is European pharmaceutical firms outsourcing such R&D to innovative U.S. firms.

With an increasing number of companies developing an international network of R&D laboratories, the task of coordinating R&D performed in far-flung laboratories becomes more complex. More R&D managers must become global coordinators instead of local administrators. An example of this is the technology manager position created by Shell Chemical during a company restructuring several years ago. A technology manager is responsible for R&D in a particular business and may supervise R&D that often takes place in different laboratories located around the globe.

Dale Holocek, former vice president, Technology Americas of Shell Chemical, notes, "Work is now being carried out by long-distance networks where building relationships, rapid learning and self- development are some of the core skills that will be needed to compete in the 21st century."

"A small R&D site sometimes does not command as high a level of respect in the neighboring scientific community."

Companies use a number of mechanisms to create a cohesive research community in spite of geographic distance. Hewlett-Packard regularly organizes an in-house science fair at which teams of researchers can present projects and prototypes to one another. Canon has a program that lets researchers request temporary transfers to other laboratories to broaden their skills.

As more pockets of scientific knowledge emerge worldwide and business competition in foreign markets mounts, the imperative to create global R&D networks will grow all the more pressing. Only research managers who embrace their role as global coordinators of R&D and managers of knowledge will be able to tap the full potential of their firm's international laboratory network.

Locating labs in hot spots

Another trend is to locate laboratories in areas of intellectual ferment. The pharmaceutical and biotechnology industries are cases in point. For example, with its 275 biotechnology companies and major university medical schools, Boston has become a magnet for major pharmaceutical company laboratories. Indeed, acreage for large laboratory buildings is in increasingly short supply. As a result, some firms such as AstraZeneca are locating large laboratories in suburbs such as Waltham. Disadvantages of distance from major universities such as Harvard and Massachusetts Institute of Technology are balanced by reduced land costs and shorter, less time-consuming commutes by laboratory staff. Novartis used a different approach, renovating an old candy factory near Massachusetts Institute of Technology for its Novartis Institutes for BioMedical Research, due in part to the lack of availability of large tracts of land near MIT.

These hot spots are not limited to the U.S. With the lure of their universities, Cambridge and Oxford have become laboratory hot spots in the U.K. Since 2006, Suzhou Industrial Park, an hour from Shanghai, has become a major biotech R&D hub, mainly for start-up companies.[2]

Other aspects of laboratory location

Local factors such as land costs and construction costs can influence the choice of laboratory location. So can the willingness of governments to extend tax incentives to firms if they locate their laboratories in a certain area. For example, last August drug contract research firm Covance received tax incentives from Indiana's Hancock County to create 315 new jobs at its Greenfield Laboratories. This will more than double the size of the laboratory staff.

Laboratories are no longer limited to the planet Earth. Laboratories on the International Space Station now orbit the planet (Photo 4). When it comes to laboratory locations, the sky's the limit!

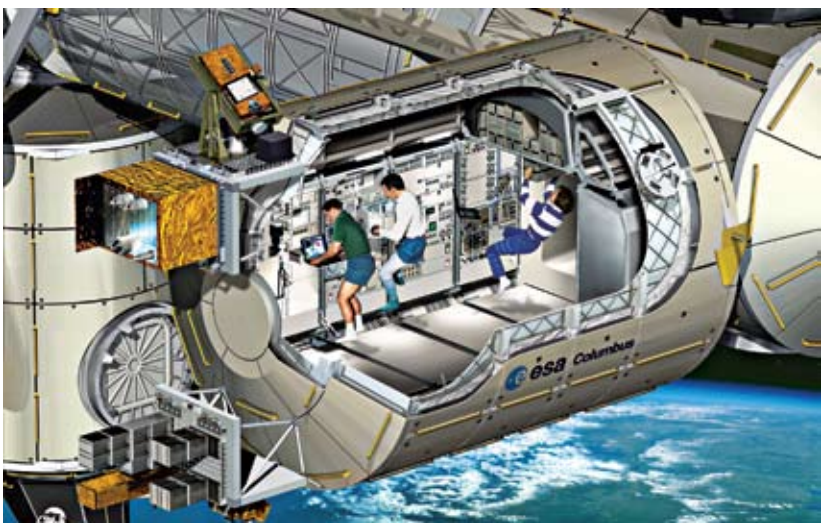

Photo 4. Artist's depiction of the ESA Laboratory located on the International Space Station. Image courtesy of the National Aeronautics and Space Administration.

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MEASURING MERCURY LEVELS IN FISH

VAPOR GENERATION AA SPECTROMETRY PROVIDES A FAST, COST-EFFECTIVE SCREENING TOOL

By Hazel Dickson

Mercury is a highly toxic element that can be fatal to humans. It can occur naturally in the environment as a metallic element, an inorganic salt and/or an organic compound. However, human activities produce most of the mercury found in the environment. Coal-fired power plants, waste incineration, metal processing and cement production are the main sources of mercury air pollution, producing approximately 75 percent of the mercury released into the atmosphere each year.[1]

"Accepted exposure levels for methyl mercury are exceeded, often by wide margins."

Once in the atmosphere, mercury eventually settles into rivers, lakes or oceans, where certain microorganisms and abiotic reactions convert it to methyl mercury. Through a process called biomagnification, methyl mercury builds up in predatory fish such as swordfish, tuna, king mackerel and shark as well as in some types of shellfish. Methyl mercury accounts for more than 90 percent of the total mercury in fish and seafood. In the U.S., mercury has been estimated to have polluted 30 percent of lakes, estuaries and wetlands and 473,000 miles of streams, rivers and coasts.[2]

Methyl mercury is acutely toxic to humans because of its ability to pass through the meninges into the brain. Similarly, in pregnant women, methyl mercury can cross the placenta and damage the developing nervous system of the fetus.

In order to ensure maximum product safety and protect the health of consumers, regulatory bodies throughout the world have introduced stringent legislation to monitor mercury and methyl mercury levels in seafood.

Regulatory framework

According to the action levels for poisonous or deleterious substances in human food and animal feed enforced by the U.S. Food and Drug Administration, the maximum allowable concentration of methyl mercury in seafood is 1 mg/kg.[3] The regulation is applicable to edible portions of fresh, frozen or processed fish, shellfish, crustaceans and other aquatic animals. Any inspected products found to reach or exceed this limit are withdrawn from the market, and any further distribution, import or export is prohibited unless otherwise implied by future inspections.

The U.S. Environmental Protection Agency has introduced a methyl mercury guideline that recommends a limit on mercury consumption based on bodyweight, more specifically, 0.1 mg/kg bodyweight per day.[4]

The CODEX alimentarius 193-1995[5] general standard for contaminants and toxins in foods specifies a maximum concentration of 0.5 mg/kg wet weight of methyl mercury in fresh or processed noncarnivorous fish and crustaceans moving in international trade. The guideline level for methyl mercury in carnivorous fish such as shark, swordfish, tuna and pike is 1 mg/kg wet weight.

The Zero Mercury Working Group, a coalition of different environmental organizations, has recently published a report indicating that fish tested in different locations around the world show that internationally accepted exposure levels for methyl mercury are exceeded, often by wide margins. Based on the fact that the consumption of fish is the major source of ingestion-related mercury exposure in humans, the group claims that seafood products should be labeled to ensure that consumers are fully aware of the potential risks associated with their consumption.[6]

In order to ensure that concentrations of mercury and methyl mercury in fish and fish products are within the above specifications, a powerful analytical method needs to be implemented. Atomic absorption (AA) spectrometry has emerged as a state-of-the-art technique, offering precise, dependable measurements of low levels of mercury in seafood.

AA spectrometry advanced capabilities

In cases where total mercury measurements are required, AA spectrometry enables fast and accurate

analysis of samples with detection limits below 0.07 ppb (µg/L) in solution, when used in conjunction with a vapor-generation accessory. This equates to 0.014 mg/kg in the original fish sample, based on a 0.5 g in 100 mL preparative method, which easily meets the maximum levels set by food safety regulations.

For the analysis of methyl mercury, AA spectrometry provides a fast, cost-effective and easy-to-use screening tool compared to more complex and expensive techniques such as HPLC-ICP-MS or GC-ICP-MS.

Application example

Analysis was performed using a Thermo Scientific iCE 3500 AA spectrometer. The spectrometer was combined with a Thermo Scientific VP100 vapor-generation accessory, which uses a continuous flow system to produce a steady-state signal for excellent analytical precision. The continuous flow of reagents ensured that the system was self-cleaning, reducing memory effects and increasing sample throughput. The VP100 was controlled by the Thermo Scientific SOLAAR software, simplifying method setup and analysis. A mercury cell provided as standard with the VP100 was also used. This accessory offered an increased path length compared to a normal vapor cell and achieved exceptionally low detection limits.

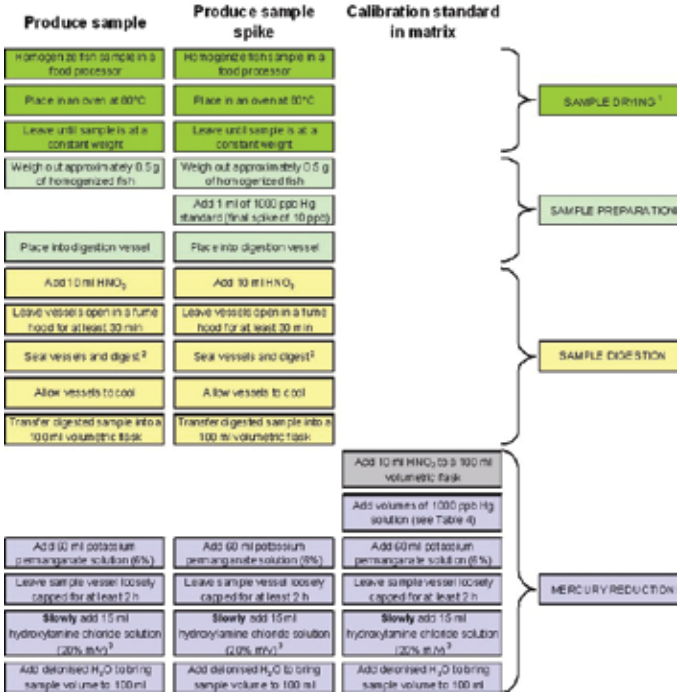

Figure 1: The procedure for preparing samples, sample spikes and matrix-matched standards for the analysis of mercury in fish.

Sample preparation

Three different fish samples were chosen for this application: fresh salmon purchased from a supermarket; canned sardines also obtained from a supermarket; and DORM-2 certified reference material provided by the National Research Council of Canada, Institute for National Measurement Standards, Ottawa, Canada. Samples were prepared following a four-step procedure that included sample drying, sample preparation, sample digestion and mercury reduction (Figure 1).

1. Sample drying phase is not necessary if the final concentration of mercury is needed for a wet-weight sample.
2. Refer to the manufacturer's guidelines when designing a digestion program.
3. CARE: The reaction is exothermic and the flask may become hot. Also, make sure to add the hydroxylamine chloride slowly, otherwise the solution may foam and eject some sample from the flask.

Sample drying is necessary only if the final mercury concentration needs to be measured as a dry weight value. In that case, the fish samples must be homogenized and dried in an oven at 80°C until they reach a constant weight. Fish tissue can be otherwise freeze-dried and homogenized using a mortar and pestle. After drying, portions of around 0.5 g must be accurately weighed out for digestion.

The FDA and CODEX alimentarius specify concentrations of mercury in a wet-weight sample, whereby fresh fish must be homogenized in a food processor and a portion of approximately 0.5 g must be precisely weighed and placed in a microwave digestion vessel. In that way, a representative fish sample is produced.

For the purposes of this experiment, 1 mL of 1,000 ppb Hg standard solution was added to half of the salmon and sardine samples. This spike gave a concentration of 10 ppb Hg in the final 100 mL sample. No mercury was added to the other half of the samples to allow for the calculation of spike recoveries. A set of microwave digestion vessels containing the samples was placed in a fume extraction hood prior to adding 10 mL of concentrated HNO_3.[3] The vessels were left for at least 30 minutes without their lids on, to allow gases to escape, and they were subsequently placed into a microwave digestion system. A hot-block digestion could also have been used.

Upon completion of digestion, the samples were

transferred to a 100 mL graduated flask and 60 mL of 6 percent potassium permanganate solution was added. The sample vessel was left for at least two hours to ensure that all mercury in the sample was reduced to Hg^{2+}. It is very important to ensure that the vessel is not sealed at this stage, since any gases produced can increase pressure. Following mercury reduction, 15 mL of 20 percent hydroxylamine chloride solution was added to the sample to remove the excess potassium permanganate. Care was taken during the addition of the hydroxylamine chloride, as this produces an exothermic reaction and the vessel may become hot. The hydroxylamine chloride was added slowly while the solution was gently mixed during the addition. Without these precautions, a violent reaction may occur that could eject some sample from the flask, leading to inaccurate results. The solution was then left to cool, and deionized water was added to make the volume up to 100 mL.

"Spectrometry has been demonstrated to achieve ... reliable analysis of low levels of mercury in fish."

Standard preparation

Standards were prepared from a 1,000 ppm (mg/L) mercury standard solution. This standard was first diluted to produce a 1,000 ppb (µg/L) stock solution to allow simple preparation of a range of standards. To demonstrate the linear range of AA spectrometry, a wide range of standards was used (1 to 100 ppb). The standards were matrix-matched and prepared in the same order as the samples.

VP100 reagent preparation

The vapor-generation accessory requires both a reductant and an acid solution to perform the reactions that form the gaseous mercury. For this application, the reductant was a solution of 7.5 percent stannous chloride (SnCl2) stabilized in 10 percent HCl. The acid solution was 50 percent HCl.

Instrument conditions

The analysis was performed using the most sensitive absorption wavelength for mercury, 253.7 nm. Five resamples were used, with each resample taking four seconds, to thoroughly assess the short-term stability of the spectrometer. For normal use, three resamples would be adequate. Deuterium background correction was implemented throughout the analysis.

Results

The calibration curve exhibited excellent linearity up to 100 ppb (Figure 2), which is equivalent to 20 mg/kg in a fish sample (assuming a sample weight of 0.5 g) with an R2 value of 0.9989. This proves the superb performance of AA spectrometry over a wide concentration range. This calibration is equivalent to concentrations of 0 to 20 mg/kg mercury in the original fish samples, assuming a sample mass of exactly 0.5 g. The percent relative standard deviations (%RSDs) for each of the standards were less than 2.5 percent. This demonstrates the excellent stability of both the spectrometer and the vapor-generation accessory.

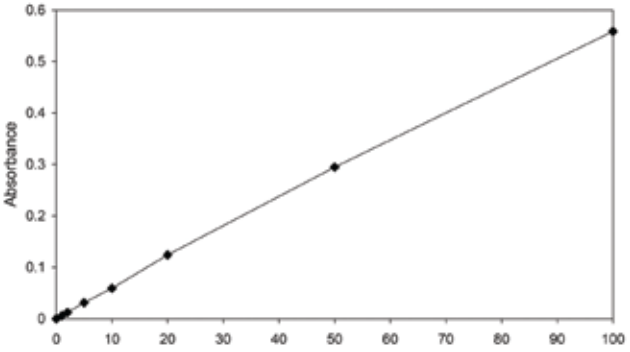

Figure 2. Calibration curve. Matrix-matched standards were used.

The method detection limit (MDL) and characteristic concentration were calculated using the automated "Instrument Performance" Wizard available in the SOLAAR software. This user-friendly feature guides users through the steps necessary to quantify the performance of the method. It also automates all the data processing, making the entire procedure quick and easy. A detection limit of 0.068 ppb (µg/L) in solution was identified. This equates to an MDL of 0.014 mg/kg in the original fish sample (assuming a sample mass of 0.5 g). The MDL provides a measure of the noise and stability of the system. A lower detection limit allows for confident determination of lower concentrations of mercury in samples. The characteristic concentration, which is related to the sensitivity of the method, was measured at 0.724 ppb in solution. This is the equivalent of 0.145 mg/kg in the initial fish sample (assuming a sample weight of 0.5 g).

Salmon and sardine samples were spiked with 10 ppb

mercury prior to digestion and compared with unspiked samples to calculate recoveries. These 10 ppb spikes would correspond to a concentration of 2 mg/kg in normal fish samples (assuming a sample weight of 0.5 g) and show the accuracy of the analysis at levels appropriate to current legislation. The spike recoveries are shown in Tables 1 and 2. The agreement with expected results was excellent, with the recovered values all falling within 6 percent of the expected values. This demonstrated the repeatability and precision of both the sample digestion procedure and the vapor analysis using AA spectrometry.

Sample	Expected Concentration (mg/kg)	Meaasured Concentration (mg/kg)	Percentage Recovery (%)
Sardine 1	2	1.93	97
Sardine 2	2	2.08	104
Sardine 3	2	1.91	95

Table 1: Table of results showing the expected concentration, measured concentration and percentage spike recovery for three separate sardine samples.

Sample	Expected Concentration (mg/kg)	Meaasured Concentration (mg/kg)	Percentage Recovery (%)
Salmon 1	2	1.89	94
Salmon 2	2	1.94	97
Salmon 3	2	1.99	99

Table 2: Table of results showing the expected concentration, measured concentration and percentage spike recovery for three separate salmon samples.

Three separate samples of the DORM-2 standard reference material were also analyzed to guarantee the accuracy of the sample preparation, digestion and analysis (Table 3). The recoveries from these samples were excellent, with an accuracy of ±2 percent or better.

Sample	Expected Concentration (mg/kg)	Meaasured Concentration (mg/kg)	Percentage Recovery (%)
DORM-2 1	4.64 ± 0.26	4.59	99
DORM-2 2	4.64 ± 0.26	4.53	98
DORM-2 3	4.64 ± 0.26	4.57	98

Table 3: Table of results showing the expected concentration, measured concentration and percentage spike recovery for three samples of the DORM-2 reference material.

Conclusion

The recognition of the acute toxicity of methyl mercury and the realization that fish is the major source of human exposure has led to the introduction of strict legislation in order to protect consumers. A dependable analytical method is required to ensure seafood product safety and compliance with the regulations. Vapor-generation AA spectrometry has been demonstrated to achieve precise, reliable analysis of low levels of mercury in fish. Offering excellent linear range, stability, sensitivity and detection limits, the technique easily meets the maximum concentration levels set by regulatory bodies. The method is also very fast, with an analytical cycle taking approximately 90 seconds per sample.

For more information on the iCE 3000 Series AA spectrometers, please call +1 800-532-4752, email analyze@thermofisher.com or, alternatively, visit www.thermo.com/ice.

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6. Food Safety Information Website, http://www.food-haccp.com/1news/021309k.html

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THE EVOLUTION OF EQUIPMENT SERVICE

STATE-OF-THE ART CUSTOMER SERVICE ORGANIZATIONS LOOK AT TECHNOLOGY, APPLICATIONS AND PROCESSES, AND PEOPLE TO RESOLVE ISSUES by Joachim Joerger

Equipment service—the business impact

The quality and reliability of your laboratory equipment are central to the generation of results when running projects and routine testing operations. As a production device in your experimental setup, that equipment delivers data that is pivotal for your business objectives and has direct impact on the success of your laboratory and your reputation. Failure immediately impacts your laboratory routine and reduces efficiency.

When you perceive the failure of an instrument as a business issue, it opens the perspective for a comprehensive, multidimensional way of looking at possible solutions. The choice of the right service providers is essential in this process. A business issue, as well as its solution, usually consists of three dimensions: technology, applications and processes, and people. All are aspects that need to be acknowledged in order to identify a quick, sustainable resolution to the issue.

"A new triumvirate in modern equipment service is evolving and is aimed at mitigating risks."

The life beyond error codes—increasing complexity

We would not talk about customer service and its role in maintaining a lab's productivity if equipment were intuitive to use and generated highly specific error codes, or if sample materials and application processes were standardized. If this were the case, one call or one service visit would always be sufficient to solve any issue. In reality, increasing the variety of sample materials and processing applications and enhanced technologies adds to the complexity of an automated system.

Today's service organizations must be capable of understanding all dimensions of the business-related service inquiry. "Understanding the user" is always the first step in understanding the issue and defining the resolution strategy.

Choosing the right customer service provider—active risk management

The flip side of complexity is risk. It is the ultimate goal of a lab manager to control the business components in order to minimize the risk of failure. State-of-the art customer service organizations look at the dimensions of technology, applications and processes, and people to resolve issues quickly, thereby maximizing productivity of the lab and minimizing interruptions of the routine processes. These organizations combine modern diagnosis and communication technologies with skilled specialists who are capable of covering the full scope of the failure syndrome. By choosing the right service supplier, companies actively manage and mitigate the risk of business issues that go along with dependency on automated systems.

The new triumvirate of business services

A new triumvirate in modern equipment service is evolving and is aimed at mitigating risks: technology improvements, such as remote instrument monitoring and diagnosis over the Internet; improved alignment between the service provider and customers, including the creation of phone-based automated applications; and support teams that provide an elevated level of service by including highly skilled field service teams comprising scientists and engineers cross-trained on all aspects of instrumentation. The novelty of the triumvirate is the full integration of these teams under one functional umbrella that is facilitated by global call centers and connected through IP telephony to improve availability and an overlap between phone- and field-based functions for application and hardware analysis.

In the beginning

In order to appreciate the benefits of the advances in service, it is important to take a step back and assess the benchmark of what has been accepted as the standard.

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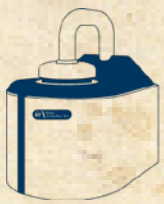

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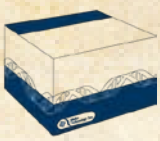

Sides

Salmonella	AOAC Approved
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In the past, if a researcher were experiencing difficulties with an instrument, he or she would call the customer support team. The customer service representative would focus on the specific piece of equipment that was causing difficulty and ask questions related to error codes, log files, module tests, etc. If a question arose about an error message on the equipment, there would be a defined technical specialist to contact. If there were a problem with the application yielding the expected outcome, an application specialist would be called. Since the application runs on a piece of equipment, the issue could very well be with either component. Bottom line: Researchers were forced to work with multiple contacts.

Even after multiple time-consuming calls, the issue might remain unresolved. In that case, the service person traveled to the lab to resolve the issue in person. This individual came prepared to deal with the problem, based on second-hand information received from customer care. There were many risks in this process, including the fact that there must be equal skill sets on the supplier side and researcher side to understand the technology and/or application.

Whether the support is offered via phone or in person, the standard operating hours for service traditionally have been Monday through Friday, 9 a.m.–5 p.m. Eastern Time. Standard operating hours are useless for diagnostic labs processing samples late into the night in China. As the level of innovation increases, so do the demands a lab manager places on his or her service partner. Eight-hour service windows five days a week are no longer enough to provide the high level of support that customers require. For this reason, it is time for researchers to demand a new level of service.

"As the level of innovation increases, so do the demands a lab manager places on his or her service partner."

Today's best practices

Many service suppliers have incorporated novel technology into their offerings by blending highly skilled people and robust technology.

Today's call centers are staffed with scientists trained in engineering and service. With this background they are able to perform comprehensive analyses that blend knowledge of the instrument and application to target the issue. This becomes a personal interaction between two highly trained individuals that focuses on analyzing the issue at hand. The service representative considers the application and chemistry to determine if there are product usage issues; concerns with the customer's experimental setup; challenges presented by the method of sample storage; or equipment issues, such as those resulting from technical errors, maintenance effects or equipment handling. It may even include additional training for researchers to help build their skill sets.

If there is a requirement to bring in a field service specialist, customers can rely on the fact that the specialist is cross-trained on both the equipment and the application. Like the call center teams, field service teams have an engineering background and are cross-trained on the application. This marries their strong technical knowledge with an understanding of the application, thus enabling comprehensive analysis. Additionally, field-based application specialists who conduct in-depth on-site analysis are able to talk to the customer in the same language (i.e., the same scientific vocabulary), allowing a deeper understanding of the current issue.

Robust technology creates the optimal offering, and technology enables detailed analysis. Internet-facilitated service tools are available that allow the service partner to connect directly to the instrument in the customer's lab. This alleviates the need for the service partner to interpret errors and issues described by the customer. The equipment diagnosis tools support the error resolution process by allowing the service partner to connect to the instrument and understand the issue firsthand. The positive effect is the ability to identify the error before field service intervention is required. Also, if repair parts are required, the correct parts can be sent the first time, for a speedy resolution.

Technology also offers an extended reach. Virtual global call centers make technical knowledge available for all customers. If a researcher encounters an issue while running a process in Italy early in the morning, and the customer support center is not available until 9 a.m. Eastern Time, all work must stop. By the same token, if a U.S. researcher is working late into the night, and the call center is open only until 5 p.m. Eastern Time, a potentially critical process must be postponed. Global call centers, powered by state-of-the-art IP telephony and business rules, enable extended business hours through automatic transfer of calls when the request comes in outside of local business hours. Anywhere in the world, researchers simply call the support number provided, although they may be unaware that they are transferred to a support desk in Asia or Europe to obtain the answers they need.

The service evolution has come so far and brought a positive impact on the industry. With service partners raising the bar for what they expect of themselves, they are able to deliver unparalleled, innovative solutions to their customers, providing them with a competitive edge. There are already efforts under way to take these offerings to the next level. Continuous equipment monitoring and preemptive service in case of performance deviations are a reality today and will further develop in the near future. Automation provides tremendous savings in time and manpower, not to mention a dramatic reduction in errors. If errors can be caught as they are about to occur and can be resolved remotely by the service partner, downtime will be further reduced. This may facilitate 24/7 equipment availability, paving the way for more groundbreaking research and discoveries.

Equipment service—part of your future risk management

Through linkage of people and technologies, service providers facilitate a comprehensive and streamlined equipment support process. They assume responsibility for minimizing a company's business interruption by addressing all potential service-related delays. Also, service providers will continue to leverage the service triumvirate for the benefit of efficient equipment service, so selecting a service provider today is also the selection of your business partner for maintaining all equipment-related processes.

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PORTABLE COOLING AT THE POINT OF USE

by Angelo DePalma

Laboratory workers have traditionally relied on water, ice, dry ice, and liquid nitrogen for portable cooling. While laboratory chillers will never completely replace these techniques, they provide advantages in portability and convenience.

Chiller applications fall into two basic categories based on the degree of temperature control required. Condensers, evaporators, temporary sample holding vessels, and diffusion pumps are generally forgiving of modest temperature fluctuations, whereas lasers, analytic instruments, and biological experiments require more precise control.

How they work

Lab chillers remove heat from one object and transfer it to another, usually by means of a liquid. Thermo Fisher Scientific defines chillers as "refrigerated recirculating liquid cooling system[s] consisting of a compressor, condenser, evaporator, pump, and temperature controller, all in one package."

Chillers cool and maintain temperatures through one of three main methods. Compressor cycling, similar to thermostatic temperature control, maintains a desired temperature by turning the cooling engine on and off. The main disadvantages are difficulty achieving precise temperature control and compressor wear. By adding a heater to the return loop, the compressor remains constantly on. While less stressful to the chiller mechanism, heater cycling is energy-intensive. Hot-gas bypass is a sort of compromise, providing relative energy-efficiency and long compressor life.

"Chillers must release the heat they absorb through either an air- or water-cooled condenser."

"Hot-gas bypass," says Alan D'Ettorre, engineering manager at Mokon (Buffalo, NY), "'fools' chillers into thinking there's a load on it when there is not," which keeps the compressor running. For example, 36,000- BTU (British thermal units) chillers are rated to remove that quantity of heat, but an application may only require the removal of 12,000 BTUs. A hot-gas bypass forces the chiller compressor to remain on rather than initiate hundreds of start/stop cycles.

Regardless of the cooling method employed, chillers must release the heat they absorb through either an air- or water-cooled condenser. Because it releases heat to the atmosphere, air-cooled condensing works best with large rooms and small chillers. Large units in smallish rooms typically use the water-cooled method. Air-cooled chillers require less maintenance than water-cooled units, are simpler in construction, and consume slightly less power; water-cooled chiller condensers must be maintained periodically because of mineral buildup.

"A circulator's reservoir can be used as a circulating bath, while a chiller's cannot."

Chillers are technically not the same as circulators, although the terms are sometimes used interchangeably (and together). Circulators tend to be small, operate in a wide temperature range, and provide high temperature stability, although they have limited heat removal capability. Chillers are suitable for larger industrial applications and operate in a relatively narrow tem-

Laboratory Chillers Survey: Are you using a laboratory chiller in your lab? Are you considering purchasing a laboratory chiller soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/lab-chillers.

perature range with modest (±0.5°C) stability, but provide much higher heat removal. A circulator's reservoir can be used as a circulating bath, while a chiller's cannot.

your application is generating, plus additional power to maintain temperature under varying loads. Normally the manufacturer of the device you are cooling will supply heat removal information."

ing temperature, desired process temperature range, temperature control tolerance, process fluid type, process fluid pumping volume, process fluid supply pressure, and most important, the amount of heat to be dissipated from the process.

Chiller applications are not as sensitive to temperature fluctuations as those relying on ovens or freezers, and units are inexpensive compared with other lab equipment. Lab managers therefore enjoy a degree of flexibility in purchasing chillers and have the luxury of being able to overbuy in anticipation of future applications or expanded use.

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"Water-cooled chiller condensers must be maintained periodically because of mineral buildup."

Choosing a chiller

Chillers are rated by the quantity of heat they can remove per unit of time, which depends on the heat characteristics of the application. Most lab managers will be put off by the calculations required for sizing a chiller. Luckily, vendors will perform the calculations provided the user knows the general parameters of heat removal required. A vendor can often help specify a chiller based solely on its intended application.

Chiller capacity is specified in tons, a misleading term that implies mass or weight. In this case, a ton is simply a measure of heat capacity in BTUs. Twelve thousand BTUs equal one "ton." Tabletop systems used mostly for laboratory processes are referred to as fractional chillers and are available in capacities of one-quarter to one-third ton (3,000 and 4,000 BTUs, respectively).

According to Cole-Parmer, choosing the right chiller often comes down to economics: "The optimum size needed is based on the amount of heat

Yet price is not the only factor. "Applications should determine chiller specifications," says Dennis Curtice, application engineer at OptiTemp (Traverse City, MI). "Most laboratory customers have unique applications and need equipment designed specifically for their needs." Factors to consider include ambient operat-

Chillers

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A TEMPERATURE FOR EVERY TASTE

by Angelo DePalma

Lab refrigerators and freezers are arguably the most common appliance in laboratories. Lab units are similar in construction to household refrigerators and freezers, and come in a variety of temperature ranges, shapes and sizes.

"Purchase decisions often come down to brand name recognition, perceived reliability, price and availability."

Freezer and refrigeration options fall into four general temperature categories: +4°C refrigerators for chromatography supplies, blood storage, and pharmaceuticals; -20°C (and below) freezers for enzymes and biochemicals; -30°C to -40°C for biological samples, and -80°C freezers for long-term storage and stability. Units range in size from under-counter systems as small as 3.6 cu. ft., to standalone chests as large as 70 cu. ft.

Upright models have a front-opening outer door and multiple compartments. Most also have inner doors, so that when one compartment opens cooled air does not escape from the unopened compartments. These systems also tend to be vertically-oriented and occupy less floor space than chests.

Chest style systems have a top-opening lid, one large compartment, and are generally about half the height of uprights. Because warm air rises and colder air falls, chest freezers will generally not experience as much of a temperature swing when the lid is opened as uprights. The disadvantage is that they take up more floor space and samples are not as accessible as with an upright.

Choices and trends

After considering temperature capabilities, capacity and footprint, choosing among lab refrigerators and freezers often reduces to secondary or subjective criteria. Eye-level controls, mechanisms to prevent door freezing and/or vacuum pressure build-up, space-saving insulation, automated data recording, alarms, digital temperature control, rapid temperature recovery after door openings, temperature uniformity throughout the box, and condition monitoring are differentiators. "But the reality," says Dan Hensler, VP of sales and marketing at So-Low Environmental Equipment (Cincinnati, OH), "is that aside from temperature range, vendors offer pretty much the same features." Purchase decisions often come down to brand name recognition, perceived reliability, price and availability. Intangible factors such as a history with a particular vendor, the manufacturer's perceived understanding of a group's workflow, and the ability to follow up with helpful advice without over-selling, also come into play.

Tamper-proof temperature logging and recording are desirable features for regulated industries and those called on to testify in court. Thermo Fisher Scientific (Marietta, OH) plans to offer a wireless recording/logging option in 2010, but companies have been slow to adopt such equipment due to difficulties in changing established SOPs. The traditional chart recorder is still the industry standard for temperature monitoring despite its manual requirement for frequent paper and pen changes. However, most industries are moving toward electronic temperature monitoring.

One notable development in refrigeration has been the emergence of cold storage to support vaccine work, particularly for H1N1 influenza vaccine storage. "We've been deluged over the last few months with requests for vaccine-worthy refrigerators," Hensler told *Lab Manager*. H1N1 vaccine is stored within a narrow temperature range (35°F to 46°F), and health agencies mandate twice-daily temperature measurements.

Laboratory Refrigerators/Freezers: Are you using a lab refrigerator or freezer in your lab? Are you considering purchasing a lab refrigerator or freezer soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/lab-freezers-refrigerators.

Kitchen units and retrofits

Many labs use kitchen refrigerators from home appliance stores to store very low-risk laboratory materials, for example biological buffers, dried plant material, animal feed, or dilute acids or bases. But kitchen units are designed for low-traffic use and lack the precise temperature control and refrigeration capabilities of lab-designed units. Several vendors have nevertheless made a business of refurbishing and retrofitting home-appliance cooling chests for labs. Common upgrades include alarms, controllers, door locks and special shelving.

Thermo Fisher Scientific offers both laboratory-designed refrigerators/freezers with upgraded insulation and compressors, and retrofitted kitchen-designed units. Explosion- and fire-proofing are also common retrofits. Retrofit refrigerators are quite common for storing flammable or volatile organic compounds, says Gordon Shields, director for cold storage at Thermo Fisher.

Cool, green and validatable

Energy efficiency has become a key driver in refrigerator/freezer purchase decisions. Many vendors, including Thermo Fisher Scientific and New Brunswick Scientific (Edison, NJ) have been working with the U.S. Environmental Protection Agency to establish industry-wide Energy Star standards for lab refrigerators and freezers, which surprisingly do not yet exist. Beginning in late 2008, vendors began submitting energy efficiency and performance data to EPA, from which the agency will eventually issue guidelines for the coveted Energy Star designation. Energy consumption for "always-on" appliances is a serious concern for large organizations like pharmaceutical companies and universities.

"The key is to reduce overall energy usage while maintaining performance," Shields commented. "Due to their heavy usage, lab refrigerators and freezers will never be as energy efficient as units purchased for the home, but we are hoping to achieve a 15 to 20 percent energy savings compared with existing models. That can mean a lifecycle energy cost saving of $1,500 for a lab refrigerator and $2,500 for a freezer." And, when it comes to ultra-low temperature (ULT) freezers, the energy and cost savings can be even greater. Ted Andrew, product manager at New Brunswick Scientific, says that their energy-efficient design can save up to 45 percent in operating costs over competitively sized models, which translates into up to $3,000 in energy savings over the lifetime of a single freezer.

Angelo DePalma *holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. You can reach him at angelo@adepalma.com.*

Freezers/Refrigerators

BioCold	Fenton, MO	636-349-0300	www.biocold.com
Darwin Chambers	St. Louis, MO	314-534-3111	www.darwinchambers.com
Helmer	Noblesville, IN	800-743-5637	www.helmerinc.com
Kelvinator	Honea Path, SC	864-369-1665	www.kelvinator.us
LABNICS Equipment	Fremont, CA	925-271-4322	www.labnics.com
New Brunswick Scientific	Edison, NJ	800-631-5417	www.nbsc.com
Nor-lake Scientific	Hudson, WI	800-477-5253	www.norlake.com
NuAire	Plymouth, MN	800-328-3352	www.nuaire.com
Sanyo	Wood Dale, IL	800-858-8442	www.sanyobiomedical.com
So-Low	Cincinnati, OH	513-772-9410	www.so-low.com
The Baker Company	Sanford, ME	800-992-2537	www.bakerco.com
Thermo SCIENTIFIC	Asheville, NC	866-984-3766	www.thermo.com/cold


LAB MANAGER MAGAZINE'S
INDEPENDENT
GUIDE TO
PURCHASING A
LAB FREEZER
www.labmanager.com

MARVEL SCIENTIFIC

Marvel Scientific offers a complete line of built-in undercounter general purpose laboratory refrigeration products as well as Explosion Proof and Flammable Material Storage models. All products recently underwent a door styling change that provides a new clean appearance across all products. The new "box style" doors offer a more securely mounted handle and an adjustable hinge feature. The "box style" doors are now standard on Marvel Scientific models featuring the MicroSentry Scientific Control. This control provides the user with the capability to select a "set" temperature and establish both high and low temperature alarm values relative to the selected "set" temperature. The MicroSentry Scientific Control also provides a high and low temperature history function, a remote alarm interface, periodic maintenance reminders and built diagnostics.
For more information please visit www.marvelscientific.com

NORLAKE SCIENTIFIC

Nor-Lake Scientific manufactures a complete line of refrigeration and environmental storage equipment to meet the most demanding needs and specifications. Laboratory and Pharmacy Refrigerators and Freezers, Stability Chambers, Blood Bank Refrigerators and Plasma Freezers, Chromatography Refrigerators and Undercounter models are available. Environmental Walk-in Rooms and Stability Chambers from Nor-Lake Scientific reproduce and closely monitor any environment with a precise combination of humidity, temperature and light. Environmental Rooms may be customized to meet the customers specific storage requirements. For more information visit www.norlakescientific.com

NUAIRE

The Glacier -86°C ultra low temperature freezers are designed to meet all research, clinical or industrial application requirements. A microprocessor temperature control system features digital temperature display and a set-point security system. The air-cooled cascade refrigeration system includes a downfeed evaporator, high-capacity air-cooled condenser and two air-cooled compressors. In addition, the system offers 100% CFC-free refrigerants and a low 47 dba noise rating. A microprocessor-controlled alarm system provides battery backup and remote alarm contacts. Additional features include heavy duty swivel casters, 3 adjustable shelves, multi-point gasket seals and claw-like inner door latches. www.nuaire.com

THE BAKER COMPANY

Baker BioScience Solutions, a division of The Baker Company, is now offering Ultra Low Temperature Freezers from Dometic Medical Systems, optimally designed to provide composition-maintaining storage at low temperatures down to -86°C. Dometic's ultra low freezers have been engineered to meet the highest standards for the handling and safe storage of research, clinical or industrial applications. With a reduced footprint and an innovative, powerful and reliable cascade refrigeration system combined with vacuum insulated panels and patented evaporator technology, you can expect to experience reduced energy consumption at optimal levels of performance while taking up less space in the laboratory. To learn more about us, including our new line of Ultra Low Temperature Freezers, please visit us at www.bakerbioscience.com

Thermo SCIENTIFIC

Researchers worldwide protect more than two billion samples inside Thermo Scientific cold storage equipment. With proven solutions including +4C refrigerators to -196C cryogenic freezers, you're free to concentrate on your work without having to worry about your valuable samples. For more information, visit www.thermo.com/cold

New Brunswick
an eppendorf company

New Brunswick Scientific offers over ten ultra-low temperature (-86°C) lab freezers in a variety of upright and chest models, including a unique 3.6 cu.ft. on- or under-bench upright freezer, and 12.7 cu. ft. ultra-slim model that fits through most any doorway. These systems are quiet running and reliable, with over a 25-year track record of dependability. NBS freezers are exceptionally energy-efficient, reducing operating cost by thousands of dollars over the life of the freezer, and substantially reducing CO2 impact on the environment. Choose our Premium models, or space-saving Innova® models with vacuum insulation panels. Data logging software, back-up systems, racking and more are also offered. www.nbsc.com

Lab Manager MAGAZINE
Run Your Lab Like a Business

LAB MANAGER MAGAZINE'S INDEPENDENT GUIDE TO PURCHASING A LAB FREEZER

Purchasing the right Laboratory Freezer is often considered a simple and straightforward decision. However, when the longevity of your samples and expensive materials depends on the right kind of freezer, it is worth a closer look. Use this guide to learn about the four main types of Lab Freezers, then work your way down to an unbiased short list of all the models from all the manufacturers to find out which best suits your needs.

GENERAL PURPOSE LAB FREEZERS (-20° to -30°C) are available in two different models; either an upright model similar to what you have in your kitchen, or an under-counter model that fits directly into your lab cabinetry. They come with a pre-set temperature point of either -20°, -25°, or -30°C, but have a range of 10 to -15 degrees that you can adjust at any time.

UPRIGHT GENERAL PURPOSE LAB FREEZERS are ideal for storing larger amounts of materials that are accessed on a more regular basis in the temperature range of -20° to -30°C. The multiple shelving options and rack configurations also make it very easy to properly organize your freezer space.

- **Kelvinator Scientific** BT30FS, 27.3 cu. ft. www.kelvinator.us
- **Kelvinator Scientific** BT5FS, 49.1 cu. ft. www.kelvinator.us
- **Kelvinator Scientific** BT80FS, 79.2 cu. ft. www.kelvinator.us
- **Thermo Scientific Revco,** ULT3030, 30 cu. ft. www.thermo.com/cold
- **Thermo Scientific Revco,** ULT2330, 23 cu. ft. www.thermo.com/cold
- **LABREPCO Arctic Series** LABW-20-FM, 20.1 cu.ft -20 Manual Defrost Enzyme Freezer www.labrepco.com/laboratory_freezers.php
- **LABREPCO Futura Series** LABW-24/33/52/80-FA, -25 Laboratory Freezer, 24 cu. ft. www.labrepco.com/laboratory_freezers.php
- **LABREPCO Arctic Series 23 cu. ft.** TSLAB-23/35/49/72F, All Stainless Steel -20 Laboratory Freezer www.labrepco.com/laboratory_freezers.php
- **Marvel Scientific** 17CAF, 17.1 cu. ft. www.marvelscientific.com
- **Nor-Lake** NSSF241WWW/0, 24 cu. ft. www.norlake.com
- **Nor-Lake** NSSF532WWW/0, 52 cu. ft. www.norlake.com
- **Nor-Lake** NSSF803WWW/0, 80 cu. ft. www.norlake.com
- **Nor-Lake** NSZF241WWW/0M, 24 cu. ft. www.norlake.com
- **SANYO** MDF-U730, 22.3 cu. ft. www.us.sanyo.com
- **SANYO** MDF-U333, 9.7 cu. ft. www.us.sanyo.com
- **Ontario Ovens** BTL305F, 27.3 cu. ft. www.ontarioovens.com
- **Ontario Ovens** BTQ50F5h0, 49 cu. ft. www.ontarioovens.com

UNDER-COUNTER GENERAL PURPOSE LAB FREEZERS are ideal for storing smaller amounts of materials that are handy to have right at your workspace but require constant freezing in the -20° to -30°C temperature range.

- **Kelvinator Scientific** BT4SD, 4.5 cu. ft. www.kelvinator.us
- **Thermo Scientific Revco,** ULT430A, 4.9 cu. ft. www.thermo.com/cold
- **LABREPCO Arctic Series** LAB-420Cu. Ft, 4.5 cu. ft. -20 Laboratory Freezer www.labrepco.com
- **Thermo Scientific-Puffer Hubbard** IUF-3004A, 4.9 cu. ft. -30 Laboratory Freezer www.labrepco.com/laboratory_freezers.php
- **Marvel Scientific** 15AF, 1.5 cu. ft. www.marvelscientific.com
- **Marvel Scientific** 4CAF, 4.5 cu. ft. www.marvelscientific.com
- **Nor-Lake** NSSLF051WMW/0, 5.94 cu. ft. www.norlake.com
- **Nor-Lake** NSXF051WMW/0, 5 cu. ft. www.norlake.com
- **Nor-Lake** LF041WWW/0M, 3.5 cu. ft. www.norlake.com
- **SANYO** SF-L6111W, 5.4 cu. ft. www.us.sanyo.com
- **SANYO** HF-5017W, 5 cu. ft. www.us.sanyo.com

LOW TEMPERATURE LAB FREEZERS (-30° to -45°C) are available in two different models, either an upright model, similar to what you have in your kitchen, or a chest model, similar to what you might have in your basement. They come with a pre-set temperature point of either -30° or -45°C, but will have a range of 10 to -15 degrees that you can adjust at any time.

LOW TEMPERATURE UPRIGHT LAB FREEZERS are ideal for storing larger amounts of materials that are accessed on a more regular basis in the low temperature range of -30° to -45°C. The multiple shelving options and rack configurations make it very easy to properly organize your freezer space.

- **Kelvinator Scientific** BT13HFS, 27.3 cu. ft. www.kelvinator.us
- **Kelvinator Scientific** BTQSHFSHD, 49.1 cu. ft. www.kelvinator.us
- **Thermo Scientific-Harris** SLT-13/17/21/25V -40 Low Temp Upright Freezer www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** ELT -13/17/21/25V -40 Low Temp Upright Freezer www.labrepco.com/laboratory_freezers.php
- **Nor-Lake** NSXF221WWW/0, 22 cu. ft. www.norlake.com
- **Nor-Lake** NSBF221WWW/0, 22 cu. ft. www.norlake.com
- **Nor-Lake** NSBF482WWW/0, 52 cu. ft. www.norlake.com

LOW TEMPERATURE CHEST LAB FREEZERS are ideal for longer term storage of materials at a low temperature range of -30° to -45° C. The chest model also enables you to store larger containers that may not fit in an upright model.

- **Kelvinator Scientific** UC540, 4.6 cu. ft. www.kelvinator.us
- **Kelvinator Scientific** UC1140, 12 cu. ft. www.kelvinator.us
- **Thermo Scientific-Harris** SLT-14/20LS-90, -40 Low Temp Chest Freezer www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** ELT 14/20LS-90, -40 Low Temp Chest Freezer www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** DLT-3LS-90, -40 Low Temp Chest Freezer www.labrepco.com/laboratory_freezers.php
- **Ontario Ovens** 34-05, 5 cu. ft. www.ontarioovens.com
- **Ontario Ovens** 43-1-3, 1.7 cu. ft. www.ontarioovens.com
- **Ontario Ovens** 60-12, 12 cu. ft. www.ontarioovens.com

ULTRA-LOW TEMPERATURE FREEZERS (-45° to -86°C) are available in two different models, either an upright model which has a door that swings open either left to right, or right to left, or a chest model which has a lid that opens up.

UPRIGHT ULTRA-LOW TEMPERATURE FREEZERS are ideal for storing larger amounts of materials that are accessed on a more regular basis in the ultra-low temperature range of -45° to -86°C. The multiple shelving options and rack configurations make it very easy to properly organize your freezer space. One disadvantage to upright models is that when opened, the cold, heavier air tends to escape the unit more easily than in a chest model, resulting in a more dramatic temperature deviation. This is why you should look for models with inner compartmental doors that help to prevent cold air loss. The advantage of uprights is that samples are more conveniently accessed.

- **Thermo Scientific Revco PLUS HD** ULT3280-10HD, 31.4 cu. ft. www.thermo.com/cold
- **Thermo Scientific Revco Ultima PLUS** ULT2586-10, 24.8 cu. ft. www.thermo.com/cold
- **Thermo Scientific Revco Elite PLUS** ULT2586-6, 24.8 cu. ft. www.thermo.com/cold
- **Thermo Scientific-Harris** DLT-32V-85HD, 32 cu. ft. -80 Super Insulated Ultra Low Temp Upright www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** ELT-13/17/21/25V-85, -86 Low Ultra Low Temp Upright Freezer www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** SLT-13/17/21/25V-85, -86 Ultra Low Temp Upright Freezer www.labrepco.com/laboratory_freezers.php
- **SANYO** MDF-U73VC, 26 cu. ft. www.us.sanyo.com
- **SANYO** MDF-U53VC, 18 cu. ft. www.us.sanyo.com
- **SANYO** MDF-U33V, 12 cu. ft. www.us.sanyo.com
- **NuAire** Glacier NU-9668, 23.6 cu. ft. www.nuaire.com
- **NuAire** Glacier NU-9843, 17.1 cu. ft. www.nuaire.com
- **NuAire** Glacier NU-9334, 11.8 cu. ft. www.nuaire.com
- **New Brunswick Scientific** Innova U725, 725 L, 25.6 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Innova U360, Ultra-slim 360 L, 12.7 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Innova U535, 535 L, 18.9 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Premium U410, 410 L, 14.5 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Premium U570 570 L, 20 cu. ft. www.nbsc.com
- **Angelantoni** Iridium 800V 28.7 cu. ft. www.amascientific.com
- **Angelantoni** Iridium 500V 18 cu. ft. www.amascientific.com
- **Angelantoni** Iridium 340V 11.5 cu. ft. www.amascientific.com
- **Baker BioScience Solutions, Dometic Medical Systems** UF 755G, 26.6 cu. ft., VIP Insulation www.bakerbio.com
- **Baker BioScience Solutions, Dometic Medical Systems** UF 455G, 16 cu. ft., VIP Insulation www.bakerbio.com
- **New Brunswick Scientific** Innova U101, On or Under Bunch 101 L, 3.6 cu. ft. www.nbsc.com

CHEST ULTRA-LOW TEMPERATURE FREEZERS are ideal for longer term storage of materials at an ultra-low temperature range of -45° to -86°C. An advantage is that the cold air tends to settle in the chest, rather than dissipating into the ambient environment. The disadvantage is that your samples are not as conveniently accessed.

- **Thermo Scientific Revco Ultima PLUS** ULT390-10, 3 cu. ft. www.thermo.com/cold
- **Thermo Scientific Revco Ultima PLUS** ULT1390-10, 12.7 cu. ft. www.thermo.com/cold
- **Thermo Scientific-Harris** SLT-14/20LS-90, -86 Low Temp Chest Freezer, 13.7 cu. ft. www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** ELT 14/20LS-90, -86 Low Temp Chest Freezer www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Harris** DLT-3LS-90, -86 Low Temp Chest Freezer, 13.7 cu. ft. www.labrepco.com/laboratory_freezers.php
- **SANYO** MDF-594C/594, 17.2 cu. ft. www.us.sanyo.com
- **SANYO** MDF-794C/794, 24.8 cu. ft. www.us.sanyo.com
- **SANYO** MDF-C8V1, 3 cu. ft. www.us.sanyo.com
- **New Brunswick Scientific** Innova C585, 585 L, 20.7 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Innova C760, 760 L, 26.9 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Premium C340, 340 L, 12 cu. ft. www.nbsc.com
- **New Brunswick Scientific** Premium C660, 660 L, 23.3 cu. ft. www.nbsc.com
- **Angelantoni** Iridium 550H 19.5 cu. ft. www.amascientific.com
- **Angelantoni** Iridium 370H 13.5 cu. ft. www.amascientific.com
- **Angelantoni** Iridium 110H 4 cu. ft. www.amascientific.com
- **Ontario Ovens** 85-1-7, 1.7 cu. ft. www.ontarioovens.com
- **Ontario Ovens** 80-9-4, 9.4 cu. ft. www.ontarioovens.com
- **Ontario Ovens** 80-12, 12 cu. ft. www.ontarioovens.com

FLAMMABLE MATERIAL LAB FREEZERS are designed to protect lab workers, the environment and stored materials that are flammable or volatile. Considerable advanced engineering goes into their design, including hermetically sealed compressors and CFC-free and spark-proof materials.

- **Kelvinator Scientific** BT3HCWFNFS, 27.3 cu. ft. www.kelvinator.us
- **Kelvinator Scientific** BT30RFFNFS, 24.6 cu. ft. www.kelvinator.us
- **Kelvinator Scientific** BT4SFFNFS, 4.5 cu. ft. www.kelvinator.us
- **Thermo Scientific Revco** FMSC112A, 11 cu. ft. www.thermo.com/cold
- **Thermo Scientific-Puffer Hubbard** FUF1804, 5 cu.ft. -20 Flammable Materials Storage Undercounter www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Puffer Hubbard** FUF1816, 16 cu. ft. -20 Flammable Materials Storage Upright Freezer www.labrepco.com/laboratory_freezers.php
- **Thermo Scientific-Puffer Hubbard** FUF1821, 20.7 cu. ft. -20 Flammable Materials Storage Upright Freezer www.labrepco.com/laboratory_freezers.php
- **Marvel Scientific** 4FAF, 4.5 cu. ft. www.marvelscientific.com
- **Nor-Lake** NSFF241WWW/0M, 24 cu. ft. www.norlake.com
- **Ontario Ovens** BT30RSFNFS, 49 cu. ft. www.ontarioovens.com
- **Ontario Ovens** BT30CWEXPR, 27.3 cu. ft. www.ontarioovens.com

Author: John Buie

MORE THAN A CONVENIENCE

by Angelo DePalma

Nobody likes doing dishes, and that goes double for lab workers. Glassware washing machines are more than convenience appliances: They ensure consistent cleaning of critical labware, free up technician time for more value-added work, and provide assurance and validation in regulated industries. With the possible exception of organic chemistry labs, most labs today rely on washers. "Generally, the more critical the research, the more likely it will employ an automated washing process," observes Ken Austin, who manages Miele Professional's (Princeton, NJ) laboratory division. Miele sells under-counter in-lab washers and much larger units for central wash areas servicing many labs.

Washers have become part of the official paper trail for regulated industries like pharmaceuticals and biotech and for environmental testing and forensics, which provide testimony for lawsuits and criminal trials. "A validated washer combined with SOPs provides a more consistent, traceable result than hand washing," Austin adds.

What it takes

Efficient cleaning is a function of cycle time, wash temperature, mechanical action, and cleaning agents. The ideal combination is high water throughput at relatively gentle spray pressure, sufficiently high temperature, a spray pattern that reaches the entire wash load, and selection of cleaning agents suitable for the task.

Because of the heavy demands placed on cleanliness and the unusual form figures of labware, unmodified home-market dishwashers are not suitable for laboratory use. For example, the pump in a high-end under-counter glassware washer is rated at a minimum of 100 gallons per minute, compared with 25 to 30 gallons per minute on a home washer. Cycling time for lab units is longer; holders and baskets are customized for lab equipment; and the final rinse uses heated, recirculated, deionized water instead of tap water. Some lab-designed machines employ bottom-heating for drying, as do kitchen units, but high-end washers employ forced HEPA-filtered air.

"Washers have become part of the official paper trail for regulated industries."

A low-end lab market does exist for home dishwashers retrofitted with a deionized water inlet for the final rinse and/or longer cycling capability. Yet even modified household units do not last in a lab environment, Austin warns. "Three-hour lab wash cycles impose stresses that a kitchen washer was not designed for. Many kitchen models lack a pump powerful enough to provide effective wash coverage; others with more robust pumps cause glassware to launch and break."

Deciding on a washer

Inputs affecting purchase decisions for lab washers include type of labware and residues being cleaned, throughput (pieces per day), and current wash methods. At the very least, buyers should consider how to exploit the full volume of the washing chamber through racks and compartments suitable for their labware.

"Unmodified home-market dishwashers are not suitable for laboratory use."

Labs operating in regulated industries, or those that come in contact with the legal system, should consider automated controls that verify and validate cleaning cycles, from initial wash through drying. The ultimate machines of this type are validated to pharmaceutical Good Manufacturing Practices.

The key for vendors is to demonstrate value. "If we can demonstrate enhanced safety and cost savings through reduced labor or lower consumption of water and cleaning chemicals, up-

Laboratory Washers Survey: Are you using a lab washer in your lab? Are you considering purchasing a lab washer soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/lab-washers.

front cost becomes less of an issue," says Austin. Other selling points include service and support and the ability to validate cleaning.

"Labs operating in regulated industries... should consider automated controls that verify and validate cleaning cycles."

Austin observes that high school and community college labs are a growing segment of glassware washer purchasers. "It seems that some of the labs that traditionally used hand washing are interested in machine washing." Another trend is the use of individual lab washers in facilities where a central wash room had been the norm. The interplay between centralized and individual lab washing involves the general aversion to washing glassware. But central washers often do not thoroughly clean items, and breakage is higher than when scientists wash their own. "Researchers don't trust the wash room, and wind up cleaning their critical pieces anyway."

"Increasingly, lab managers and facility designers are specifying lab washers based on environmental and ergonomic factors."

Increasingly, lab managers and facility designers are specifying lab washers based on environmental and ergonomic factors. "Purchasers are interested in how the machine coordinates with the building, the lab, and an organization's 'green' strategies," says Mike Henley, general manager at Lancer (Winter Springs, FL). Utilization of water, energy, and cleaners and wastewater disposal are important factors that affect operating cost. "Purchasers have moved beyond up-front cost and are beginning to take these other issues into account." Utilization of lab space and human resources also factor into purchase decisions. Research space is expensive, and so are salary and upkeep of personnel. "They don't come to work to wash glassware," Henley notes.

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Lab Washers

Bio-Rad	Hercules, CA	800-424-6723	www.bio-rad.com
Geneva	Fontana, WI	877-436-3827	www.geneva-scientific.com
Labconco	Kansas City, MO	816-333-8811	www.labconco.com
LABNICS Equipment	Fremont, CA	925-271-4322	www.labnics.com
Lancer	Winter Springs, FL	800-332-1855	www.lancer.com
MatriCal Bioscience	Spokane, WA	509-343-6225	www.matrical.com
MidSci	Valley Park, MO	800-227-9997	www.midsci.com
Miele	Princeton, NJ	800-421-4685	www.labwashers.com
Molecular Devices	Sunnyvale, CA	800-635-5577	www.moleculardevices.com
Scientek	Richmond, BC (Canada)	604-273-9094	www.scientek.net
TriContinent	Grass Valley, CA	800-937-4738	www.tricontinent.com
Washer Solutions	Fairport, NY	585-742-6388	www.washersolutions.com

Lab Manager Magazine supplier lists are generated from manufacturer lists posted on LabX. To include your company on this list, please contact assistant editor Kaitlin Caporicci at kaitlinc@labmanager.com.

CONTROLLING TEMPERATURES TO A FRACTION OF A DEGREE

by Angelo DePalma

Ovens are particularly common in chemistry, biology, medical, materials, and forensics labs. Applications range from low-tech glassware drying to sample drying and incubation, equipment sterilization, evaporation, hardening/curing, tempering, stability testing, aging, baking, annealing, brazing, sintering, burn-off of organics, melting, heat-treating, and hot-pressing.

"Throughput and types and breadth of applications are the principal factors influencing oven purchases."

Most basic lab uses employ oven temperatures from just above ambient to several hundred degrees Fahrenheit, although ovens used for materials processing reach temperatures in excess of 1000°F. Kilns, specialty ovens used to process ceramics, may reach 2400°F.

Basic components common to all general-purpose lab ovens are an electrical heating coil, insulation, temperature measurement and/or recording, and a circulation mechanism that provides even temperature distribution. Advanced features include double doors, digital control, and temperature recording (useful for regulated industries requiring documentation).

Differentiators

Oven configurations include bench- or cabinet-style, conveying, and vertical. Cabinet ovens are used for batch processing, while conveyor designs—common with medium-to-industrial-sized process applications—provide continuous heating of many samples.

Circulation ovens (the most common in labs) come in two types: gravity convection or mechanical (forced) draft. The former often suffer from temperature inhomogeneities and stagnation, which is why ASTM and AASHTO standards call for forced draft ovens.

Throughput and types and breadth of applications are the principal factors influencing oven purchases. Larger labs primarily interested in glassware drying are better served by large ovens with customizable configurations than by high-tech units with advanced controls. Materials testing or pharmaceutical development groups involved in drying or curing should focus on temperature stability/uniformity and perhaps automated recording and diagnostics. Users should modestly overbuy on temperature range to ensure that their applications will easily be covered.

However, for a given heat rating, oversized ovens consume considerably more energy than compact designs, have a larger footprint, and may require specialized electrical hookups. Smart buyers whose oven volume and application needs vary often purchase several smaller ovens rather than one large one. Lab ovens range in size up to capacities of 25 cubic feet, but most applications employ units of 6 cubic feet and smaller.

Other features to consider are general location, exhaust capabilities, mounting (floor or tabletop), fire/explosion protection, ambient or inert atmosphere, and controls/displays. Location is connected with unit size, ease of use, compatibility with other equipment, exhaust, and access to electric utilities.

PID [proportional-integral-derivative] controllers add precision, accuracy and uniformity to temperature control, notes Frank Brombley, general manager at JEIO Tech (Woburn, MA). PIDs provide step programming in user-defined increments and times

Laboratory Ovens Survey: Are you using a laboratory oven in your lab? Are you considering purchasing a laboratory oven soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/lab-ovens.

and are desirable in precision applications like materials curing, biology, chemistry, or drying. "PID controllers minimize errors between a measured process variable and a desired set point by calculating, and then outputting, a corrective action that can adjust the process accordingly and rapidly," says Brombley.

Inexpensive controllers act like home thermostats that simply turn the heater on and off, resulting in temperature cycling. Even precise thermostating results in whole-oven temperatures varying over time by several degrees. Temperature variations, in turn, cause the system to expand and contract, compromising the integrity of the seals, which adds even more temperature fluctuation. This may not be an issue for glassware drying ovens but may introduce variability for materials curing or biological cell culture.

Uneven temperature distribution often arises with lower-cost ovens in which the heating element is in contact with the outer envelope of the main oven compartment. This design causes contact points to heat more rapidly and stay hotter than the rest of the oven for a given overall temperature. Binder has pioneered a double outer chamber system comprising an insulating air jacket that prevents contact between the heating element and the oven chamber. The result is low-fractions-of-a-degree variability throughout.

Trends in lab ovens

Uwe Ross, executive VP at Binder (Great River, NY) notes that in recent years, users' preferences have shifted from gravity ovens without fans to fan-based forced-air units. Fans distribute heat more rapidly on startup, and "people are becoming less willing to wait for units to heat up," Ross observes. Fans are suitable for most applications, with one notable exception: powders.

Fans provide more even heating by minimizing temperature variability within the oven, to the point where temperature distribution becomes a selling point. ASTM, for example, specifies an oven's temperature deviations by measuring at nine locations inside the oven, while the newer DIN (Deutsches Institut für Normung) standard uses 27 points. Vendors supply temperature specifications, which vary from fractions of a degree in high-end ovens to several degrees. "Users will tell you that an application works great—on the middle shelf in the rear left corner—but nowhere else," comments Ross.

Angelo DePalma *holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. You can reach him at angelo@adepalma.com.*

Ovens

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MORE FOOD TESTING CAPACITY NEEDED IN THE U.S. AND OVERSEAS

by Bernard Tulsi

Acting on the urgent need to reinvigorate food safety measures in the United States, the Obama administration moved recently to strengthen government agencies charged with monitoring and ensuring the safety of the country's food supply. Along with the recent appointment of Food and Drug Administration (FDA) Commissioner Dr. Margaret Hamburg, President Obama established a cabinet-level panel, the Food Safety Working Group, which will recommend ways to enhance food safety laws and engender cooperation among the various agencies that list food safety among their responsibilities.

Lisa Shames, director, U.S. Government Accountability Office, in an address to the second annual Global Food Safety Policy Forum—convened by Waters Corporation in Washington, D.C., in October 2009—noted that the U.S. imports food from more than 150 countries and territories. Imports make up 15 percent of the country's total food supply, 60 percent of the fresh food and vegetables, and 80 percent of the seafood. The forum brought together

"The U.S. imports food from more than 150 countries and territories."

policy makers and food industry experts from around the world to discuss pending legislation and potential solutions to improve food safety in the United States and worldwide.

In late July this year, the United States House of Representatives passed the Food Safety Enhancement Act based on a bill authored by Rep. John Dingell (D-Mich.), which will give the FDA greater capabilities to fight food-related outbreaks. Similar moves are afoot in the Senate, and in mid-March a bipartisan group including Sen. Richard Durban (D-Mich.) and Sen. Judd Gregg (R-N.H.) proposed the Food Safety Modernization Act.

Gerry Broski, food safety marketing director with Thermo Fisher Scientific, says the food safety and testing community continues to advance standards and concerns over the safety of our global food supply. "Europe and Japan have taken leadership roles in food monitoring. They have aggressively established very low maximum residue limits and are very concerned about the long-term health effects of what people consume. In the U.S., we have new legislation pending in Congress that will change the way food safety is regulated. China has a new Food Safety law implemented earlier this year. While you cannot "test-in" safety for food, you can mitigate the risk of inherent and deliberate contamination through testing and analysis," says Broski.

Despite effective legislation, it can hardly be expected that incidents involving food contamination will be eliminated. "We can put good systems in place, and along with better mechanisms for control, we can minimize the occurrence of these events, but they will never go away completely," says Paul Young, senior manager, Chemical Analysis Operations, Waters Corporation.

He says that the lab testing capacity needed for food analysis is far from adequate here in the U.S. as well as overseas. U.S. agencies such as the FDA have been under-resourced, and they have seen their net funding decrease over the last five years.

Young adds that in foreign countries, there is a lack of clarity about U.S. safety requirements for imported food at the moment. As a result, there is a need for U.S. authorities to inform trading partners about standards and

to help them build the necessary capacity to test in compliance with those standards, he says.

"The alternative is to use the same approach that, for example, Japan has adopted, where they test a high percentage of the imports themselves. That is not the most efficient approach—it should be a partnership, and if the U.S. authorities work with their trading partners and help them to establish effective testing programs, then they can ensure that the food is being tested before it leaves the exporting countries," says Young.

"In foreign countries, there is a lack of clarity about U.S. safety requirements for imported food."

To be sure, for some time now a number of analytical instrument designers and developers have been building, tweaking and improving the tools that have proven indispensible in food safety laboratories. The most recent iteration of new and improved tools for food testing was displayed at the 123rd AOAC INTERNATIONAL Annual Meeting and Exposition, which was held mid-September 2009 in Philadelphia.

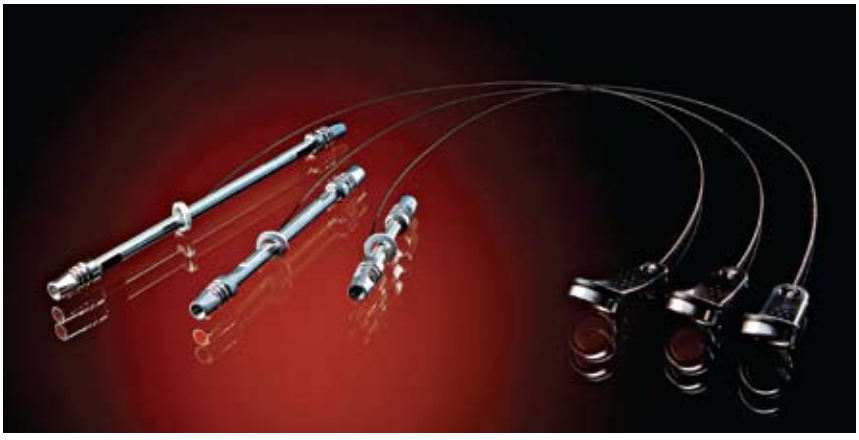
Joe Romano, senior manager, Chemical Analysis Business Development with Waters Corporation, says that sample preparation is a key concern in modern food testing and featured prominently among the innovations demonstrated at the AOAC meeting. "We are seeing a large request for these tools, as that seems to be a bottleneck. One of the tools we are offering for this is known as DisQuE, which is a dispersive technology known in the field as a QuEChERS technique. DisQuE enables multiple pesticide residue analysis on a variety of fruits and vegetables and allows a generic type of sample cleanup. It is fast, cheap and easy to use and works well with LC-MS/MS technologies, and when combined with UPLC. The DisQuE kit consists of centrifuge tubes and preweighed sorbents and buffers compatible with official methods. It is part of a streamlined process—sample preparation through analysis, data generation and specialty software for reporting the results.

The DisQuE™ dispersive sample preparation kit.

Turning to the subject of beverage analysis, Romano notes that just two years ago there was considerable concern about pesticides in soft drinks in India from two large manufacturers of beverage products. "There was a rapid reaction to that concern that led to the development of methods and enhanced capabilities within the two organizations to deal with the issue," says Romano

There are similar concerns in the area of new ingredients. The fastest-growing areas in the food manufacturing business are functional and health foods and one of the largest categories is artificial sweeteners, according to Romano. A new sweetener, stevia (also known by other names), which is a natural product derived from a plant source, was introduced to the market by several food manufacturers. Stevia, which is FDA approved, has zero calories and is a thousand times sweeter than sugar—so it provides a number of health benefits.

"When products claim that they contain stevia, there is a need to be able to verify that the correct ingredient is present. As a result, we have worked with some manufacturers to develop QC methodologies, based on the profile of different isomers of stevia, to test for this natural sweetener," says Romano. The test, called the BEH Glycan, which was designed on brand-new chemistry based around UPLC particle technology, enables



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the detection of the isomeric forms of stevia in about three minutes using ultraviolet technology. This test is valuable for QC and for ensuring that food labeling claims are met.

Broski believes that the melamine contamination outbreaks have raised the level of awareness within society that our food supply must be constantly monitored for both known and unknown contaminants. He notes that melamine is a persistent chemical, which is in the environment, and as a result it will remain in the food chain for some time.

"Industrial chemicals constitute one large area of contaminants that we will have to continue look out for—and another important category is mycotoxins. Mycotoxins are generating a lot of international interest, with many organizations devoting considerable attention and resources to this area," says Broski.

Changes in climate appear to cause fungi to produce toxic metabolites. They grow on a variety of beans, grains, and nuts, where they create toxins that people can ingest with unpleasant consequences," says Broski.

Thermo Fisher Scientific offers a wide range of products for the detection of numerous contaminants—chemical residues, pesticides, veterinary drugs, trace elements, natural toxins and pathogens, among others. The company is also engaged in the development of tools for food profiling where the objectives are traceability, authenticity and the origin of ingredients.

Broski sees considerable value in screening or profiling food. "The question is what should a particular food look like? Anything that does not fit the normal profile has to be considered a contaminant. So what the labs are looking for and what people in technology are converging on are products that can rapidly screen food

for suspected contaminants.

"Our Exactive high-resolution mass spectrometer uses Orbitrap technology to enable a wide dynamic range and resolution of up to one part in a hundred thousand. With these capabilities, the Exactive is able to find contaminants that are not detectable by other means. This product also has powerful targeted and non-targeted analysis capabilities, making it an attractive tool for contract labs where throughput and cost per sample are key considerations."

Broski notes that Thermo Fisher also has a product that addresses the sample preparation side of the workflow—the Transcend system, which uses turbulent flow chromatography to reduce the burden associated with sample preparation, while increasing throughput.

"Sample preparation is a key concern in modern food testing."

"What we are seeing now is what was once considered research-grade instrumentation becoming the routine. This is most noticeable in areas where there is a need to detect increasingly smaller traces of contaminants and for authenticity. An example of this is the use of isotope ratio mass spec instruments being used in food authenticity applications.

"New standards are constantly being developed, new food ingredients and delivery systems such as nanoparticles are being engineered, maximum residue limits are being revised, new contaminants are being detected, and the sensitivity of the detection instruments is increasing. Given these dynamics it is clear that food safety will remain an area of intense interest for the foreseeable future," says Broski.

Applied Biosystems established an Applied Markets division a few years ago to leverage technology that was developed for basic research—genome sequencing along with a variety of other basic research tools—and put them into real-world applications including food analysis, according to Phil Pielage, director of sales for Applied Markets at Applied Biosystems.

"In the food area, we have had some partnerships over the years, including an exclusive relationship with DuPont back in 2005. Within the last year and a half we have gone directly to the market within the food industry," says Pielage.

"The main concept is to take classic

microbiological techniques, which really haven't changed in 200 years, and leverage them into a molecular basis. With the genomes of most of the organisms sequenced, we have been able to use that information to create effective tests based on DNA, which increases the sensitivity of the analysis," says Pielage. He explains that this allows the specific targeting of organisms based on their DNA match.

"That is the foundation that has enabled us to develop a variety of tests that have more sensitive assays, increased turnaround times (making tests fast enough to be completed in a single shift) and greater specificity (that allows the detection of pathogens—even different strains, if necessary) with a high degree of confidence," he says.

The Transcend™ sample-extraction system.

Commenting on the overall preparedness to address chemical contaminants in food now, Andre Schreiber, technical marketing manager for Food and Environmental Testing, Applied Biosystems, says, "Government agencies and food testing laboratories are way more ready to identify contamination before they cause problems than they have ever been in the past."

Turning to Applied Biosystems' offerings to test for chemical contaminants in food, Schreiber says, "Our portfolio of tools for the food testing laboratory is based on liquid chromatography technology together with mass spectrometry. These tools analyze organic molecules in foods and residues that are not supposed to be present.

"We have these instruments on different performance platforms, depending on the concentration to be detected. Our instruments vary in cost, depending on applications, but we also have highly sensitive instruments, which can be used for ultra trace analysis. The common characteristic of all our instruments is that they are very fast, which is especially important in residue analysis, where laboratories need to detect hundreds if not thousands of chemical residues in a single analysis."

Schreiber says that in the course of the last two years there were two important driving forces. "It had become clear that increasingly labs have less than the required expertise to move into food testing, though they wanted to enter the field because it is a growing concern.

"So we developed innovative tools, especially software, to make it easier for them to use our equipment. We also developed a system that made it possible to download methods for analytical techniques, which can then be loaded into the software of a mass spectrometer, and very quickly achieve the stage where reliable results can be generated. This required making everything easy to use and ready to go," he says.

The AB SCIEX 3200 system.

The second initiative was for more established laboratories, which are under strong pressure to turn around samples faster—where there is a strong demand to get results out quickly or there is a need to earn more revenue. "For this group, we developed a system with two liquid chromatography streams going into a single detector to double the throughput. This is very important in contract laboratories," he says.

Bernard Tulsi *is a freelance writer based in Newark, Del. He may be contacted at btulsi@comcast.net or 302-266-6420.*

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EVOLUTION OF THE ANALYTICAL LAB BALANCE

JOHN BUIE

AN ONGOING QUEST FOR INCREASED PRECISION, ACCURACY AND RELIABILITY.

Today's analytical lab balance is a product of over 60 years of continuous innovation from a handful of equipment manufacturers around the globe. Each improvement has aimed to increase the analytical lab balance's precision, accuracy or reliability for researchers. The origins of the modern analytical lab balance date back to the short-beam analytical assay balance produced by Sartorius in the early 1900's (pictured below). This article will look at the major technological breakthroughs—from the first single-pan analytical balance manufactured in 1945 to that which more closely resembles what's in your lab today.

1940 1950 1960 1970

PRECISION

ACCURACY

RELIABILITY

1945

The invention of the single-pan analytical balance by Mettler Toledo company founder Erhard Mettler.

The company was established as Einzelfirma E. Mettler, in Switzerland. With the introduction of its scale, the company broke the less accurate two-pan weighing mold, using Mettler's so-called "substitution principal" to achieve more accurate measurements. Large-scale production of the unit began in 1946.

1971

The first nanogram balance sets the world record for the most precise weighing. This balance, manufactured by Sartorius, was used to weigh the moon rocks that astronaut Neil Armstrong brought back to Earth from his expedition.

1973

Mettler debuted its PT1200 scale, the industry's first fully electronic precision balance. With a capacity of 0 to 1,200 grams, the PT1200 had sensitivity to 0.01 grams. The new balance proved immediately successful upon its official 1974 launch.

Sartorius debuts the world's first explosion-protected version of an electronic precision balance.

Since the beginning, manufacturing state-of-the-art force restoration balances required the controlled assembly of numerous parts, dissimilar metals and fasteners carefully torqued and aligned to tight specifications. The resulting hardware was subject to small but unpredictable changes due to ambient temperature changes and aging.

Shimadzu's R&D engineers clearly addressed this problem and envisioned a solution in their 1989 patent for a single piece force-restoration balance mechanism. Their solution would only be fully realized when manufacturing technology advanced to include computer numeric control (CNC) milling and electric discharge machining (EDM) machines capable of cutting a block of metal alloy to a single piece that replaced as many as 70 individual parts. This is the technology now present in Shimadzu UniBloc and Mettler Monobloc components, which deliver stability of calibration against temperature changes and time, and enable quick response by reduced mass and movement. Computer-controlled cutting eliminates many hand assembly steps, assures manufacturing quality control and ultimately reduces cost.

1980

1990

2000

2010

1982

1989

1992

1993

1996

1997

2000

2005

2009

2009

Mettler Toledo introduces the first electronic microbalance with a 51 million point resolution.

With the introduction of the revolutionary MonoBloc weighing cell, Mettler Toledo set another milestone. More compact, robust and durable than its predecessors, it has become the reliable and precise "heart" of many of their balances.

Sartorius introduces the world's first ultra-microbalance with a weighing capacity that features a resolution of 21 million digits and an accuracy of 0.1 µg.

Most balance users must eventually record weight or computed values generated by their balances. Often, additional calculations are performed, such as combining weighing data with other instrument analysis, to compute sample values.

Shimadzu's Windows Direct communication function makes this easy. Winner of the most outstanding new product award at the International Society of Weighing and Measurement (ISWM) exhibition in 2000, Windows Direct allows the user to leverage the capabilities of any Windows-based software. Once configured, the displayed weight is transmitted directly to the PC just as if it were entered via the keyboard. No additional software is needed to interface with spreadsheet, database, word processing or laboratory software. This function eliminates data input errors, offers extensive flexibility for application development, and simplifies system validation and compliance. Windows Direct also works together with other balance functions to automate weighing data collection.

The first monolithic weigh cell technology is presented by Sartorius. The monolithic weigh cell replaces a complicated weighing system made up of up to 150 different parts. This new mechatronic system is the basis for many successive generations of balances and scales.

Sartorius releases the Cubis analytical lab balance whose many firsts include: The first balance in its class with automatic motorized leveling at the touch of a key; the first top-loading analytical balance with a motorized draft shield; and the first lab balance with Q-Pan off-center load compensation that adjusts accordingly when a sample is off-centered on the pan. All this means reliable and repeatable results in a larger working area.

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Mettler Toledo's introduced many innovations with their new XP analytical series analytical balance. Adding a color touch screen, Bluetooth connectivity and the peerless gridpan technology that gave a major improvement in stability and accuracy.

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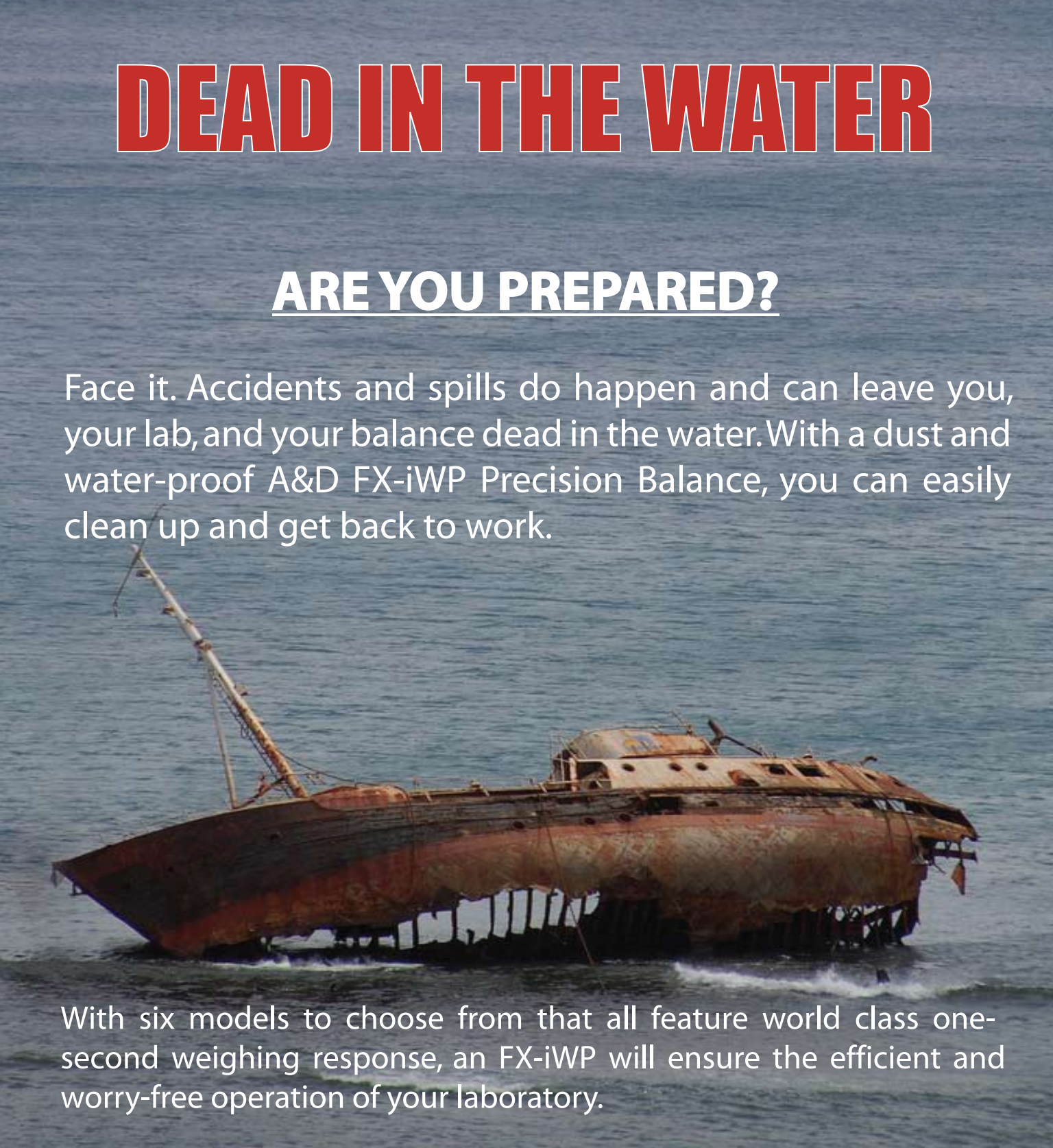

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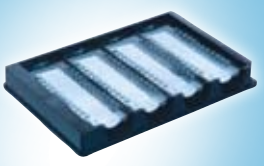

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For more information, visit www.greinerbioone.com. Product Scientist Dr. Ulrike Honisch can be reached at ulrike.honisch@gbo.com or by phone at +49/(0) 7022/948-420.

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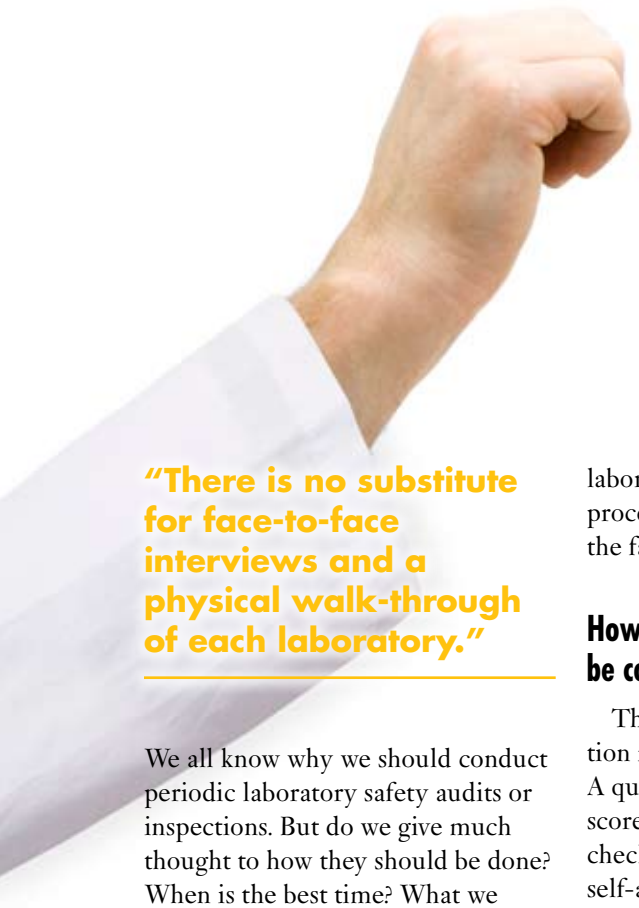

KNOCK! KNOCK!

THE HOW, WHEN AND WHAT FOR A MEANINGFUL LAB SAFETY AUDIT

By Vince McLeod

"There is no substitute for face-to-face interviews and a physical walk-through of each laboratory."

We all know why we should conduct periodic laboratory safety audits or inspections. But do we give much thought to how they should be done? When is the best time? What we should be looking for?

This month's column will answer all these questions and guide you through a meaningful laboratory safety survey. Our intent is to stimulate you into setting up and implementing a successful program.

The typical research facility contains a variety of hazards. Most facilities will have a mix of research laboratories, instrument rooms, chemical storage areas, waste-handling areas and busy receiving/loading docks. The OSHA Laboratory Standard[1] is an excellent resource and the starting point for any lab using hazardous chemicals.

Appendix A of the standard recommends performing inspections at least semiannually and quarterly for labs with high personnel turnover. The focus of this column will be on conducting safety audits in the laboratories, but the steps and the process can be applied to all areas of the facility.

How should the lab safety audit be conducted?

This apparently innocent question may cause you the most agony. A quick Google search will produce scores of audit instructions and checklists. But should you go with self-audits and let the lab manager complete the checklist or should you try something different?

Personally, we think there is no substitute for face-to-face interviews and a physical walk-through of each laboratory. The crucial thing here is that the auditor or surveyor must be trained and knowledgeable about the type of research being performed in the laboratory undergoing the safety audit. Checklists can help guide the process, but you need to know what you are looking for and what questions to ask if something does not appear right.

Lab safety auditors are basically "in-house inspectors" who must be able to look for and spot the same health and safety issues that would be identified by the regulating agencies if they visited the lab. Depending on the research focus of the lab, those agencies could include OSHA, EPA, USDA, CDC, DEA and NIH, to name a few. Therefore, a complex lab may require more than one visit and/or auditor, as it is rare that one person is well versed in all these different areas.

When should the audit be done?

This question boils down to—should the safety audit be scheduled with the lab manager or should the auditors show up unannounced? We prefer the latter, as this can provide insights into true lab operations. However, there are drawbacks to this approach. If the lab is very busy, you might not be able to gain the full attention of the principal investigator (PI) or lab manager, and all areas might not be accessible because of ongoing experiments. You need to be flexible, and that means a mix of scheduled audits and unannounced surveys might be the best option.

What do we look for?

Now we get to the heart of this column and the question everyone wants answered—what are we looking for during a lab safety audit? The simple answer, of course, is—everything! The reality is that we are performing a walk-through inspection and trying to spot obvious safety hazards.

We also are gaining insight into

the day-to-day operations of the lab by interviewing the PI or lab manager and observing overall conditions in the lab. A final goal of the audit is to ensure that regulatory requirements are being met and the lab is in compliance with all applicable rules. So let's get started on our virtual lab safety audit.

"A complex lab may require more than one visit and/or auditor."

The virtual lab safety tour

Our virtual inspection will visit a general chemical research lab, although brief mention of other specialty labs is also given. Obviously, special research labs such as those dealing with radiation, select agents or biosafety level 3 and above must receive a focused audit in addition to what is presented here.

Let's begin by approaching the main entrance. We should know that we are about to enter an area with special hazards. Lab entrances should have appropriate signage to alert those preparing to enter about the hazards that are present. One excellent method is posting a notice board that includes all hazards present and, most important, emergency contact information. Be sure to check this again when exiting to note whether all hazards are represented and that any new ones have been added.

Upon entry, we suggest that you seek out the lab manager or PI and identify yourself and the purpose of the visit. We recommend opening with the paperwork, as this gives you an opportunity to begin the interview while becoming familiar with the focus of the lab. Start by asking for the chemical hygiene plan, the chemical inventory, the MSDS (material safety data sheets) and the lab SOPs (standard operating procedures). For labs working with select agents or BSL3 materials, make sure to review their registrations.

When you have completed the records review, it is time to commence the walk-through. As mentioned

above, copious checklists are available on the Web; the University of Florida has a good example.[2] Our recommendation is to use one. There are just too many things to remember to do justice with a blank notebook.

We also recommend that you tailor your checklist to cover the majority of your labs. But do not be shy about expanding beyond the checklist. If something looks wrong, it probably is. Additional lists can be included for those "special" labs, e.g., lasers, radiation, rDNA.

Technologically advanced reviewers can use electronic lists on touchpads, netbooks or notebook computers that record data directly into a database. However you choose to do it, we suggest that you take a few minutes before the audit to read over the list and bring your focus to all the different areas involved:

- General lab signage and safety equipment such as hoods, eyewash stations and safety showers
- Personal protective equipment that is appropriate for the tasks: lab coats, aprons, gloves, eye protection, etc.
- Overall lab housekeeping and organization
- Chemical safety and proper storage
- Electrical safety (this is a big one)
- Basic fire safety (another major category)
- Lab waste disposal

Are you getting the picture? A lab safety audit is a serious undertaking, and preparation is paramount to success and useful effort.

If there is a golden rule for lab safety audits it is this: Do not rush. More than likely, you are only going to do this once per year, per lab. So take your time and look carefully at each counter, each shelf and each cabinet. Do not be afraid to ask lab personnel if you are not sure about equipment setup, function or potential hazards. It will add to your knowledge base for the next one.

Discuss all discrepancies and needed corrections with the PI or lab manager during a brief exit interview. That way, any questions can be addressed immediately. Finally, do not forget to follow up with a written report or you could find out the hard way that if it is not documented, it did not happen.

One last suggestion is to include a certain time or date to complete the corrections. This will encourage quick action.

Keep safety first!

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2. http://www.ehs.ufl.edu/Lab/checklst.htm – Lab Safety Checklist, University of Florida, Environmental Health and Safety.

Vince McLeod *is an American Board of Industrial Hygiene–certified industrial hygienist and the senior IH with the University of Florida's Environmental Health and Safety division. He has 22 years of occupational health and safety experience at UF and specializes in conducting exposure assessments and health hazard evaluations for the university's 2,200-plus research laboratories.*

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STAFFAN NILSSON, Ph.D. | *Professor of Technical Analytical Chemistry, Lund University, Sweden*

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HASSAN JAFERI, M.Sc. | *Analyst, Commercial Development, PARTEQ Innovations*

At first, it was like entering a new universe.

"It really is the biggest event in the instrumentation field. It took a little while to find my way, but it was a good opportunity to learn about new theoretical subjects during seminars, and to see practical applications on the exhibition area. My lab presented a poster on a new instrument we developed, and we had many opportunities to share ideas with other researchers."

VÉRONIQUE PERES | *Maître de Recherche, Ecole Nationale Supérieure des Mines, Saint Etienne*

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PURPOSE-BUILT LIMS

REAPING THE INTEGRATION BENEFITS OF ENTERPRISE-LEVEL LABORATORY INFORMATION MANAGEMENT SYSTEMS

by Dave Champagne

The importance of integration

Enterprise-level integration is particularly relevant in today's business climate, where near-instantaneous response is required by pharmaceutical companies, food growers and manufacturers, oil and gas companies, and many other types of business in order to protect the public and the environment. Seamless enterprise-wide integration is a necessity because it makes key knowledge originating in the laboratory available to management in real time. For this reason, the world of laboratory informatics is changing to meet the needs of today's diverse industries, which are continually searching for ways to reduce costs, accelerate time to market and respond to increasing regulatory requirements.

"Working with multiple disparate systems with minimal to no integration is no longer an option."

Integrating the enterprise facilitates better data correlation and collaboration, end-to-end report generation and more-secure data exchanges, with the goal of providing management with a dashboard view of the key business metrics essential to running the business. This integration enables management to have the critical data it needs before, not after, any point of crisis. Enterprise-level laboratory information management systems (LIMS) can help streamline the flow of information successfully, providing companies with the information they need to make critical business decisions in today's business climate.

Evaluating the role of generic LIMS

Historically, LIMS have delivered only 30 to 40 percent of the functionality needed for a specific industry, requiring extensive customization to achieve effective performance in a particular setting. Such customization is commonly possible only through the use of proprietary programming languages that are developed and provided by the LIMS vendor. The combination of minimal industry-specific functionality and often outdated and/or costly proprietary languages has been particularly troublesome in the pharmaceutical industry. In addition, pharmaceutical laboratories often create their own user documentation, design documentation, validation scripts and help files. As a consequence, the implementation of LIMS in various laboratory settings has been, almost without exception, a long, costly and painful process, not only during installation but also in operation and maintenance of these systems over the years.

Addressing the business needs of today's industry

Companies operating in the current economic climate can no longer afford to delay the implementation of next-generation tools that will help them increase productivity. With pressure to cut costs, shorten the pipeline life cycle and maximize return on investment, these companies need tools that help them improve enterprise-wide communications, reach critical decisions faster, and produce timely and accurate reports on how their products are moving through the pipeline or production process. Working with multiple disparate systems with minimal to no integration is no longer an option.

MEET THE AUTHOR

To see an interview with *Lab Manager Magazine* contributing writer, Ronald Pickett, visit www.qorpak.com/labmanager.

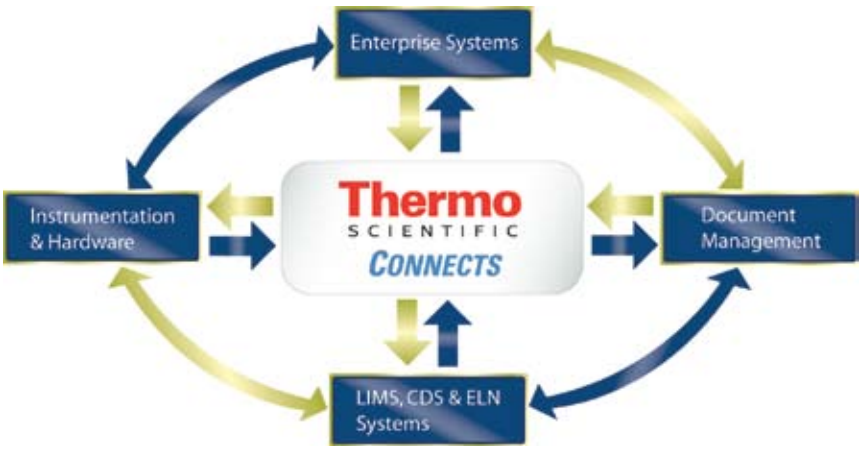
Ronald Pickett is an organizational effectiveness consultant based in Escondido, CA. His first article for *Lab Manager Magazine* ("'Scientist' Stereotype: Is it Working For or Against You?," April 2009) looked at the validity of the stereotype and the benefits, challenges and expectations associated with it. In October, Ron contributed a piece called "Honing Your Interviewing Skills," in which he provided practical advice for identifying the job candidate best suited for your specific lab and work culture. In this issue, Ron delivers Part II of "Motivating a 21st Century Lab Staff," focusing on the key generational differences you need to understand in order to motivate your entire staff.

To learn more about Ron, visit the link above.

Look for more 'Meet the Author' video links in upcoming issues of *Lab Manager Magazine*.

Today's LIMS solutions

Today, global deployments of LIMS solutions have become more consistent and more rapid. The implementation of purpose-built LIMS across the enterprise allows for simpler system upgrades, minimized project risks and enhanced compliance. In addition, industry-specific solutions facilitate enterprise-wide application and training. These multifaceted benefits help lower the total cost of ownership of the solution, which is critical to companies that are under ever-increasing pressure to contain costs and increase efficiency. This goal can be achieved by integrating the LIMS with instrumentation and enterprise systems, which can facilitate the global harmonization of business processes, automation of operations and consolidation of data management in a single system, allowing for near-instant decision making.



Purpose-built integration solutions

As companies today look for processes that can help them consistently deliver improved efficiencies and lower costs, LIMS are key contributors in this effort. Delivering advanced functionality that is specific to each stage of the drug development process or to an ISO-regulated manufacturing process, sophisticated, purpose-built LIMS streamline processes and costs and present organizations with unique integration opportunities. These LIMS provide superior capabilities by delivering real-time analysis and reports, facilitating regulatory compliance and product quality, integrating with the company's broader network and providing secure access to key data throughout the organization.

When the required functionality is built into the base system as standard, it eliminates the need for user-specific customizations during implementation. This, in turn, results in reduced validation time, shortened deployment and easier ongoing support. Purpose-built LIMS for pharmaceutical applications are particularly relevant. According to Frost & Sullivan's "2008 Strategic Analysis of the U.S. Laboratory Information Management Systems Market," preconfigured solutions with test methods for specified industries will drive growth across all markets. The more functionality included in the core product out of the box, the less risk, lower costs and less time involved in the implementation, validation and

support of the applications. According to the same Frost & Sullivan report, market growth indicators for LIMS solutions providers are focused on providing customers with not only purpose-built LIMS that are fully integrated with other laboratory equipment but also LIMS that easily align with global enterprise solutions.

In response to the needs of our customers and these market growth indicators, Thermo Fisher Scientific has introduced a new informatics initiative aimed at bridging the gap between laboratory-generated data and the enterprise-level information that is required for mission-critical management decisions. Because of the breadth of our company's product offerings and our strategic partnerships, we are uniquely positioned to offer Thermo Scientific CONNECTS, an enterprise-level solution set that allows companies to more fully integrate the work of the laboratory into the enterprise. CONNECTS enables our customers to extend the business of science from the laboratory throughout the enterprise, providing both the integration of instruments and systems and the interoperability necessary to transform data into relevant business drivers.

Thermo Fisher's 25 years' experience in integrating laboratory informatics with the enterprise has been built and strengthened by its ongoing partnership with industry leaders such as Microsoft, Oracle, and Symyx and members of our Global Partner Alliance program. With CONNECTS, we bring a strategic vision and the resources necessary to help facilitate management-level discussion about the necessity of integrating various sources of data (including laboratory and related instrumentation), enterprise systems (such as MES, PIMS and ERP systems), and enterprise communication tools (such as SharePoint, BizTalk and document management systems), thereby elevating the role of the laboratory in the day-to-day mission-critical decisions required of management throughout the enterprise.

Conclusion

LIMS that are fully integrated with laboratory instruments and enterprise systems can help bring key business knowledge originating in the laboratory to management at all levels of the enterprise. By effectively integrating laboratory data and providing management with key business knowledge, laboratory informatics can elevate the role that the laboratory plays in mission-critical decisions. LIMS can help organizations respond with more certainty to the unforeseen challenges that can often make or break a company.

Modern LIMS serve as common platform frameworks that other informatics solutions, instrumentation, enterprise systems and enterprise communication tools can plug in to in order to share common functions, without having to build them from scratch for each product. A coherent strategy that can integrate data from the LIMS, chromatography data system enterprise resource planning system, manufacturing enterprise system, electronic laboratory notebooks and other sources across the enterprise is a key business driver for pharmaceutical companies.

For more information about Thermo Scientific Informatics solutions, please call +1 866-463-6522 (US) or +44 161 942 3000 (EU), send e-mail to marketing.informatics@thermofisher.com or visit www.thermo.com/informatics.

OBTAINING COST-EFFECTIVE AND PRECISE QPCR CHEMISTRIES

Problem: Quantitative PCR (qPCR) assays using the 5′ nuclease process are used for a variety of applications, from basic validation to complex screening studies. The volume of reagents and enzymes used in a given time frame can, therefore, vary extensively depending on the application and research laboratory. Unfortunately, due to restrictions on reaction scales available for purchase, researchers must often pay for larger solution volumes than they will use, especially when analyzing a limited number of samples. This is not cost-effective and is extremely wasteful. Furthermore, the issue of cost may also lead some researchers to choose intercalating fluorescent dye-based methods instead of the 5′ nuclease method which is less specific and may not be able to provide the necessary quality of results. The real-time data obtained may not always be a true representation of the amplification due to the occurrence of primer-dimers and non-specific binding. Researchers can avoid these issues by using the 5′ nuclease-based PrimeTime assays from Integrated DNA Technologies (IDT).

Solution: IDT has recently developed its PrimeTime qPCR assay portfolio. This complete range of assay scales enables more affordable gene studies which better reflect the needs of the customer. By providing quantities that accurately match a broad range of research applications, scientists can work in a cost-effective manner and stay within their allocated budgets. The PrimeTime Mini, consisting of 100 reactions, is ideal for those requiring a limited number of reactions and makes smaller-scale qPCR more affordable. The PrimeTime Standard (500 reactions) and PrimeTime XL (2,500 reactions) complete the range by offering larger reaction quantities that reflect the needs of more frequent users who perform qPCR experiments on a regular basis.

In addition to the choices in scale, users also have the ability to set the thermodynamic parameters to match the specific requirements of their assay. The assays are designed to reduce the detection of genomic DNA by spanning exon-exon junctions. Furthermore, the sequence of all primers and probes can be viewed and evaluated prior to any purchase. As a result, all personal and experimental preferences can be met with ease.

▲ *IDT PrimeTime 5′ nuclease reagents are available in three different sizes: PrimeTime mini (100 reactions), PrimeTime Standard (500 reactions) and PrimeTime XL (1000 reactions)*

To avoid the inaccuracies that come with the use of intercalating fluorescent dyes, all of the PrimeTime qPCR product offerings are 5′ nuclease assays consisting of a forward and a reverse primer along with a dual-labeled probe. This oligonucleotide combination allows for relative or absolute quantification of target sequence within a sample. Unlike intercalating dyes, the probe provides improved specificity by increasing fluorescence only when the target sequence is extended. During the elongation phase of the PCR cycle, the polymerase cleaves the 5′ reporter which allows it to separate from the quencher and emit fluorescence. Therefore, this method avoids misleading results that arise from primer-dimers or non-specific binding and provides increased specificity and precise, repeatable results with every reaction.

For more information, visit www.idtdna.com/primetime.

SAMPLE PREPARATION FOR THE DETECTION OF PAH AND PHTHALATES

Problem: Polynuclear aromatic hydrocarbons, also known as PAH, are used as plasticizers in many caoutchouc products, such as the rubber grips of tools. Some PAH have a proven carcinogenic effect on humans; this is why there are critical limits for the maximum concentration allowed in consumer products. Phthalates are used as plasticizers in plastics as well, in products such as PVC. Recent tests (by the German consumer magazine *Test*, issue 09/2009, p. 72ff) have shown that these harmful substances occur in such sensitive products as children's strollers. Not only PAH was found, but also chlorinated paraffin and flame retardants, which are considered harmful to health.

The analysis of the above-mentioned compounds is usually done with chromatographic methods (HPLC-MS, GC-MS). It is first necessary to extract the compounds in question from the test material (i.e., by solvent extraction). To facilitate the extraction of a small but representative sample, the material must be ground to a particle size of approximately 0.5 mm. Because the material is very elastic and can be fibrous and heat-sensitive, this presents an added challenge in the size-reduction process. Moreover, it must be ensured that volatile components of the sample are not expelled by heat generated during the grinding process. Therefore, it is recommended to process the sample in two steps.

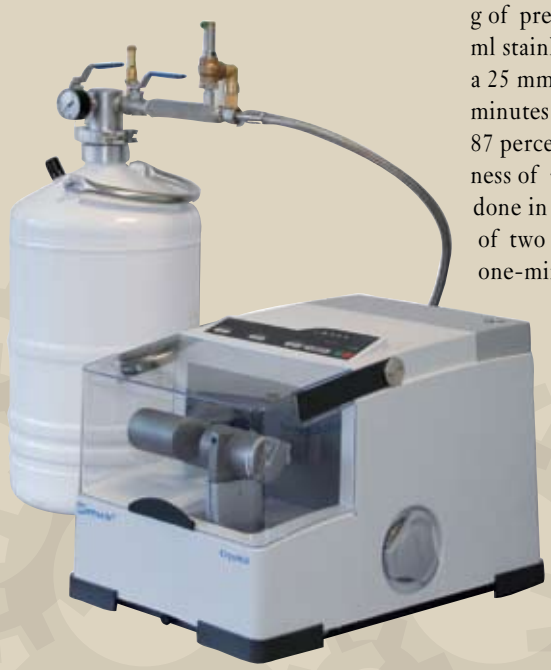
Solution: The best way to prepare such materials for analysis can be demonstrated with the rain cover of a stroller. It is made primarily of PVC, which—partly due to the use of plasticizers such as phthalates—is highly elastic and heat-sensitive.

First, the entire rain cover is processed quickly and gently using the RETSCH Cutting Mill SM 300 and a 6.0 mm bottom sieve. The mill features a powerful 3 kW drive with very high torque and can process the plastic cover to <5 mm within one minute. The variable speed, which can be set between 700 and 3,000 rpm, can greatly reduce the unfavorable temperature increase that could lead to evaporation of volatile components. Thanks to the fold-back housing, push-fit rotor and smooth interior surfaces, the mill can be cleaned quickly and easily.

Liquid nitrogen must be used as a grinding aid to reduce the elastic material to a fineness of <0.5 mm. Liquid nitrogen helps to embrittle the plastic, improving its breaking behavior. In addition, LN^2 cools the sample material to ensure that the volatiles don't escape. The CryoMill is the ideal instrument for this application. This mill features an integrated cooling system that continually cools the grinding jar before and during grinding. The CryoMill is particularly efficient and safe: the liquid nitrogen is replenished from an autofill system in the exact amount required to keep the grinding chamber at -196°C.

After representative sample division, 2 g of precut rain cover are put into a 50 ml stainless steel grinding jar along with a 25 mm grinding ball. After only four minutes of grinding with the CryoMill, 87 percent of the sample has a fineness of <500 microns. The grinding is done in intervals: two grinding cycles of two minutes each, interrupted by a one-minute cooling cycle. The obtained sample can then be subjected to extraction for the subsequent chromatographic separation.

For more information, go to www.retsch.com.



▲ *The CryoMill with AutoFill dewar is the safest and easiest way to mill temperature-sensitive samples. In minutes, the CryoMill prepares plastics for GC-MS analysis of phthalates and PAH.*

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PREDICTING CENTRAL NERVOUS SYSTEM (CNS) DRUG PENETRATION

Problem: Penetration of a drug into the central nervous system (CNS) is vital for pharmacological efficacy if the target is located in the CNS, but represents an unwanted risk factor if the therapeutic target is peripherally located. CNS penetration is therefore required when it is known that the peripheral target exists in the CNS, or when and if any interactions with targets located or co-located in the CNS are likely to have undesirable consequences.

A commonly quoted index of brain penetration is the ratio of drug in brain tissue to that in circulation, i.e. [brain]/[plasma]. Obtaining such data in drug discovery can require a significant use of animals and is not resource effective when assessing the CNS penetration potential for multiple compounds. Furthermore, the concentrations of drug in brain and in plasma that are measured are most often the total concentration of drug in brain homogenate and total concentration of drug in plasma. But it is generally accepted that it is the free fraction of drug that is available for pharmacological activity and the difficult measurement is that of free drug in the brain.[1] Deriving this value from *in vivo* studies relies on technically challenging microdialysis or sampling of cerebrospinal fluid (CSF), techniques rarely available early in a drug discovery program.

Solution: Data from a number of *in vitro* models can be combined to assess the potential for molecules to penetrate the blood-brain barrier (BBB) and cause an effect in the CNS.

Under freely diffusible conditions it is expected that the free concentration in plasma and brain tissue will be the same, i.e.

$[plasma]xfu_{plasma} = [brain]xfu_{brain}$ (where fu = fraction unbound)

Therefore from an efficacy perspective, there is no advantage in having a compound with a high [brain]/[plasma] ratio if the unbound drug concentrations in plasma are insufficient for efficacy. Conversely, if the unbound drug concentrations in plasma are sufficient for efficacy, this should also be true in brain tissue. The driving force for drug diffusion across the BBB is fu_{plasma} hence, the degree of drug penetration of the BBB is limited by high plasma protein binding (PPB). The fu_{plasma} can be determined *in vitro* using equilibrium dialysis performed in 96-well format.

By combining the *in vitro* PPB data with the expected circulating plasma concentrations, an assessment of the free drug concentrations achievable in plasma can be made. This provides guidance on the likelihood of achieving efficacy (or side-effects) at a CNS target, assuming passive diffusion.

▲ ***BioFocus' ADME/PK abilities offer solutions within the CNS area***

However, freely diffusible conditions may not exist if the drug has poor intrinsic cell permeability, or if active efflux takes place across the capillary endothelium. Cell lines such as Caco-2 or MDCK expressing the human MDR1 gene provide a measure of a compound's intrinsic permeability and the potential impact of active transport. In particular, the efflux transporter, P-glycoprotein (MDR1), is highly expressed in brain microvessel epithelium, and confirmation of efflux by this protein can be obtained by the addition of inhibitors along with test compounds in the cell permeation assays.

If carrier-mediated uptake at the BBB occurs, fu_{brain} may be higher than fu_{plasma}. In the absence of such uptake, fu_{brain} is unlikely to be higher than fu_{plasma} and could be lower if active efflux of compound occurs. A guide to the amount of free drug in interstitial fluid can be obtained by measuring fu_{brain} *in vitro* using an equilibrium dialysis method with drug added to brain homogenate.

Therefore, assessing data from *in vitro* PPB studies, permeation assays and binding to brain homogenate provides an indication of the CNS penetration potential of test compounds.

For further information on the application of these techniques please contact BioFocus at info@glpg.com or visit www.biofocus.com.

1. De Lang, E. C.; Danhof, M. Considerations in the use of CSF pharmacokinetics to predict brain target concentrations in the clinical setting: implications of the barriers between blood and brain. *Clin. Pharmacokinet* 2002.41: 691-703

SAMPLE SECURITY

Problem: The issue of sample security in laboratories is becoming a prominent topic, especially with the abundance of biobanks opening up across the globe. In an ideal world, there would be industry guidelines to standardize, and in some cases even regulate, the storage of samples in all laboratories. However, in reality, storage is far from standardized.

The need for sample tracking and security is rising, but many laboratories do not have the funding or resources to update their processes with advanced sample management systems. Most laboratory freezers are opened and closed manually, which does not provide any level of sample security.

21 CFR Part 11 compliance, including sample audit trails, is an important requirement in pharmaceutical applications. In many government labs, biosafety is a critical issue requiring sophisticated storage access controls. Some of these concerns stem from the anthrax incident in 2001, after which investigators determined the chain of custody documentation was incomplete. In an effort to help prevent future incidents, Congress introduced the Select Agent Program and Biosafety Improvement Act of 2009 to help develop standards for laboratory biosafety. But even this bill does not provide universal standardization, and it does not cover all laboratories.

The bottom line is that without standards in place, most laboratory samples are not secure and sample integrity is not safeguarded.

Solution: Hamilton Storage Technologies has developed an automated sample management system that provides sample security, audit trails and complete chain of custody documentation. The Sample Access Manager (SAM) is the only -80˚C automated storage module on the market equipped with 21 CFR Part 11-compliant software that provides a laboratory with the ability to manage and track samples. This is achieved by supplying access control functions and detailed reports that document the security of a sample.

In a manual freezer, samples can be accessed by anyone in the laboratory. With SAM, user rights and groups can be set up to limit access to specified libraries. Password protection ensures that a user can only access samples for which he/she is authorized. The system includes electronic signature capability for 21 CFR Part 11 applications. SAM maintains a complete sample log providing information such as who took out the sample, how long it was out and how many times it was taken out. These reports help a laboratory properly manage chain of custody.

▲ *The Sample Access Manager, available in -20˚C and -80˚C models, automates and documents the secure storage of compounds.*

Hamilton's SAM is a compact, robust and localized storage system for secure sample management of plates and tubes. The SAM offers reliable automation, multiple sample type capability, cherry-picking, sample tracking and easy-to-use software. The SAM is environmentally controlled with a temperature range of -55˚C to -80˚C in the -80˚C platform or +20˚C to -40˚C in the -20˚C platform, which allows for storage of both compounds and biological samples. The SAM is useful for a wide range of biobanking, forensics, genetic analysis and drug discovery applications.

For more information, visit www.hamilton-storage.com.

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Marketplace

PARTING POINTS

Takeaways from this month's issue:

Becoming a Super Lab Manager, p. 10

Many people fear for their jobs in an unstable economy. However, management can help alleviate stress among employees with proper communication and keeping workers in the loop. Here are some tips on how to be a super lab manager:

- Let workers know how their individual jobs contribute to the overall success of the company
- Empower the staff to take ownership and get them involved in making positive contributions
- Hold the staff accountable for their actions – it's an effective way to motivate them
- If you can't afford to motivate your staff with pay raises, do so with pay decreases. If done properly, it can help employees feel as though they are helping the company stay afloat

Motivating a 21st Century Lab Staff, Part II, p. 16

When managers consider ways to motivate their staff, they should take into account the different age cohorts that exist in the workplace. The members of each of these groups have different outlooks and expectations. Consider each cohort's characteristics when developing new policies and rewards.

- Baby boomers (born 1946 through 1964): They expect to work beyond age 65; they value flexibility and autonomy in their jobs; their children and elderly parents depend on them.
- Generation X (born 1965 through 1980): They are independent and resourceful and feel comfortable around technology; they value freedom and responsibility and prefer a hands-off management philosophy.
- Generation Y (born 1980 through 1994): They are ambitious and comfortable in a multicultural environment; they want to network and they are committed to healing the planet.

Location, Location, Location, p. 22

There are many factors to consider when choosing a location for a R&D laboratory. Big and small companies have adopted different approaches:

- The central laboratory: Often located in close proximity to company headquarters, which facilitates teamwork between researchers, design engineers and marketing staff.
- Smaller, scattered R&D labs: Often located in or adjacent to company production facilities, which keeps the company from spending money on personnel relocation.
- Overseas labs: Locating production facilities in regions with rapidly growing markets, such as some Asian countries, can keep companies internationally competitive.
- Labs in hot spots: Locating labs in intellectually vibrant areas keeps companies in close proximity to major hubs such as universities and hospitals.

The Evolution of Equipment Service, p. 30

With advanced software and cutting-edge technology comes complex and intricate machinery. In the past, when that machinery failed, a researcher would have to spend hours on the phone trying to solve the problem with multiple service representatives. However, there are increasing means by which a user can receive assistance. For example:

- Field service specialists: They have engineering backgrounds and understand the technology behind the instrument.
- Internet-facilitated service tools: They allow the service partner to connect directly to the instrument in the customer's lab, allowing the service person to see the problem for himself.
- Global call centers: Powered by IP telephony, they enable extended business hours through automatic transfer of calls when requests come in outside of regular business hours.

Perspective On: A Food Testing Laboratory, p. 40

As food laws become stricter, food testing labs are being required to deal with contaminants quicker and more efficiently. Some experts say it's impossible to completely prevent all food-related incidents, but proposed legislation by the Obama administration aims to improve food safety around the world. Here are some of the suggestions related to improving food safety:

- Authorities should inform trading partners in foreign countries of U.S. standards and help them to test in compliance with them
- DisQuE, which is known as a QuEChERS technique, enables multiple pesticide residue analysis on fresh produce, and it is fast, cheap and easy to use.
- The BEH Glycan test, which was initially used to detect isomeric forms of stevia using UV technology, can be used in QC tests and to ensure labeling claims are being met.
- Isotope ratio mass spectrometry instruments are being used routinely to detect increasingly small traces of contaminants.

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