



OIL ANALYSIS

Past, Present & Future

In the second half of a two-part series, our expert panelists discuss the biggest challenges in condition monitoring today and technologies you just might see sometime in the next 20 years.

By Mike Johnson
Contributing Editor



PART II:

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In the May issue of TLT, STLE invited a panel of recognized industry experts to reflect on the early days of the oil industry and discuss some of the changes they have collectively experienced. This month our panelists discuss the current

state of oil analysis practice and their expectations for the next 20 years. In addition, you'll find the results of a survey of STLE members who are actively involved in oil analysis. These members express their thoughts and concerns with the current state and future needs of the oil analysis profession.

To begin, let's reintroduce our panel of experts:

'Knowledge and training are, as they've always been, the keys to good oil analysis practices and results.'

What do you see are the pressing issues with the state of instrumentation and technology for today's business environment?

Shirley Minges: I believe training and staffing are the most pressing issues. This is such a specialized field, and it requires dedication to make it work.

Jack Poley: Data evaluation is the most pressing need in the oil analysis industry. When one considers the state of things, most labs have equipment made by the same few manufacturers, and when a significant development occurs most labs upgrade like lem-



Daniel P. Anderson began his tribology career with The Foxboro Co. in 1977 working as lab manager in the ferrography product group. In 1982 he published the industry's (still) primary reference on ferrography, *The Wear Particle Atlas* (revised). In 1984 Dan became lab manager for start-up Predict Technologies. He joined Spectro in Littleton, Mass., in 1986 and now is the company's vice president of sales. Along the way Dan developed the Rotrode Filter Spectroscopy, co-founded National Tribology Services and traveled the world promoting instrumentation and turnkey PdM (predictive maintenance) oil analysis laboratories.



Ray Garvey entered the oil analysis field as an officer in the Army Corps of Engineers in 1975 and continued in the data-user role until 1980. From 1991 until now Ray has helped Emerson Process Management/Machinery Health Management (formerly known as CSI) develop a new generation of minilab instruments used for comprehensive on-site industrial oil analysis. Minilab products Ray has helped develop include the Oil View® analyzer, digital viscometer, particle counter and LIMS software, all of which are used in hundreds of power, paper, chemical and manufacturing plants worldwide.



Bill Herguth began his oil analysis career in the early 1970s operating instruments and tabulating data. In 1980 he co-founded Herguth Laboratories, Inc., in Vallejo, Calif., to address fundamental problems in the availability of high quality, sophisticated analysis in the areas of lubrication analysis, equipment condition monitoring and rapid solutions to tribological problems. Bill is CEO of Herguth Laboratories, Inc.

mings going over a cliff, because that makes sense. Get the best data possible.

Ultimately, all quality labs with active quality programs obtain good data, the occasional test instrument malfunction or lab technician error notwithstanding. Data evaluation, on the other hand, is not easily standardized and, therefore, defies complete definition, but that shouldn't stop us from making efforts to improve it.

Dan Anderson: As it pertains to the laboratory environment, the biggest needs for used oil analysis instrument technology are in the areas of sample preparation automation, reduction of cycle testing times, eliminating the need for and use of solvents, hazardous chemicals and waste streams, developing reliable and maintenance-free instruments and instrument automation in general. Data analysis management is evolving with the best advances in intelligent software for this industry yet to come.

What do you feel are the three toughest problems facing the oil analysis practitioner in serving customers?

Ray Garvey: Most instrumentation is chemistry related, but the big issues for industrial machine failure relate to system contamination and machine wear. Misplaced focus is on changing oil. Instead focus should be on preventing machine failure. Spectroscopy, FTIR and AN are common measurement methods, but these methods alone are not sufficient to find machine health problems.

Keep in mind the object is to impact maintenance. Seven mechanisms cause machines to wear out: abrasion, corrosion, fatigue, adhesion, erosion, cavitation and electrical discharge. Pay particular attention to the first four: abrasion, corrosion, fatigue and adhesion. These wear modes are by far the most frequent mechanisms and are nor-

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'In 20 years maintenance personnel will be able to accurately monitor oil quality, contamination levels and wear as if they were checking the temperature of the oil. Original Equipment Manufacturers will install sensors or hook-ups for after-market sensors on new equipment.'



Shirley Minges began her oil analysis career in the mid-1960s through Analysts, Inc. She moved to Texas to open and run their new lab in the early 1970s and eventually became lab manager. In the mid-70s she joined Lubricon as vice president of technical services and marketing to pursue the possibilities of developing a PdM concept and remained vice president until she retired in 1997. Following Lubricon, Shirley was a consultant to Polaris in the final years of her career. Shirley is now the certified librarian for her town library.



Don Pirro was introduced to oil analysis as an intern lab technician in a laboratory analyzing fuel, crude oil and lubricating oils. He started working full-time for Mobil as a field engineer in 1979, providing assistance and training for new customer oil analysis programs (Mobil EM/PA). In the mid-1990s Don assumed responsibility for Mobil's U.S. Used Oil Analysis programs. Don is EM's global technical advisor for used oil analysis and co-author of the *Lubrication Fundamentals Second Edition* textbook.



Jack Poley began his oil analysis career in the early 1960s with Analysts, Inc. He later founded and was CEO of Lubricon (acquired by Cummins Engine Co. (Fleetguard Division) and then CTC Analytical (now Staveley Services)). He also founded Condition Monitoring International (CMI) and is the current CEO. Jack also writes a bimonthly column on condition monitoring for TLT.

mally the most damaging to industrial machinery. To monitor damage from these mechanisms, you really need more than spectrometric oil analysis. Ferrography, particle counting (PC) and ferrous sensitivity should be routinely included in the test slate.

Bill Herguth: The three toughest issues facing oil analysis practitioners in servicing clients are directly related to the client's training and understanding of the process. When the proper information is available, analysts can use available computer technology to track the smallest changes in data and warn the client of impending problems. But first the machine has to be identified properly. Next, the sample has to be taken properly and, finally, the results acted upon in a timely manner. If all three of these things are not done, the value of the program suffers.

Dan Anderson: Three big problems facing the oil analyst are:

1. Getting a representative sample and information from the customer. This could include: getting a proper sample and accurate information about machine and oil operating hours since the last change, getting accurate details on operating conditions, getting feedback from the end-user regarding whether oil analysis actually found a problem or gave a false positive indication of problems.
2. Maintaining a short turnaround time that is not adversely affected by instrument availability (many labs do not have backup instruments) and uneven workloads (all the samples show up on the 1st of the month).
3. Hiring, training and retaining capable competent personnel.

Jack Poley: Knowledge and training are, as they've always been, the keys to good oil analysis practices and results. On the user side, understanding the importance of providing good information, representative samples, using the information promptly and effectively, sharing the findings (internally and back to the analyst, as appropriate), are all areas where money is left on the table if not followed reasonably rigorously.

On the data provider side, too much

emphasis is placed on the test itself rather than evaluation of the test data toward correctly assessing machine condition. As such it is unfortunate that the technology is called "oil analysis" and not "machine condition analysis."

What do you think oil analysis users and providers will see over the next 20 years? What will be the most significant changes during this period?

Shirley Minges: The study of particulates is an important key to PdM (predictive maintenance). I believe and hope that the process of particulate study, whether it is ferrography or something not yet developed, continues to evolve.

Ray Garvey: The instruments in use today are very capable, but any of them can be improved. One thing that often stands out is the need for simplicity. Designers could focus more on making instruments practical and easy-to-use, as well as making the results easier to understand.

Online technologies will be coming next, but it is probably going to take a decade or two to get there. A lot of effort has been and continues to be devoted to the development of online sensors for oil analysis. Progress has been made in online dielectric, particle counting, chip-detection, ferrous-particle-detection and viscosity measurement. This technology will be developed for engines first because this is the biggest single application and because something like a dielectric sensor alone or a dielectric sensor with viscometer will do the job quite well.

The military Joint Oil Analysis Program and Defense Advanced Research Projects Agency are encouraging adoption of online oil quality sensors. The engine oil quality sensors in use and under investigation are fighting with reliability and fouling issues and don't currently outlive machines. Those issues will be resolved progressively during the next 20 years. Eventually, installed oil quality sensors will have their place. Today, they are a novelty.

In the meantime, improvements will continue for minilabs and for traditional lab instruments. So for the next two decades, you can expect to see a lot of oil samples pulled for lab or minilab analysis.

'Online technologies will be coming next, but it is probably going to take a decade or two to get there.'

Jack Poley: Sensors will be “perfected” well before 20 years’ time and will gradually, then totally, change the nature of take-a-sample-to-a-lab (TASTAL) oil analysis. Sensor technology will gradually incorporate all of the currently essential and routine test data parameters. The laboratory’s role will be important but ancillary, augmenting the sensor’s output with more sophisticated testing for clarification and decision-making.

There will be less testing in terms of sample volume, but deeper testing will be routine in the lab, such as ferrography or scan-

ning electron microscopy or other sophisticated graphic approaches.

Bill Herguth: Within the next 20 years, I believe that inline sensors will be able to capture the basic oil sample data, and laboratories will be a secondary echelon of analysis. It’s happening today.

There are actually four levels of oil analysis: the everyday observations of the machine operator, on-site or inline test instruments, first-echelon oil analysis labs and then labs like Herguth that specialize in

‘Within the next 20 years, I believe that inline sensors will be able to capture the basic oil sample data, and laboratories will be a secondary echelon of analysis. It’s happening today.’

MEMBER SURVEY: ‘Management, customers need to focus on the

In the fall of 2006 STLE members were invited to participate in an informal oil analysis practitioner survey addressing the issues and needs within the oil analysis trade. The survey was limited to those who were either private or commercial practitioners or users of oil analysis and resulted in 218 responses. Some of the question responses were combined in the synopsis below to clarify the results.

A few background notes. 76% of the survey responders indicated that they work in a manufacturing environment. When asked about the nature of their maintenance strategy, a significant majority of oil analysis users indicated that they worked in a proactive environment, as shown in Figure 1.

Although 82% of the respondents fall into the proactive or predictive maintenance description, keep in mind that the

majority of manufacturers don’t conduct machine care and maintenance practices in a highly proactive mode. Accordingly, for the balance of the following responses, the answers are provided by those who, in general, are prone to adopt technology and press for new methods and strategies. Although oil analysis is not a new technology, many and perhaps most manufacturing plants either do not conduct oil analysis or only conduct analysis in a simplistic and cursory way, and it is unlikely that these less sophisticated users are reflected to a large degree in this survey.

What is your role in supporting maintenance practice and strategy?

Final Decision Maker	15%
Technical Manager	67%
Planning and Scheduling	12%
Machine Repair	6%

Based on survey responses from 140 STLE members.

Where is your oil analysis conducted?

On-site	20%
Off-site	46%
Combination of on- and off-site	34%

Based on survey responses from 157 STLE members.

Maintenance Strategy Type

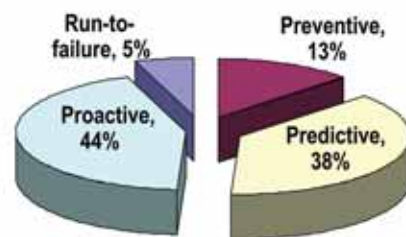


Figure 1. Respondent’s Dominant Maintenance Mode

tribology studies and failure analysis.

In 20 years maintenance personnel will be able to accurately monitor oil quality, contamination levels and wear as if they were checking the temperature of the oil. Original Equipment Manufacturers (OEMs) will install sensors or hook-ups for after-market sensors on new equipment.

Dan Anderson: As technology improves, I would expect to see the use of inline sensors on customers' equipment that provide real-time oil analysis data with self-diag-

nostic capability. This will not eliminate the need and use of laboratory analysis, but it will change its use as we know it today and put an increased importance on the quality of the analysis.

Industry as a whole can do more to fully utilize the value of the data that is present in used oil analysis databases, and I believe systems and software will be developed that will teach us more about what is happening to both oil and the equipment than we know today. <<

Mike Johnson heads his own consulting company, Advanced Machined Reliability Resources, in Franklin, Tenn. You can reach him at mjohnson@amrri.com.

big picture'

Does your site plan to increase the use of oil analysis as a key plant maintenance technology?

Yes72%
No28%

Based on survey responses from 162 STLE members.

Does your site plan to increase or decrease the use of on-site oil analysis as a key plant maintenance technology?

Increase on-site analysis78%
Decrease on-site analysis11%
No change either way11%

Based on survey responses from 96 STLE members.

What improvements would you recommend for oil analysis test equipment?

Make the equipment easier to use ...16%
Automate operation of the equipment11%
Improved software to analyze the data 9%
Improvements in particle counters equipment 9%
Improve repeatability of the instruments 7%

*(The remaining responses represented <5% each)
Based on survey responses from 56 STLE members*

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Interpretation of survey data

The survey information supports the panel's projection of an area of key concern: lack of knowledge. The survey data suggests that management is overwhelmingly satisfied (85%) with the state of oil analysis as it is today, but only a minority of respondents (37%) rated their practices as among the best in the business. Anyone who has ever tried to conduct serious analysis with inferior or poor quality data collection and/or poor quality process definition will understand the seriousness of this dichotomy. In other words, garbage in, garbage out!

From personal observation and experience, it is evident that the level of contribution expected from oil analysis is set very low, too low.

In support of a comment by Ray Garvey, the business reason to conduct oil analysis is to impact maintenance. In order for customers to make the value judgment to maintain or expand the use of oil analysis, the customers need to clearly understand how maintenance supports the broad business goals and objectives and how oil analysis can have a positive impact on maintenance.

Without an appreciation of this bigger picture, oil analysis, and the whole machine lubrication practice, will continue to be undervalued, and underfunded to a regrettably large extent. It may not be justified to expect that the service provider help the customer communicate the big picture to those inside the company, but it is in the best interest of this service industry to do so anyway.

The education of the customer base on the strategic value of long-term, proactive machine care, and on the tactical value of high quality collection, analysis, interpretation and response, are the keys to the future of this practice and profession. <<

—Mike Johnson

Which answer best describes your site's analysis practices?

Among the best in the business	37%
Not the best but very well developed	29%
Moderately well developed	29%
Poorly developed	4%
Crude	1%

Based on survey responses from 165 STLE members.

What are the three biggest problems hampering the proper use of oil analysis technology at the site where you work?

High cost issues	14%
Senior management acceptance and support	10%
Poor training on use of tools and analysis of data	10%
Inadequate staffing (skills and headcount)	8%
Poor sample collection methods	7%

(The remaining responses represented <5% each)

Based on survey responses from 130 STLE members.

Is management satisfied with the site's oil analysis service as it is currently deployed?

Yes	85%
No	15%

Based on survey responses from 158 STLE members.

What is the budgetary maximum per critical machine that your site would consider for embedded (installed and continuously operating) oil sensors?

Average	\$9,848
Median	\$1,500
Mode	\$ 500
Maximum value reported	\$100,000
Minimum value reported	\$ 50

Based on survey responses from 32 STLE members. <<

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