Innovation Sprouts from Lifetime of Soils Research

By Deborah Nash, MMEC

Automating production is the latest step in the long road from research to commercial reality for an innovation developed by Earl Skogley, a soil scientist and entrepreneur, at UNIBEST Inc. (Universal Bioavailability Environmental/Soil Test) west of Bozeman. The device is a cherry-tomato-sized capsule, filled with unique resin beads, that can change the way soils are analyzed. This technology allows direct measurements in the field, reducing the amount of material transported and handled in the laboratory. It simplifies and improves data collection for agricultural, environmental, and reclamation efforts in soils, water, or other media.

Data Needed
To learn how to scale up production cost-effectively and have solid data to submit for a “Growth through Agriculture” proposal to the Montana Department of Agriculture, Skogley, who retired from Montana State University in 1998 after 35 years of service in the College of Agriculture, naturally turned to the University. This time, he tapped expertise from several groups at the College of Engineering to explore feasibility, cost estimates, and a prototype design for a custom-built machine to increase capsule production.

Resin technology for soils research has been a lifetime passion for Skogley. The capsule is based on his doctoral research work on resins four decades earlier and shaped by his experiences as an MSU scientist. In addition to teaching duties, he conducted research, primarily in soil fertility and crop nutrition, and conducted field plots all over the state of Montana.

The Yellowstone National Park fires of 1988 provided some of the early field tests for the capsules where effects of forest burning were studied over two and a half years, Skogley said.

The PST-1 capsules for studying agricultural soils hold resin beads that take up ions from the soil by the same processes that plants use to get their nutrients. The capsules are returned to the lab after a designated time period to examine the inorganic contents that collect within the beads. This simple, accurate measure of availability of elements to a plant, gives agriculturists a way to identify nutrient deficiencies or imbalances, and serves as an aid to diagnosing problems. It can also assist long term crop management planning.

Traditional Methods
This innovation changes long-standing laboratory methods and will require new regulatory protocol for some uses, which has slowed its path to market. Traditionally, a soil sample of a pint or two is removed from a plot, dried, and then ground into powder. A small portion of this sample is then extracted with selected chemical solutions to determine how much of certain nutrients can be removed from the soil in this manner. This does not represent the processes used by plants to get their nutrients, so many years of “statistical correlation” studies have been conducted to learn how to use these data for crop management decisions. This methodology has been used for 60 or 70 years, and there is strong resistance to change, Skogley said. “We knew that standard soil testing was not realistic, not how plants work, but it was the best technology available. It pushed us to develop a more realistic system of soil testing based on true nutrient availability processes.”

The improved system requires only the insertion of the resin-filled capsules into the soil. They are later removed and taken to the lab for analysis. The resin is capable of adsorbing and storing ions over time for a more complete look at what is happening in soil under the actual conditions of plant growth, Skogley explained. About 100 capsules make up the weight of a single traditional soil sample, and capsules are easily disposed of after use. When testing near the soil surface, no special equipment is needed, but for deeper sampling, a soil access...
Time to “Get the Lead Out”

By Mark Shyne
MMEC Field Engineer

New environmental regulations will significantly impact Montana companies that produce electronic products, starting with those that export to Europe.

New laws in the European Union (EU) will force manufacturers to eliminate virtually all lead, mercury, cadmium and other toxic materials from their products (and manufacturing processes) by next year. Similar laws are also in development in Japan, China, the USA, and other places around the world. Many refer to the new laws as “lead-free manufacturing,” although lead is only one of the substances being banned from consumer electronics.

New directives from the EU


The WEEE directive requires that product manufacturers take back products at the end of their useful life, at no cost to the consumer, and have a recycling program to reclaim or reuse as much as possible. The RoHS directive is the big one impacting companies and will be the focus of this article.

RoHS requires that by July 1, 2006 all new products being placed on the EU market will be free of certain hazardous substances.

- Lead (Pb)
- Mercury (Hg)
- Hexavalent Chromium (CVI)
- Polybrominated Biphenyls (PBBs)
- Polybrominated Diphenyl Ethers (PBDEs)
- Cadmium (Cd)

What is driving this legislation is the endless availability of new “disposable” consumer electronic products, and the amazing ability of product designers and producers to put more functionality into smaller and smaller spaces. It’s a sort of paradise for users of technology, but at a price – recycling and e-waste dumping poured into our landfills at warp speed.

We have sensed the lack of awareness of advanced manufacturing in the state’s average manufacturing wage ($27,000 and considerably higher than the average state wage of under $15,000), and especially lead. It’s pretty clear what needs to be done – “design out” the lead-based materials.

Years ago lead in paint, gasoline, and plumbing was a problem. These new laws are a natural extension of that. In short, it’s time to “get the lead out” of our environment and workplace.

Specific manufacturers and their OEM customers. Requirements include:

- Reduced or eliminated lead in solder alloys
- Reduced or eliminated lead in printed circuit boards
- Reduced or eliminated lead in lead-free components
- Reduced or eliminated lead in lead-free interconnects

Changes will impact solder temperature, flux activation & other factors.

RoHS, if asked. The RoHS directive requires that the company provide the data within 28 days of the request.

1. Part Numbering. Some component manufacturers are not changing part numbers but may be changing materials. Watch out! That part you had no problems with in the past but cannot seem to solder now has changed. Where it had a tin-lead finish in the past, it likely has a pure tin finish now, affecting soldering temperature, flux activation, and other factors.

2. Flood of Data Requests. Component manufacturers are being flooded with requests for data from customers about every part on every circuit board for every different product they produce. This will become the “objective evidence” needed to prove compliance with the law.

3. Alloy Test Results Not Shared. Many solder alloys are being tested (for high yield production and field reliability), but companies are being tight lipped about the results. It’s being viewed as a competitive advantage in the market place.

(continued on page 5)
Public-Private Team-Up Enhances Training

The Montana Manufacturing Center (MMEC) teamed up with the Montana Aerospace Development Association and Neptune Aviation Services in Missoula recently to deliver a three-day AS9100 Internal Quality Auditor Training workshop to aerospace manufacturers from across Montana. Neptune Aviation performs heavy aircraft maintenance, has an engineering design and fabrication shop, and is involved with fire suppression aircraft. The company is committed to a quality management program and AS9100 certification. The course covered the AS9100 quality standard (and the broader ISO-9001:2000 standard) including what formal registrars look for during registration and surveillance audits at companies certified to the standard. It explored the relationships between the quality policy, a quality manual, procedures, and supporting records, and participants learned how to document nonconformance and corrective action.

A day of live audits at Neptune’s facility focused on practice auditing with checklists, evaluation techniques, and related documentation specific to AS9100 that were covered in the workshop. After course completion, 11 students were certified as AS9100 Internal Quality Auditors and will play a vital role in sustaining a documented quality system for their companies. MMEC engineers served as audit coaches for the course taught by certified instructor Jeff Omelchuck from IQA Associates, Portland, Oregon.

If you are interested in attending a three-day ISO9001:2000 Internal Quality Auditor Training workshop being organized for Bozeman later this year, contact MMEC at 406-994-4507.

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Get the Lead Out (continued from page 3)

4 Challenge to Process Engineers. Tin — Silver — Copper (Sn-Ag-Cu) or SAC is emerging as a replacement material. Some companies are adding a little Indium to get the melting temperatures down to closer to the temperatures used today with tin/lead systems. This is especially true for wave soldering materials. For surface mounts, it’s not clear which materials are emerging as the best replacements. Regardless, they will cost more and have a tighter “process window” driving process engineers crazy as they try to dial in the soldering recipe.

5 Lots of Rethinking. Product manufacturers are asking themselves, “Which products will we redesign, and which will be end-of-life?” It will be costly to redesign, but market share is dependent on delivering what customers are demanding. Marketing and Engineering are pondering these questions as they discuss it with top management.

6 Data Management Challenge. Many companies are modifying their MRP or ERP systems (integrated accounting and manufacturing software) to address Lead Free. And they are having to greatly expand their parts numbers — one for the lead free part, one for the regular one. Same with assemblies, on up to the top assembly.

7 Circuit board finishes are changing. The old tin lead dip is going away and choices are becoming OSP (organic solder preservative), tin dip, silver dip, nickel over gold, and little else.

8 Training Required. Workman shop training for Lead Free are being developed, but do not exist today. The new alloys will result in solder joints that look different, requiring training and really understanding the process and reliability issues. Remember, “wetting” of the solder to the metal surfaces being soldered is still the number one criteria.
Innovation Sprouts from Soils Research

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without the prototype design work, support, and advisory capacity of MMEC. The Center helped me with contract and detail management while the machine was being built. I was sure I was happy with the product — that it was meeting my needs.” Skogley envisions a day when 10 machines will be up and running, using locally and having them available when needed was a big advantage in launching the automation project, he said, commending the efforts of MMEC engineers and Tom Jungst and Matt McCune at Jungst Scientific.

UTAP Successfully Re-Competes; Adds New Service

The University Technical Assistance Program (UTAP) in the Montana State University College of Engineering is one of only six university center programs in the 10-state Denver region to successfully compete for a three-year grant from the U.S. Economic Development Administration this fiscal year. A new manufacturing systems service was added to the engineering and managerial assistance that has been offered by UTAP since 1986. Under the direction of Steve Holland at the Montana Manufacturing Center, UTAP is an excellent example of the partnership of higher education with key leaders in business, government, and civic groups to move Montana’s economy forward.

MMEC/UTAP partnered with the Montana World Trade Center in the School of Business Administration at the University of Montana to provide the specialized marketing service. Graduate students earning advanced degrees work directly with companies under supervision from professionals Mark Shyne and Fraser McLeay at the respective campus outreach centers. The MSU graduate students are Jesse Lohse, graduate research assistant; and Beth Skogley, University College of Engineering graduate research assistant.

Scam Alerts

The Department of Agriculture Rural Business Development Service (RBS) reminds farmers and ranchers to be aware of email scams that target small businesses and manufacturers. Click on the International Business Information Network (RBS) for more information, contact Megan Harrington at MWTC, 406-243-6982, or by email megan@mwtc.org.

Summer Trade Mission Planned

The Montana World Trade Center in partnership with Congresswoman Denny Rehberg’s Office is putting together a Trade Mission for this summer. The trip is tentatively set for July 2-9, and countries to be visited are Ireland, Germany, Brussels, and Spain.

The trade mission is a real opportunity for companies to meet one on one with potential trade partners, pre-screened buyers, and suppliers and to discuss concerns with U.S. Trade Representatives. Individuals may register at www.uctc.com. The venture is in partnership with the U S Commercial Office. The closing date to participate is April 29, 2005.

For more information, contact Megan Harrington at MWTC, 406-243-6082, or by email megan@mwtc.org.
Mark Your Calendar: Spring 2005 Workshops

April 19  Lean Manufacturing Workshop/Simulation, 1 day   Holiday Inn Grand MT - Billings
April 20  Lean Manufacturing Workshop/Simulation, 1 day   Holiday Inn Grand MT - Billings
May 10  Lean Manufacturing Workshop/Simulation, 1 day   West Coast Center at the Mall - Kalispell; with enough interest, course will be offered again May 11. Contact MMEC.
June 7  Environmental Management System Training, 1 day Billings Hotel/Convention Center with Kentucky Pollution Prevention Center hosted by MMEC & MT DEQ
June 9  Environmental Management System Training, 1 day Grant Creek Inn - Missoula with Kentucky Pollution Prevention Center hosted by MMEC & MT DEQ

For more information, course fees or to register on-line go to www.mtmanufacturingcenter.com or call MMEC at 406-994-3812.

2005 Other Dates To Remember

April 27  Forklift Instructor Course, 9-noon, Montana Safety Council, Billings
May 18  Government Accounting for SBIR Companies, 9 am - 4 pm - Helena

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