THE JOURNAL OF COAL QUALITY

WINTER 1981

# CQ

# we're number ONE in coal testing equipment

## CALORIMETER CONTROLLER FAMILY

MULTI SINGLE DUAL

ASTM-D 2015

## AIR DRY CABINET

ASTM-D 3302

## ASH FUSION FURNACE

ASTM-D 1857

## VOLATILE MATTER PROGRAMMER

ASTM-D 3175

## HARDGROVE GRINDABILITY TESTER

ASTM-D 409

## RAPID SULFUR ANALYZER

ASTM-D 3177

## EVERYTHING YOU NEED FROM ONE SOURCE

- SAMPLING SUPPLIES
- PREPERATION EQUIPMENT
- SCREEN & SIEVE TEST
- LABORATORY FURNITURE
- MUFFLE FURNACES
- CALORIMETERS
- ULTIMATE FURNACES
- CHEMICALS REAGENTS

TELEPHONE TOLL FREE

W.VA. 800/642-9038

OUTSIDE W.VA. 800/624-8285

# Preiser/MINECO

MINECO

94 Oliver Street
St. Albans, W.Va. 25177
Telephone: 302/727-2902

For information, circle No. 1

THE JOURNAL OF COAL QUALITY
3322 Pennsylvania Avenue
Charleston, West Virginia 25302
(304) 343-5185



CQ

WINTER 1981 NUMBER 1

# FEATURES



# COLUMNS



# DEPARTMENTS





Published quarterly by the Coal Testing Conference, a division of Standard Laboatories, 3322 Pennsylvania Avenue, Charleston, West Virginia 25302. Issues in 1982 are planned for March, June, September and December.

Subscriptions are sent free of charge to executives, managers, engineers, consultants, researchers and other operating and supervisory personnel in the coal quality industry. Address subscription requests to *THE JOURNAL OF COAL QUALITY*, 3322 Pennsylvania Avenue, Charleston, WV 25302. On business letterhead, state your complete mailing address; title, job or position; responsibilities; name of firm and exact nature of business. The publisher reserves the right to accept or reject any subscription. Paid subscriptions are $14 (U.S.) per year; $4 for single copies. Foreign prices are $20 (U.S.) per year; $8 per single copy.

# CALENDAR

## JANUARY

Jan. 14-17. *West Virginia Surface Mining Association* semi-annual meeting, Boca Raton Hotel, Boca Raton, FL.

Jan. 27-28, *Surface Mining Symposium*, Charleston House Holiday Inn. Sponsored by WV Surface Mining Association. Contact: Ben Greene, (304) 346-5318.

## FEBRUARY

Feb. 16-17, *2nd Annual Coal Testing Conference*, Lexington Center and Hyatt Regency, Lexington, KY. Sponsored by Standard Laboratories. Contact: Karen Gallagher (304) 343-5173. More on Conference on pages 16-19.

Feb. 16-18, *9th Energy Technology Conference and Exposition*, Sheraton Washington Hotel, Washington, D.C. Contact: Martin Heavenner, Government Institutes Inc. (301) 251-9250.

## MARCH

March 8-13, *Pittsburgh Conference and Exposition* on Analytical Chemistry and Applied Spectroscopy, Atlantic City Convention Hall, Atlantic City, NJ. Write: Pittsburgh Conference, Department J-208, 437 Donald Road, Pittsburgh, PA.

March 20, *Virginia Surface Mining and Reclamation Association annual meeting*, Ramada Inn, Kingsport, TN. Contact: Sandy Dysart (703) 523-4200.

March 25-27, *Indiana Coal Mining Institute's annual meeting*, Executive Inn, Owensboro, KY. Contact: (812) 232-5011.

March 28-April 2, *American Chemical Society annual meeting*, Las Vegas. Contact: Al Winstead (202) 972-4600.

Scheduled during March, The Center for Professional Advancement *short courses* concerning Coal Cleaning Technology, Coal Mining Technology, Current Coal Conversion Process Technology. Call: (201) 249-1400.

## APRIL

April 27-May 6, *China/Build*, Tianjin Exhibition Center, People's Republic of China, First international construction and mining equipment exhibition in China.

## MAY

May 9-12, *American Mining Congress Coal Convention*,St. Louis, MO. Contact: AMC Convention/Exposition Services (202) 861-2800.

## JUNE

June 6-8, *Symposium on Instrumentation and Controls* for Fossil energy Processes, and Exposition, Adam's Mark Hotel, Houston, TX. Call: Trade Associates (301) 656-5794.

June, annual meeting of *Ohio Mining & Reclamation Association*, Columbus, OH. Contact: Neal S. Tostenson (614) 228-6336.

The Journal of Coal Quality welcomes announcements of industry events. Send announcements to: The Journal of Coal Quality, 3322 Pennsylvania Ave., Charleston, WV 25302. The deadline for the March issue is January 22, for events occurring in March, April and June or later.

# EDITORIAL

# A FORUM FOR THE INDUSTRY

The coal quality industry is uniquely poised to take advantage of the tremendous boom in coal production and use in the years ahead. Nearly 850 million tons of coal were produced in the United States in 1981. Almost 95 million tons were exported. These numbers are expected to double in 10 years.

To keep those involved in coal quality abreast of the latest developments and innovations in their industry, we present this inaugural issue of The Journal of Coal Quality.

We intend for The Journal to be the forum not only for those intimately involved in producing analytical data, but also for those involved in production and consumption of the world's most reliable energy source. As the nation and the world become more reliant on coal, the role of our industry will become more critical to producers and consumers alike.

Accurate coal quality data for the more efficient use of coal will have its benefits all around. It will:

- Expand knowledge of coal reserves and enhance exploration planning.
- Contribute to improved preparation plant design.
- Provide the industry with the knowledge to better control production, transportation and use of coal.

### CQ AS A FORUM

To promote these purposes, The Journal will present information on all facets of the coal quality industry from production through consumption. It will also show-case new ideas for testing methodology and new laboratory equipment. Personnel news and industry events of interest will be highlighted.

The Journal will be a place where pertinent questions will be asked and answered.

"What types of testing are being done? Who's who in the industry? Where is research taking us? How does ASTM work? What kinds of coal contracts are being written? Who are the laboratory accreditation people? Are new methods being used in coal testing? How are manufacturers refining their instrumentation to keep up with new technologies?"

### PROFESSIONAL VIEWPOINTS

A group of Contributing Editors (listed on the title page) will provide the basis for an overview of coal quality each quarter. In each issue, different aspects of the industry will be addressed to keep you informed of both general and specific trends and occurrencs in coal quality determinations, data generation and utilization. Through their contributions, The Journal will help provide a sense of community, comraderie, occupational alliance and fraternal professionalism to all people whose jobs are related to the quality control of coal production, utilization and research.

### THE CQ COMMITMENT

We pledge to provide you with information and ideas regarding the state of the coal quality industry in a continuing effort for the effective use of coal throughout the world.

As a forum — the only forum uniquely focused on our industry — we invite your comments, your opinions, and your contributions.

Together, we can meet the challenge in the years awaiting us.

Karen Gallagher

Karen Gallagher
Editor

# Coal analysis in minutes– "Ultimate" and "Proximate."

*Model 240C Elemental Analyzer with Elemental Analysis Data Station, TGS-2 Thermogravimetric Analyzer, and System 4 Microcomputer Controller.*

Perkin-Elmer's instruments for coal analysis can save hours of tedious procedures while achieving the precision you need.

The Model 240C Elemental Analyzer, shown above left with the Elemental Analysis Data Station, determines the percentage C, H, N and ash in less than 15 minutes per sample. Special kits are available for S and O. A "Carbonate Kit" permits the differentiation of combustible carbon from carbon present in carbonate form.

The Elemental Analysis Data Station, center, enhances the convenience and productivity of the Model 240C. It simplifies calibration and calculates percentage C, H, N, O, S and ash. It reports C/H and C/N ratios. It displays results on the interactive CRT screen and in hard copy on a printer. All data, operation parameters, sample and operator identification, plus time and date, can be stored on microfloppy disks for safety and easy recall.

The Model TGS-2/System 4 Microcomputer Controller, on the right, measures percentage moisture, volatiles, fixed carbon and ash. It determines all values directly, in contrast to the classical method, which determines fixed carbon by difference. This complete "Proximate" analysis is accomplished in less than 20 minutes per sample, without operator interaction between the beginning of the analysis and display of results. All operating parameters may be stored in the System 4 memory and recalled with a single keystroke. Operator convenience and measurement precision are assured.

The Models 240C and TGS-2 are helping to increase production in coal conversion and oil shale synfuel processes. The Model 240C delivers fast and accurate C, H, N and ash values for feed coal, process streams and final products. It measures C, H, N and mineral content in oil shale and the nitrogen levels in "spent shale" and shale oil. The Model TGS-2 is used for "Proximate" analysis of feed coal and for monitoring solids content in process streams. It can determine unreacted carbon and be used to study the kerogen cracking process in raw shale.

For details on the performance of these units and for applications notes, contact your Perkin-Elmer representative or one of the offices below:

Perkin-Elmer Corp., Analytical Instruments, Main Ave. (MS-12), Norwalk, CT 06856 U.S.A. Tel. (203) 762-1000

Bodenseewerk Perkin-Elmer & Co., GmbH, Postfach 1120, 7770 Ueberlingen, Federal Republic of Germany. Tel. (07551) 811

Perkin-Elmer Ltd., Post Office Lane, Beaconsfield, Bucks HP9 1QA, England. Tel. Beaconsfield (049 46) 6161

**For information, circle No. 2**

PERKIN-ELMER

Responsive Technology

# DYNAMIC GROWTH AHEAD

## Coal research is the key that will enable coal to become the dominant fuel of the future.

GEORGE W. HEUNISCH
CONOCO COAL DEVELOPMENT CO.

Coal research is the catalyst that will put coal back in its once dominant position as a fuel. You have heard many times in recent years that coal is the fuel of the future, but with so little apparent progress you probably consider the statement rhetorical by now. Research, however, is the key.

Research applied to mining and burning coal more efficiently and safely, as well as to producing alternate fuels that remove undesirable environmental pollutants and replace the hydrocarbon fuels that are now in diminishing supply, will make coal that dominant fuel of the future. Those of us in coal research today should be prepared to accept greater responsibility tomorrow as coal begins a period of dynamic growth.

The analytical chemist is in the forefront of this growth, too, because we will be called upon to:

- Push the development of faster and more practical procedures to analyze and test coal and coal related products.
- Analyze the solid, liquid and gaseous products of improved combustion systems.
- Characterize the products and by-products of synfuel production processes.
- Answer the environmental questions generated by the increased use of coal.

The environmental aspects alone of using coal provide the analytical chemist with a great new challenge, which he is best suited to accept. After all, environmental analyses are simply part of analytical chemistry. However, we must not stop with improving our laboratory methodology, but should supervise sampling, be aware of government regulations, and become intimately involved with the environmental problems of our industry. To do this we must become familiar with mine and plant operations and add the reading of process flow sheets to our list of skills.

### Editorial Intention

In this editorial column I will address two aspects: what is being done in coal related analytical research today, and what analytical needs are going unfulfilled that will require future research. Being aware of present research will show us where to expect changes and will help us to see future needs. It will also give you an opportunity to express your thoughts, and I look forward to your comments. I hope to stimulate your thinking and maybe your energies by suggesting areas in which analytical research should be directed; areas in which the analytical chemist can contribute to the growing needs of the coal industry. Overall then, we will take a look at where analytical coal research is headed now, what is seen as future research projects, and, perhaps, a little about who is doing the research.

### Research Today

The major emphasis today is on the determination of trace elements. Both industry and government laboratories have projects directed toward some aspect of the determination of trace elements in coal. The research is directed at both sample preparation and the analysis of the prepared sample material.

To avoid extensive sample preparations such as low temperature ash (LTA) and special acid digestions or innovative salt fusions that often require hours of analysis time, the analysis of raw coal is being investigated. Instrumental techniques are of primary interest because they can now be programmed to analyze samples rapidly and automatically with a minimum of operator manipulation. Instruments have been developed that can measure the concentrations of 40 or more metals simultaneously in a matter of minutes.

Atomic absorption spectrophotometry is receiving the greatest amount of attention at this time, but X-ray spectrometry and spark source mass spectrometry are both under investigation. Atomic emission spectrometry, an old technique with a new source, is gaining a stronger foothold in coal analysis. The plasma source and equipment miniaturization are contributing to reviving this most appropriate technique.

Thermal methods are being studied to reproduce the proximate test and to develop new terms for characterizing coal. Instrument manufacturers are especially interested in developing these methods because TGA and DTA instrumentation is already available and may only need minor modifications to fill a need in the coal industry.

Instrument manufacturers are concentrating major efforts in the development of instruments for coal and coke analysis. A new carbon, hydrogen, nitrogen (CHN) analyzer should be available next year at about the same time a new proximate analyzer is presented. Recently, new sulfur determinators and a high sample volume calorimeter for measuring the Btu content of coal and coal products were introduced. ASTM should be encouraged to evaluate these new innovations as they are introduced and sanction them if appropriate.

### Research Tomorrow

I have only discussed very briefly the major topics of interest to the coal industry that are presently being investigated. This will give you an introduction that I hope to expand upon in future articles. In the same way I would like to introduce what I see as needs that will require our research efforts just as soon as resources will permit.

The analytical determination that I see as warranting our immediate attention is the determination of carbon, hydrogen, and nitrogen (CHN) in coal, coke, and coal-derived products. The present ASTM methods are adequate if only accurancy and precision are considered; however, as the utilization of coal increases the ultimate analysis will be requested more frequently, and a much faster CHN analysis will be required. Coal-derived products should include both solids and liquids and be applicable to not only coal and coke but also synfuel products and environmental samples. New instrumentation to be introduced next year may successfully answer this need.

Environmental sampling and synfuels offer the analytical chemist two great opportunities to do meaningful and innovative research. A few subjects of concern include:

- Sampling procedures, especially for heterogeneous mixtures.
- Sample preparation techniques, especially in the area of trace metals.

**Continued on next page**

## PRODUCT INFORMATION

Use this card to request more information about any of the products advertised in this issue. Circle the number that appears on the ad, product description or literature mentioned and drop the card in the mail. Expires April 1.

Name _____ Title _____

Company Name _____

Address _____

City _____ State _____ Zip _____

INFORMATION SERVICES WINTER, 1981

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |

Please check one only:

- ☐ Laboratory
- ☐ Utility
- ☐ Manufacturer
- ☐ Consulting/Engineering
- ☐ Coal producer
- ☐ Coal user
- ☐ Coal export/import
- ☐ Coal sales
- ☐ Academic/research
- ☐ Government

_____ Other.

Please ☐ add ☐ leave my name on mailing list.

## INFORMATION

**Advertisers** Circle Number



**Reports**



**Product Gazette** (Pages 28, 30 & 31)



**Others**



## COMMENTS

**WHAT did you think about this issue of THE JOURNAL OF COAL QUALITY?**

1. Please circle the number that best describes each article.

| | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| Research | 1 | 2 | 3 | 4 | 5 |
| International | 1 | 2 | 3 | 4 | 5 |
| Low ranks coals | 1 | 2 | 3 | 4 | 5 |
| Standards | 1 | 2 | 3 | 4 | 5 |
| Interlaboratory quality control | 1 | 2 | 3 | 4 | 5 |
| Mass spectrography | 1 | 2 | 3 | 4 | 5 |
| Experimental coke oven | 1 | 2 | 3 | 4 | 5 |
| Trade notes | 1 | 2 | 3 | 4 | 5 |
| About people | 1 | 2 | 3 | 4 | 5 |
| Product Gazette | 1 | 2 | 3 | 4 | 5 |
| Editorial | 1 | 2 | 3 | 4 | 5 |

Did the contents of this issue meet your expectations?
Totally Close enough Not enough Not at all

3. How useful will the product information be to you?
Very useful Useful Not useful

YOUR NAME (please print) _____ TITLE _____

 COMPANY _____

**BUSINESS REPLY MAIL**
FIRST CLASS PERMIT NO. 1874 CHARLESTON, WV

Postage will be paid by addressee

CQ

THE JOURNAL OF COAL QUALITY
3322 Pennsylvania Avenue
Charleston, WV 25302

ATTN: Karen Gallagher

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

**BUSINESS REPLY MAIL**
FIRST CLASS PERMIT NO. 1874 CHARLESTON, WV

Postage will be paid by addressee

CQ

THE JOURNAL OF COAL QUALITY
3322 Pennsylvania Avenue
Charleston, WV 25302

ATTN: Karen Gallagher

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

# STANDARD DEVELOPMENT PROMOTED BY ISO

## Specialized agency made up of national standards organizations of 87 countries.

W. J. MONTGOMERY
CONSULTANT

From my many contacts with people in the North American coal industry in recent years, I am left with the impression that there is a lack of understanding of the purpose or the mechanics of international standards relating to the analysis of coal and coke. To clarify some misconceptions I will describe the organization briefly as it pertains to solid mineral fuels.

The International Organization for Standardization (ISO) is a specialized agency made up of national standards organizations of 87 countries (as of Jan. 1, 1981). The primary purpose of ISO is to promote the development of standards to assist international trade in goods and services. ISO covers standardization in all fields except electrical and electronic engineering standards, which are covered by a sister organization, the International Electrotechnical Commission (IEC).

The work of ISO is carried out through the cooperation of almost 2000 technical organizations involving more than 100,000 experts from the member countries. At the beginning of 1981, 4,269 ISO standards had been published.

Quoting from the *ISO MEMENTO* 1981, "International standardization started in the electrotechnical field 75 years ago. While some attempts were made in the thirties to develop international standards in other technical fields it was not until ISO was created that an international standards organization devoted to standardization as a whole came into existence."

Following a meeting in London in 1946, delegates from 25 countries decided to create a new international organization "the object of which would be to facilitate the international coordination and unification of industrial standards". The new organization, ISO, began to function officially on 23, February, 1947.

Membership in ISO, unlike ASTM, ASME or ACS for example, is not on an individual basis. The single national standards body considered to be the most representative is chosen by each country as its member body; for example, ANSI in the U.S.A., SCC in Canada, BSI in the United Kingdom, and

**Please turn to page 6**

# RESEARCH

**Continued from page 4**

- Methodology that will give timely and accurate analyses at very low concentration levels.

The simple coal washability test, often referred to as the float/sink analysis, also needs attention to define the practical limits for the use of both organic solvents and aqueous solvents. New, completely nonhazardous organic solvents would be highly beneficial since health protecting measures and employee insecurities could be eliminated.

Research keeps the industry productive for the future, and as analytical chemists and analysts we can contribute significantly. Let us continue to communicate and share our experiences, so that we can share in the dynamic growth of our industry.

**George W. Heunisch**

*GEORGE W. HEUNISCH is the Research Group Leader-Analytical for the CONOCO Coal Development Co., where he directs the analytical laboratory and develops and implements environmental programs for pilot plants. He has worked 15 years for the wholly-owned subsidiary of CONOCO Inc. He received his master's degree in analytical chemistry from the University of North Carolina at Chapel Hill and received a bachelor's degree in chemistry from the Citadel in Charleston, S.C.*

# ASTM: the private sector standards system

## Volunteers, not the government, write standards in the United States.

GLADYS BERCHTOLD

CHAIRMAN OF THE BOARD
STANDARD LABORATORIES

Standardization is a very important word in the coal industry. In fact, it is a very important word in most industries. The best definition for the word standard is "an agreed upon method of doing something." In the world of commerce it is essential that the buyer and seller agree upon a specific method of tests to be used, particularly when price is contingent upon the analysis of a product.

The United States has a voluntary, private sector standards system, wherein standards are written by about 300,000 individuals in thousands of committees of approximately 400 separate organizations. In most other countries, the only standards that have broad, national acceptance are those approved by national standards bodies. This is not the case in the United States, which is the only country in the world where the national standards body is neither associated with nor supported by the federal government.

Of 400 separate standard writing bodies, the one that is most important to the coal industry is ASTM. ASTM is the largest voluntary standards writing body in the world. It is subdivided into 137 technical committees. The individuals who are members of these committees voluntarily contribute their time and pay their own expenses at committee meetings, usually two annually. They lend their expertise to develop the standards used in their particular industry. ASTM standards are written by volunteers and are used voluntarily. They become mandatory only when they are written into a business contract or when required by law.

ASTM Committee D-5 on Coal and Coke is a classified committee, which means that the voting interests in the committee are identified as to whether they are producer, user, or general interest. In a classified committee, the number of producer voting interests cannot exceed the total number of user and general voting interests. The general interest category includes professionals, laboratories, academia and government, although government may be classified as user or general interest depending upon the nature of the committee.

D-5 as a classified committee is well within the balance required with about 34 percent producer, 19 percent user and 47 percent general interest classification.

The underlying principle in ASTM classified committees is that no interest, however preponderant, can dominate standards action at the expense of any other interest. ASTM committees operate under the principle of consensus. When a task group of one of the subcommittees prepares a draft document, it is reviewed by the parent subcommittee through a balloting procedure.

If the draft is approved by two-thirds of returned ballots, it proceeds to main committee ballot. Here 90 percent of those returned ballots must approve. It then goes to a society ballot on which each ASTM member is entitled to vote. All negative ballots must be acknowledged within 30 days of receipt and the notice must state when and where the vote will be considered. If a member feels he is not qualified to vote on a particular matter, he may abstain, but a negative vote — to be valid — must be accompanied by an explanation. A negative without explanation is counted as an abstention. All negative votes are acted upon either at a meeting or by letter ballot of the subcommittee. Action to consider a negative vote as non-persuasive requires an affirmative vote of at least two-thirds of the combined affirmative and negative votes cast on the action. If the negative vote is considered to have merit, the sub-committee makes the agreed upon changes and the process is repeated.

Various other mechanisms available under the by-laws insure that the negative voter has ample opportunity to express his views to the committee or subcommittee. Human nature being what it is, it would be impossible to get unanimity on each ballot. ASTM considers consensus to be the most nearly unanimous agreement that can be achieved within practical limits of time and definiteness.

Once a standard has received approval on society ballot, it is submitted to the committee on standards (COS) and if approved by COS as complying with procedural requirements, the document is published as an ASTM standard.

*GLADYS B. BERCHTOLD is chairman of the board of Standard Laboratories, which she founded in 1949. She is active in ASTM serving as treasurer of the Board of Directors. She is a cum laude graduate of Concord College.*

# TRADE NOTES

## D-5 Officers Elected

PHILADELPHIA, Pennsylvania — Officers have been elected to the American Society for Testing and Materials D-5 Committee on Coal and Coke.

Forrest Walker of Geochemical Testing Inc., was re-elected chairman. William Banks of ATIC Coal Service Ltd. of Newport News is first vice chairman. Dr. Neil F. Shimp of the Illinois State Geological Survey is the secretary. The membership secretary is James Addington of Peabody Coal Co.

The officers will serve two-year terms, from January 1, 1982 until Dec. 31, 1983.

## CT&E Opens Kentucky Lab

JEFF, Kentucky — Commercial Testing and Engineering Co. has opened a new, full-service coal testing laboratory, situated at the junction of highways 15 and 7 in Jeff, Kentucky. President Kenneth E. Lindsay made the announcement.

The new lab will serve the Hazard and Whitesburg region in Southern Kentucky, as well as Southwestern Virginia. Rodney Campbell is the manager. CT&E operates more than 40 branch laboratories.

For information, circle No. 4

## J. T. Boyd Opens N.Y. Office

NEW YORK, New York — J.T. Boyd Co. has opened an office in New York for the convenience of its international clients, financial institutions and area-based corporations. The office is situated in the Chanin Building, Grand Central Station.

## 'Hot Coal' Standard Being Considered

FORT WALTON BEACH, Florida — The American Society for Testing and Materials D-5 Coal and Coke Committee discussed the problem of the spontaneous heating of coal export shipments at a fall meeting.

The ASTM Committee is studying the problem with the aim of developing long and short range plans of action. A temperature measurement standardization is being considered.

The National Coal Association is also reviewing the problem dealing with temperature measurement, cargo handling, heat prevention and methods of cooling "hot coal." NCA also has stated an interest in a standard method of temperature measurement.

Many factors, such as particle size, pyrite sulfur content, etc. in addition to reactivity, act together to determine the spontaneous heating potential of coal. The NCA group plans to put together a list of factors that contribute to spontaneous heating and make it available to the industry.

## Lab Opens at Norfolk

NORFOLK, Virginia — Standard Laboratories announces the opening of a new coal testing laboratory in Norfolk, Va. to service the Hampton Roads area coal export market. Merrill Bergstedt will be the manager.

For information, circle No. 31

# Ah, the security of having the right answers...

Remember the feeling. No second guessing or anxious uncertainty. No fear about the consequences of having wrong answers. Just the confidence of knowing you are right.

In coal testing, quality information is everything. There are no second chances, no reprieves. If you don't have the right answers, you can have serious problems.

This is why Standard Laboratories operates by precisely defined procedures and uses the most advanced equipment. Our analytical services in the fields of sampling, preparation, and testing of coal and coal derived substances require a high level of competency in our technicians. Our dedicated staff consists of nearly 250 employees in 12 laboratories operating in seven states.

Standard also owns two subsidiaries. Standard Instrumentation, Inc. develops, manufactures, and markets specialty coal testing apparatus and Precision Samplers, Inc. produces and sells self-contained sampling systems for stationary coals.

In a business where a mistake could really cost, the right answer is the only answer.

Standard helps you to stay at the top of the class.

**Where quality is standard.**

**STANDARD LABORATORIES, INC.**

3322 Pennsylvania Ave., Charleston, W. Va. 25302 304-343-5173

**For information, circle No. 8**


scales
DO
HOMEWOR

The rebirth of coal utilization as an increased energy source and as a feedstock for other technologies has increased the necessity for increased quality control at laboratories engaged in coal and coal-related testing.

# INTERLABORATORY QUALITY CONTROL

R. D. GRAHAM

MANAGER, AMAX COAL COMPANY
MIDWEST AREA LABORATORY

The goal of every analytical laboratory and of every analyst is to produce highly precise and accurate analyses in a timely and cost effective manner. Quality assurance must be an intregal part of any laboratory's standard operating procedures to insure the precision and accuracy of analyses.

Interlaboratory quality assurance is an important subject. This report will address in a general overview the necessity and results of an active quality assurance program in the hope it can assist in developing, improving or expanding quality control/quality assurance programs.

The terms quality assurance and quality control will be used almost interchangeably in this text. But there are differences in the terms which must be recognized.

Thomas R. Hauser and Dwight G. Ballinger define **quality control** in "Environmental Science & Technology" as those internal operations performed during the measurement process to document the quality of data. **Quality assurance** is the performance of those components on a more occasional basis, usually by someone outside of normal operations, to gain an independent assessment of monitoring operations and data assessment.

Both definitions are good, but it is difficult to categorize some quality elements by either definition. For that reason, neither term will be mutually exclusive as it appears in this text.

## Misconceptions About Quality Assurance Programs

Misconceptions about quality assurance programs abound through ignorance, misunderstanding or design, and especially among those uninitiated in the fundamental statistical concepts of sampling and sampling analysis.

Three misconceptions are:

- The primary aim of the quality control program is to chastise individuals or groups whenever a process or a product fails to meet specification.
- Individuals who are found out by these quality control groups are subject to ridicule, scorn and embarrassment.
- A quality control program is too time consuming, utilizing too much of the laboratory's overall resources and detracting from the productive analysis of actual test samples.

In actuality, the primary purpose of the quality control group is to keep individuals or groups out of trouble through its inspection and auditing roles. This process involves the monitoring of systems and procedures, evaluating whether or not written procedures are being followed and establishing the validity of generated data and areas of concern. Deviations are reported and documented leading to improvements in methods and technique with a concurrent improvement in accuracy and precision.

A good quality control/quality assurance program will minimize the occurrences that may lead to an embarrassing situation and will keep the causes of embarrassment to a least critical level. Problems will be found and corrected before they get completely out of control and jeopardize the reputation or livelihood of a product, institution or individual.

It can be more expensive in the long run not to have a good quality control program than it costs to have one, even if the program requires 20 to 30 percent of available time and resources. Whenever data is generated without sufficient control, its quality may become suspect. When this happens the old data is typically discarded, and new samples are obtained and analyzed. The initial effort is lost and additional effort must be expended to repeat the process.

Additionally, there can be indirect costs associated with an inadequate quality control program, such as the loss of respect, reputation or trust in the analyst or lab; the loss of self confidence on the part of individual analysts; heightened apprehension and tension from being under increased pressure to produce more accurate analyses; unnecessary rechecks; and increased maintenance costs from repairs which could have been detected early through an adequate quality control program.

## Developing a Quality Assurance Program

The development and institution of a productive quality assurance program is no small project. It is not something which can develop overnight but requires the dedication, involvement and commitment of all individuals. This commitment must start with upper management and be passed down to the analysts actually performing the bench work.

*RONALD D. GRAHAM is the manager of the Midwest Area Laboratory for AMAX Coal Company's Evansville facility. He was formerly a laboratory technician for the Kingwood (West Virginia) Mining Co., a chemist with the former Energy Research and Development administration at Morgantown, WV and a teacher. He has received degrees in chemistry from West Virginia University and Youngstown State University. The West Virginia native is affiliated with the American Society for Testing and Materials (D-5) and the American Chemical Society.*

For a laboratory which has no formal quality assurance program, its development can seem to be an insurmountable project. For a laboratory with an existing program, it is a continuous, ongoing battle to maintain and update the program.

## Individual Components

*Standardized Procedures:* Standardized methods are the first elements of a good quality assurance program. Some tests are so empirical in nature that without exact duplication of equipment, operating conditions and measurement technique there could be no agreement between even the most conscientious individuals (e.g., volatile matter or moisture analysis of low rank coals). While objectivity may require that in compliance testing the participatory factions obtain their respective analyses independently, common sense requires they first agree on common or standard procedures each party will use to independently procure, prepare and analyze the material in question.

Several types of protocols must be established:

- Sampling procedures.
- Sample preparation procedures.
- Analytical procedures.

Sampling procedures: Improper sampling or sample preparation has a far greater potential of introducing bias into analytical results than does the analysis itself. Considering the technique necessary to properly take a representative sample from 10,000 tons of a material as heterogeneous as coal, dividing and reducing this representative sample into 50-100 grams of laboratory sample suggests the validity of this statement.

Sample preparation: Reproducible methods of receiving samples, logging and storing them must also be included as a part of the preparation procedures. These methods should allow for tracing the history and custody of the sample for later reference (chain of custody). The method of logging and storing samples as they are received can also be applicable to logging and storing reserve splits and analytical samples after analysis.

Analytical procedures: Accurate chemical analyses cannot be based solely upon the response of a device — be it an instrument, human eye or "black box". One needs to consider the change of the response of the test instrument to the characteristic properties of the sought-for-component as it changes with concentration, time, temperature, humidity and other "environmental factors." The effect of other properties of the component being sought and the properties of other components within the matrix of the sample being tested must also be considered.

Standard analytical procedures for calibration and standardization of the instrument must be established as follows:

**1.** Equipment set-up procedures: At least two copies of the instruction manual, including set-up instructions should be received, one for general use and the other for filing. Copies of repair manuals, wiring diagrams, parts lists, etc., should be obtained. Set-up procedures should be based upon the manufacturer's procedures.

> "It can be more expensive in the long run not to have a good quality control program . . ."

**2.** Calibration procedures: All essential calibration materials (weights, thermocouples, galvanometers, etc.) should be traceable to the National Bureau of Standards. Written procedures for periodic reverifications of the accuracy of the calibration materials should be established. The individuals doing the reverification of the calibration materials should use NBS calibrating materials and furnish certificates of recalibration. A written history of when calibration materials were purchased, recalibrated, etc., and by whom should be maintained.

**3.** Standardization procedures: The purity of standards, solvents and reagents should be checked. They must be checked for strength, for deterioration with time, temperature, humidity and other environmental factors, for contamination and for expiration dates. The purchasing procedures should be standardized. Everyone in the laboratory system should use the same materials from the same vendors. Only standard reference materials, traceable to NBS Standards, should be used. Prepare reagents carefully. Procedures for preparation, use, storage and restandardization of reagents should be documented.

Only high quality glassware and equipment should be used during preparation, standardization and use of standards. The container should be labeled as to when the standard was prepared and standardized and by whom. The standard should be discarded before the container is completely empty to avoid possible contamination. Secondary or tertiary standards can be used for restandardization. They are less expensive and plentiful. These standards may consist of a previously analyzed round robin sample, a purchased secondary standard or a previously analyzed test sample in which the components of interest are known with a high degree of accuracy.

**4.** Quality assurance check procedures: Quality assurance procedures should include the analysis of uniformly distributed check samples. Some should be known by the analyst in order to provide him immediate feedback. Others should be known only at an appropriate time after the analyses have been submitted for review in order to obtain an unbiased measure of the performance of the analyst and of the test.

Blind duplicates should be analyzed. Two types are recommended: one unknown to the analysts and one unknown to the laboratory. These blind duplicates should be known after completion of the analysis and the submittal of the analytical report.

Spiked samples should be included. Blanks and spiked blanks should be incorporated into the program, too. Round robin or split samples should be analyzed regularly. Synthetic, "junk" samples or tertiary standards should be a part of the daily routine. Certified standards should be run regularly. Proficiency samples are also an important requirement for the program.

**5.** Maintenance procedures: Procedures must be established prescribing certain maintenance functions. Periodic preventative maintenance or equipment checkouts should include lubricating and changing filters; cleaning, dusting and washing; replacing worn parts; and recalibration.

Equipment should be monitored routinely for wear, e.g., of hammermills by screening the product; for loose bolts and guards; and for unusual noises, speed, appearance or condition. The equipment should be repaired as needed and good maintenance records must be kept.

A standardized equipment list or inventory should be maintained because it allows for easier troubleshooting, repairs and replacement of equipment. The central lab can act as a supply warehouse for spare parts, accessories, materials and supplies. Bias caused by different types of equipment can be minimized.

The following list should be on file for all laboratory equipment:

The names of the manufacturer; equipment model and serial number; properties subject to standardization; range of operation and the range of calibration; a reference to a recognized calibration procedure; the frequency of

**Continued on page 14**

Continued from page 13

calibration; allowable tolerences or maximum sensitivity; sources of verification; a chronological history of repairs, modifications or substitutions; and the traceability of reference standards or accepted values or natural physical constants.

Approved measurement procedures: Acceptable measurement procedures must incorporate the basic concepts of calibration, standardization and maintenance.

Most standard procedures have their basis in standard methods from EPA, NIOSH, other regulatory and governmental authorities, or by ASTM, ANSI, API or other industrial consensus groups. If the laboratory's standard operating practice is a variant of one of these standard procedures, the standard procedure should be referenced and the deviations noted. Statistical data should be noted stating the expected repeatability and reproducibility of the test data. Proper methodology for weighing, measuring and cleaning is essential. Cautions and safety considerations should be listed, too.

Procedures for performing calculations should be listed. The data review procedure should be discussed and reporting protocol should be noted.

## Sample Exchange Program

The laboratory should engage in more than one proficiency testing program, especially in those programs sponsored by federal agencies such as EPA, NIOSH, Department of Commerce, etc. These programs provide an economic source of high quality "standards" and under some circumstances participation can be paramount to "certification".

A program set up for interlaboratory comparison produces a special type of proficiency sample. The split sample or round robin samples can be done routinely to monitor results produced by different labs or it can be done whenever two or more labs produce disparate results.

Whenever undertaken for the latter reason the exchange should be preceded by a visit to each lab by members of the other lab's staff in order to eliminate any obviously nonstandard practices or to select potential sources of error which will be monitored by the exchange. Whether the bias is caused by something within the lab or whether the bias has been introduced in the sampling or preparation steps of reduction and division could be determined by such a visit. This could be less expensive than conducting a sample exchange that otherwise may not locate the source of the disparity.

If the source of the bias is not located by the exchange visits the length of the sample exchange, the type of sample exchanged (its state of preparation, top size, etc.) and analyses determined will depend on the nature of the suspected problem.

The sample exchange program must be well planned in order to guarantee that once the exchange is complete, meaningful results will be obtained which will either locate and identify the source of the bias or will give direction about what to do next.

If the exchange is a periodic interlaboratory comparison mutually agreed upon in advance by the parties, it is important to establish what methods will be used by each participant. Different methods can yield slightly different results. A slightly positive or slightly negative bias by one method as compared to another is not to be unexpected. The report form should contain space to state which method is used or how the method used varies from the standard procedure.

Some round robin programs are available commercially and are especially useful to laboratories who have inadequate time or expertise to formulate their own programs or to those who want an independent third-party basis for their quality control programs.

*Documentation:* The keystone of any quality assurance program is documentation. Each component of the program must be adequately documented in order to provide the historical perspective which is necessary in detecting trends which can be helpful in taking corrective actions. Formal standard operating procedures must be written and all procedures should be dated to include issue and review date. All calibration and restandardization actions should be dated and noted. Results obtained from quality assurance samples must be recorded.

Repairs and other maintenance related events, temperature, humidity and other environmental factors should be noted. A chain of custody should be maintained. All lab bench sheets should be dated and initialed; all reports should be dated and signed. If there is any question whether or not a number or event is important, it should be recorded.

An especially valuable method of documenting data — where the data trend is as important as the data — is the Control Chart. ASTM Manual STP 15D is a valuable tool for suggesting various types of such control charts.

*Data Management:* Data management consists of handling the data which is generated. It should be a format that allows it to be readily accessible for use. Manual methods such as the control charts, bound laboratory notebooks, file cabinets and microfilm are popular. A decision should be made to determine how long each type of document will be retained on file.

More and more, however, computers are taking over the management of data files. The hook-up of instrumentation with the appropriate interface to computers allows for direct acquisition of the raw data into the computer memory. This process eliminates much of the sources of errors which could occur in data handling, such as transcription errors, calculation errors and typographical errors. The physical requirements for data file storage is reduced, data is easily accessible and data can be produced in almost any format desired, either as raw or calculated data.

*Auditing:* Auditing involves ascertaining that all data generated and all reports are complete, clear and concise. All quality assurance procedures are reviewed to see that they are followed exactly and completely. On-site surveys of satellite labs or independent per-

formance audits of a laboratory system are a very important part of a quality assurance program. At times an "outsider" can detect deviations from good laboratory practice that have been overlooked by the employees of the site.

For all procedures, there needs to be a formal protocol for review, approval, audit, update, recall and distribution of the established procedures. Inaccurate or outdated procedures can cause quality problems. It is important to keep a record of all existing and former standard procedures. It may be important sometime to know how the procedure used to generate today's data differs from the procedure used to generate similar data six years ago.

*Training:* Implementation, documentation and utilization of a quality assurance program will not be effective if the individuals using the system do not understand it. If the formal documents previously described were presented all at once to a typical analyst he would be overwhelmed just by the sheer volume of the material. The formal standard operating procedures should primarily be used as a reference. Instruction programs referencing the formal standard operating procedure should serve as the main training instrument for the analyst. Shortened bench sheet instructions should be available for routine daily use.

An adequate training program must be an integral part of a quality assurance program. Subjects for discussion should include: sampling, sample preparation, and analysis procedures (including set-up, calibration and standardization), quality assurance principles, and safety and legal regulations governing laboratory analyses.

Laws such as the Clean Water Act, Resource Conservation and Recovery Act, Occupational Safety and Health Act, and others establish penalities to individuals and/or companies for violations of the acts. Federal guidelines affect the analyst and they should be communicated to him.

## Final Considerations

Organizations and governmental agencies are pursuing various accreditation programs. The rebirth of coal utilization as an increased energy source and as a feedstock for other technologies has increased the necessity for increased quality control at laboratories engaged in coal and coal-related testing. This need is partly because of the continually rising world-wide energy costs and the economic incentives associated with compliance testing.

Stricter environmental regulations make it essential that required analyses are precise and accurate. Adding to the difficulty in obtaining "accurate" analyses are the demands made by an ever increasingly more technologically oriented society that, because of great strides and achievements made by technology in other areas, insist that analyses always be completed more quickly and more accurately at lower and lower concentrations. Potential accreditation programs need to be scrutinized to determine if such programs would be beneficial in dealing with these demands placed upon laboratories engaged in coal and coal-related testing.

## References


Berman, Gerald A., Editor, Testing Laboratory Performance: Evaluation and Accreditation, National Bureau of Standards Special Publication Number 591, U.S. Government Printing Office, Washington, D.C., August 1980, 178 pages.

Committee E-11 (prepared by), ASTM Manual on Presentation of Data and Control Chart Analysis, ASTM Print Shop, Lancaster, PA., October 1976, 162 pages.

Amore, Francis, "Good Analytical Practices," Analytical Chemistry, Vol. 51, No. 11, September 1979, pp. 1105A-1110A.

Amorosi, Roger J., "American Association for Laboratory Accreditation: All About AALA," ASTM Standardization News, Vol. 8, No. 11, November 1980, pp. 21-24.

Berman, Gerald A., "ASTM Committee E-36: Participation in Laboratory Evaluation and Accreditation," ASTM Standardization News, Vol. 8, No. 12, December 1980, pp. 8-10.

Booth, Robert L., "EPA's Laboratory Certification Program," Analytical Chemistry, Vol. 51, No. 8, July 1979, pp. 861A-862A.

Federal Register, Part II, Dec. 22, 1978, "Good Laboratory Practice Regulation," pp. 59986-60013.

Fischbeck, Robert D., "Good Laboratory Practice Regulations," American Laboratory, September 1980, pp. 125-130.

Hauser, Thomas R., and Dwight G. Ballinger, "Quality Assurance Update," Environmental Science & Technology, Special Report, Vol. 13, No. 11, November 1979, pp. 1356-1366.

Hayes, Jana M., "Licensing Registration and Certification: What Does It Mean to You as a Chemist?", Analytical Chemistry, Vol. 51, No. 3, March 1979, pp. 333A-334A.

Horwitz, William, "Good Laboratory Practices in Analytical Chemistry," Analytical Chemistry, Vol. 50, No. 6, May 1978, pp. 521A-524A.

Kirkpatrick, Diana and Jeffrey Horlick, "Proficiency Testing: An Essential Element of Laboratory Accreditation," ASTM Standardization News, Vol. 8, No. 12, December 1980, pp. 14-17.

Krashes, David, "National Accreditation: A Laboratory Owner's View," ASTM Standardization News, Vol. 8, No. 12, December 1980, pp. 18-20.

Locke, John W. and John A. Gilmour, "Australia, New Zealand, and United States: Laboratory Accreditation Systems Compared," ASTM Standardization News, Vol. 8, No. 11, November 1980, pp. 14-17.

March, Joe L., John W. Gable, Jr., John E. Regnier, "Safe Drinking Water Act": Laboratory Certification Trends, American Laboratory, December 1980, pp. 55-59.

Miller, Stanton, "Trace Analysis of Environmental Pollutants," Environmental Science and Technology, Vol. 12, No. 12, December 1980, pp. 1434-1435.


# Publications on 'hot coals' are available

Two publications concerning the spontaneous heating of coal are available from the U.S. Bureau of Mines. They are: "IC 8756 Laboratory Studies on Spontaneous Heating of Coal" and "RI 8474 Spontaneous Combustion Susceptibility of U.S. Coals." Write: USBM, 4800 Forbes Ave., Pittsburgh, PA 15213.

(Top) Portion of audience during 1981 presentation. (Below) Exhibitors who gathered at 1981 Exhibition.

## 2nd ANNUAL

# Coal Testing Conference

A host of key figures in the coal quality industry will gather again in Lexington, Kentucky February 16th and 17th for the only national symposium and exhibition geared exclusively to coal testing.

LEXINGTON, Kentucky — Key leaders and professionals in the coal quality industry will gather again in Lexington, Ky. February 16th and 17th for the 2nd Annual Coal Testing Conference, a symposium and exhibition sponsored by Standard Laboratories, Inc. — the only national conference to recognize the significant role coal testing plays in the coal industry.

Seventeen prominent speakers will present technical papers or panel discussions on subjects of current interest in the industry. Four panel discussions — a new feature of the conference — are planned regarding sampling, rapid analysis, quality control and innovation in analysis. (See story, page 19)

The presenters and the panelists will represent a broad spectrum of the coal quality industry, with representatives from research, coal producers, utilities, laboratories, and engineering.

More than 40 national manufacturers and distributors of coal testing laboratory equipment and materials, and consulting and engineering firms, will exhibit in Lexington Center's large exhibition hall. In addition, several exhibitors will present workshops.

Last year's Conference attracted nearly 600 persons, including 27 exhibitors, representing 32 states and Canada. In all, 255 companies sent attendees or exhibitors. Conference Manager Karen Gallagher said an audience approaching 1,000 persons is expected.

Persons with interests and responsibilities in the quality control of coal will attend the Conference. They will include executives, laboratory supervisors and managers, technicians, coal producers, equipment manufacturers and suppliers, sampling personnel, quality control personnel, chemists, engineers, re-

**Please turn to page 18**

# Coal Testing Conference

## A SYMPOSIUM AND EXHIBITION

Sponsored by Standard Laboratories

**February 16 & 17, 1982**

**Lexington Center, Lexington, KY**

### 2ND ANNUAL CONFERENCE

Mark your calendar and plan to attend the 2nd annual Coal Testing Conference, Symposium and Exhibition February 16th and 17th at the Lexington Center, Lexington, Kentucky — the only national conference to recognize the coal testing industry and the significant role it plays in the coal industry.

Persons with interests and responsibilities in the quality control of coal will attend. Seventeen prominent speakers will present papers and panel discussions. At least forty exhibitors will display the latest equipment, supplies and services available to the coal testing industry.

## AGENDA

### Tuesday, February 16, 1982

8 a.m. Registration and Exhibit hall

9:00 RAPID ANALYSIS OF COAL: "Accelerated air drying methods in sample preparation," a panel discussion. Panelists: Richard A. Mullins, Old Ben Coal Co. and Gust Rudnik, Tennessee Valley Authority.

10:20

10:30 Exhibits and coffee break

11:00

11:00 Presentation: "Experience with the application of the equilibrium moisture test to sub-bituminous and lignites," by J. A. Luppens, Phillips Coal Company.

11:30

11:00 Workshops by various exhibitors

12:00

Lunch

1:00 INNOVATIONS IN ANALYSIS AND EQUIPMENT: "Methods of calorimetry," a panel discussion. Panelists: Dr. Roger L. Blaine, E. I. Dupont De Nemours Co., Inc., Dr. Hans Sommerauer, Mettler Instrument Co, Art Johnson, Research Director, Parr Instrument Co.

2:30 Exhibits and break

3:00

3:00 Presentation: "Using the oxygen bomb to prepare coal samples for the determination of trace metals by atomic absorption spectrophotometry," by Peter C. Lindahl, Exxon Production Research Company.

3:30

3:30 Presentation: "Formulas for calculating the heating value of coal and coal char: development, tests and uses," Dr. A. T. Talwalkar, Institute of Gas Technology.

4:00

4:00 Workshops by various exhibitors.

5:00

6:30 Cocktail hour, sponsored by Standard Laboratories, Inc.

7:30 Dinner, with an address by Carl E. Bagge, President, National Coal Association.

### Wednesday, February 17, 1982

8 a.m. Exhibit hall opens

9:00 SAMPLING OF COAL: "Time-based and mass-based sampling," a panel discussion. Panelists: J. J. Ellis, Peabody Coal Co., John W. Harrison, Ramsey Engineering Co., Art McCabe, Consumers Power, and James A. Redding, J. A. Redding Co.

10:20

10:30 Exhibits and coffee break

11:00

11:00 Presentation: "Process sampling, EPRI Coal Cleaning Test Facility," by Ray W. McGraw, Electric Power Research Institute.

11:30

11:00 Workshops by various exhibitors

12:00

Lunch

1:00 QUALITY CONTROL METHODS: "Running replicate samples as contrasted to other quality control methods," a panel discussion. Panelists: Mick Samples, Standard Laboratories. Another panelist to be announced.

2:20

2:30 Presentation: "The rebuilding, operation and advantages of an experimental movable wall coke oven," by C. T. Ingraham and Richard Rice, Westmoreland Coal Co.

3:00

3:00 Presentation: "A simplified method of determining the $T_{250}$ temperature of molten coal ash," by Dr. Alfred E. Kober, Apollo Technologies.

3:30

3:30 Workshops and exhibits

5:00

For information circle No. 11

For room reservations contact:

**HYATT REGENCY LEXINGTON**

Convention Reservations Dept.
400 W. Vine St.
Lexington, Kentucky 40507

Dial Direct 606-253-1234 or
Toll Free 1-800-228-9000

☐ YES, I PLAN TO ATTEND COAL TESTING CONFERENCE

**REGISTER TODAY**

Join the professionals in coal testing, quality control, production, utilization and research at the 1982 Coal Testing Conference. Register today. The fee for each person ($195 U.S.) covers all technical presentations and panel discussions, admission to the exhibit hall and workshops, admission to the reception and banquet sponsored by Standard Laboratories, and one copy of the proceedings.

The deadline for registration is Jan. 15. Make plans to join the coal testing industry in Lexington.

Phone (304) 343-5173

NAME

COMPANY

ADDRESS

CITY STATE ZIP

Make checks payable to Coal Testing Conference

Lexington Center and Hyatt Regency Hotel

Continued from page 16

searchers, professors and others. They will represent testing labs, coal sales organizations, utilities, research & development labs, universities, coke & steel companies, engineering & consulting firms, and national associations in the U.S., Canada and Mexico, as well as participants around the world.

### Technical Presentations

Three presentations will be made each day of the conference, beginning Tuesday, the 16th.

J. A. Luppens, of Phillips Coal Co., will present the first paper, entitled *"Experience with the application of the equilibrium moisture test to lignite."* The equilibrium test (ASTM-D-1412) was developed to approximate the bed, in situ or inherent moisture of a coal seam. The test can have a significant impact on resource evaluation and BTUs.

Peter C. Lindahl, of the Exxon Production Research Co., will make the presentation *"Using the oxygen bomb to prepare coal samples for the determination of trace metal by atomic absorption spectrophotometry."* Renewed interest in the use of coal as a fuel has created a need for the development of rapid and accurate methods for coal analysis, which has prompted considerable research in the determination of trace metals. Atomic absorption spectrophotometry has been used frequently. Lindahl will report on the reliability of the oxygen bomb analysis for trace metals.

*"Formulas for calculating the heating value of coal and coal char: Development, tests and uses"* will be the subject of Dr. A. T. Talwalkar of the Institute of Gas Technology. The paper deals with the importance of the heating (calorific) value of coal and coal char in the direct use of coal, as well as its conversion to other useful forms of fuel.

On Wednesday, the 17th, Ray W. McGraw of the Electric Power Research Institute will present a paper on *"Process sampling of the EPRI coal cleaning test facility,"* where he is assistant manager. One of the primary goals at the test facility is to advance the state of the art in sampling slurry and solid coal process streams, McGraw said. There are 54 sampling systems within the test facility, consisting of three basic systems: solids samplers, gravity slurry samplers and pressurized slurry samplers.

*"The rebuilding, operation and advantages of an experimental movable wall coke oven"* will be addressed by C. T. Ingraham and R. A. Rice of Westmoreland Coal Company's Gallagher Research Center. "The advantages of the results obtained from a movable wall oven have proven to be invaluable to commercial coke operations," said Ingraham. The oven has been particularly helpful in relating Westmoreland Coals to specific customer needs. (A special version of the paper appears on page 25 of this issue.)

Alfred E. Kober, Ph.D., associate director, research and development for Apollo Technologies, Inc., will present a paper entitled *"A simplified method of determining the $T_{250}$ temperature of molten coal ash."* The determination of the $T_{250}$ by the technique Kober will describe involves an actual physical measurement and is not subject to the limitations of the predictive methods based on ash composition. The technique, he said, greatly simplifies the evaluation of flow properties of molten coal ash by eliminating the need for elaborate viscosity measurements or time consuming analyses.

An agenda listing the times of the presentations is on page 17.

### Exhibits

Lexington Center's Exhibition Hall East, with 25,000 square feet, will be the site for an exhibition of state-of-the art laboratory and sampling equipment. Engineering and consulting firms will also be represented. Attendees will be able to compare and evaluate the best equipment offered by the suppliers to the coal quality industry. The exhibit hall will be open from 8 a.m. until 5 p.m. both days of the Conference. Workshops will be presented from 11 a.m. — noon and from 4-5 p.m. both days.

A complete list of the exhibitors, as well as the complete program, is available from Standard Laboratories.

### Transportation Information

Lexington is situated in central Kentucky. I-64 and I-75 cross at Lexington. Three airlines serve the city, Delta, U.S. Air and Piedmont. The terminal is 10 minutes from the Conference headquarters at Lexington Center. A delegation from the City of Lexington will greet conference participants arriving by air.

The Hyatt Regency, situated within the Lexington Center complex, is the official host hotel for the Conference. Spillover reservations will be made with the Marriott Resort Hotel, 1.5 miles from the Conference Center. Transportation will be provided each day to and from the Marriott.

For further information about the Conference, contact Karen Gallagher at Standard Laboratories (304/343-5173).

Carl E. Bagge

## BAGGE BANQUET SPEAKER

The speaker at the Tuesday evening banquet sponsored by Standard Laboratories will be the distinguished president and chief executive of the National Coal Association, Carl E. Bagge.

Bagge assumed the presidency of the NCA on January 1, 1971. He is a former member of the Federal Power Commission, serving twice as vice chairman.

## PANELS TO DISCUSS TOPICS OF INTEREST AT CONFERENCE

A new feature of the second annual Coal Testing Conference in February 1982 will be four panel discussions. The topics were chosen as subjects of interest to the industry as a whole from a survey of last year's registrants.

Panelists will explore each topic to clarify differing viewpoints:

- **Sampling,** a comparison of time based and mass based sampling — what are the advantages and disadvantages of each?
- **Innovation in Analysis and Equipment,** methods of calorimetry — what is being done in differential scanning, thermal gravimetric and thermal mechanical calorimetry? Of what use are these methods to the coal industry?
- **Quality Control,** why run replicate analysis? Are other quality control measures just as informative? What percentage of sales should a laboratory expend for quality control programs?
- **Rapid Analysis,** accelerated air drying methods in sample preparation — What is the quickest drying method? What does rapid analysis do to results?

After each panel discussion, the floor will be open to question-and-answer sessions, with microphones placed in the audience so that registrants can address the panel.

The panel discussions have been added to the Conference program to provide an educational forum. Although some issues may not be resolved and consensus may not emerge, the panels are intended to help explore varying ideas on these subjects.

Panelists include:

*Dr. Roger L. Blaine,* Supervisor of Technical Services, Thermal Analysis, E. I. Dupont De Nemours Co., Inc.

*J. J. Ellis,* Director of Customer Service and Utilization, Peabody Coal Company.

*John W. Harrison,* Senior Sampling Engineer, Ramsey Engineering Co.

*Art Johnson,* Research Director, Parr Instrument Co.

*Art McCabe,* Fuel Transportation Manager, Consumers Power.

*Richard A. Mullins,* Manager-Analytical Procedures, Old Ben Coal Co.

*James A. Redding,* President, J. A. Redding Co.

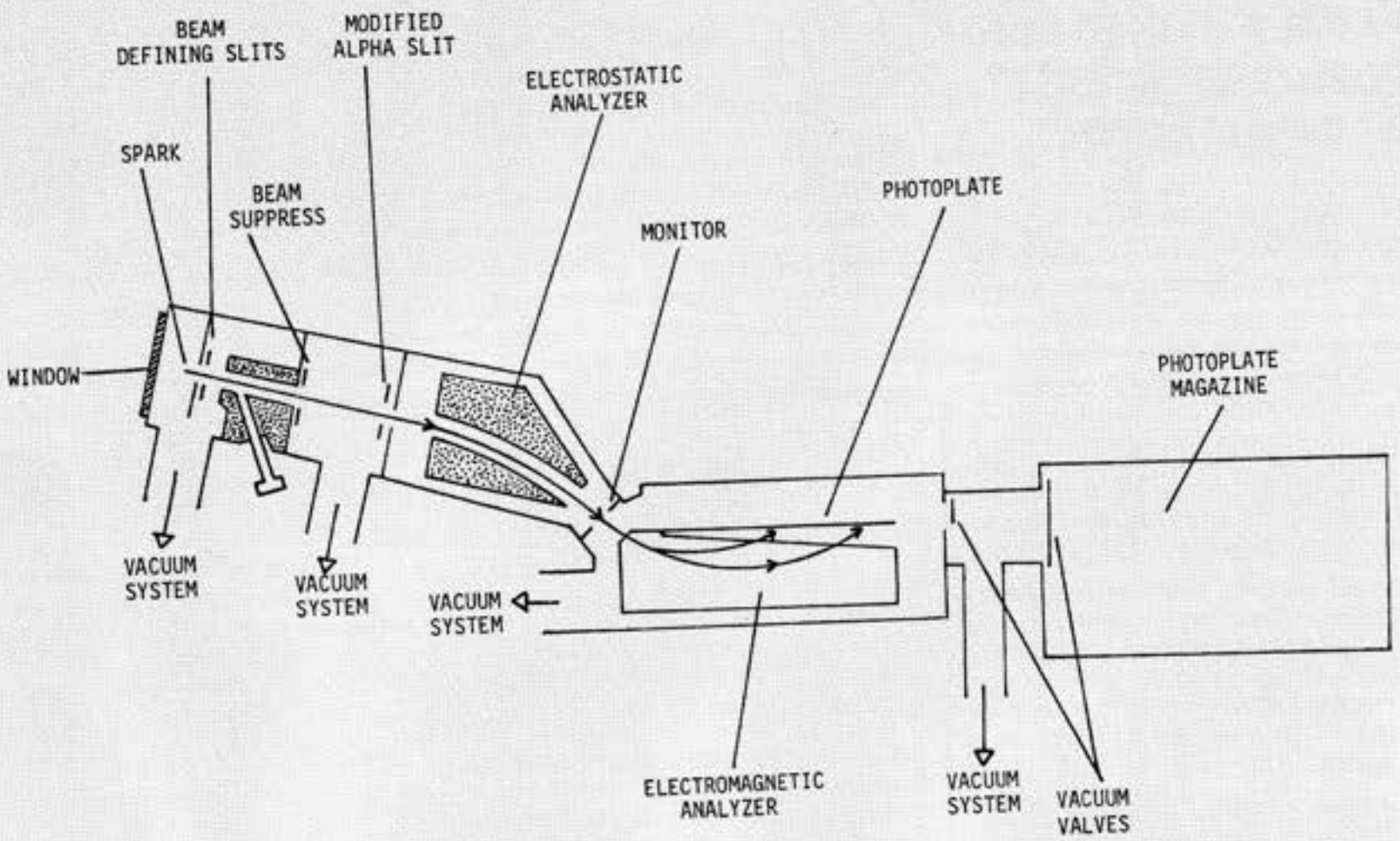
*Gust Rudnik,* Supervisor of Quality Control Section, Fossil Fuels Planning Branch, Fuels Division, Tennessee Valley Authority.

*Mick Samples,* Special Projects Manager, Standard Laboratories.

*Dr. Hans Sommerauer,* Product Marketing Specialist, Mettler Instrument Co.

One other panelist to be announced.

The panel discussions will be held at 9 a.m. and 1 p.m. each day of the Conference (refer to Conference agenda on page 17 for specific panel discussion times). By addressing issues of interest to last year's registrants, the Conference hopes to play an important role in keeping the industry aware of the reasoning behind differing opinions in the testing of coal in today's industry.




**Schematic layout of a spark source mass spectrograph (Figure 1)**

The multi-element examination of coal and its by-products by spark source mass spectrography is a commonly used analytical tool.

# SPARK SOURCE MASS SPECTROGRAPHY

M. L. JACOBS, PhD.

COMMERCIAL TESTING & ENGINEERING
INSTRUMENTAL ANALYSIS DIVISION

Spark source mass spectrography provides unique capabilities in trace elemental analyses. This analytical technique has many advantages for trace element surveys and has become a commonly used analytical tool for the analysis of coal and coal by-products.

Some of the advantages of the techniques are:

— *Low detection levels:* Typical detection limits in solid samples for the majority of elements is 50-100 parts per billion (ppb).

— *Comprehensive element coverage:* The spark source mass spectrometer allows the simultaneous detection and quantification of approximately 80 elements in most solids or liquids with a minimum of matrix effects, spectral overlap, or inter-element interferences.

— *Uniform sensitivity:* The high-voltage, radio-frequency, spark-ionization source ionizes all elements with approximately equal sensitivity. Also, the high energy source produces a leveling effect which tends to give a constant element sensitivity from one matrix to another.

— *Linearity:* The relative intensity of a spectral line is related directly to the concentration of that element in the matrix. The relative intensity has been proven to be linear in relation to concentration over several orders of magnitude.

With these advantages, it is obvious that the spark source mass spectrometer is a powerful, comprehensive survey tool, which, in a single operation, can provide multi-elemental knowledge of a fossil fuel sample.

## Instrument Description

The work by Dempster in 1946[1] and Hannay in 1954[2] describes the first mass spectrometers fitted with a spark ionization source. Since then many investigators have described improvements and applications[8] of a high-voltage radio-frequency spark source mass spectrometer.

The spark source mass spectrometer consists of three major instrumental segments: a source for producing ions, an analyzer, and a means of detecting the ions. A schematic of a spark source mass spectrometer is presented in Figure No. 1[7]

In Figure No. 1, the source for producing ions is identified as the spark. The electrostatic and magnetic analyzers comprise the instrumental area where energy focusing and magnetic focusing are achieved.

The ion sensitive photoplate, located in the magnetic analyzer, is the normal means of detection. A photoplate magazine allows vacuum degassing of up to eight photoplates prior to the introduction of the plate into the high vacuum of the magnetic analyzer section through a vacuum lock system. The whole of the mass spectrometer is held at a high vacuum, normally $10^{-11}$ atmospheres ($10^{-8}$ Torr). During sparking of samples that out-gas heavily under the sparking conditions in the source, the source pressure will rise to as high as $10^{-6}$ Torr. However, a series of small slits between the source and electrostatic analyzer and a differential pumping system allows the maintenance of the $10^{-8}$ Torr vacuum in the analyzer and photoplate region.

The spark source mass spectrometer at the Instrumental Analysis Division laboratory uses a radio-frequency, high-voltage, pulsed spark discharge that can be varied in voltage up to 80 kilovolts to produce ions from conducting sample pins. Normal sparking voltages will be in the 25 to 35 kilovolts range.

A portion of the positive ions produced during the radio frequency sparking is accelerated through beam defining slits by a positive accelerating potential of 18 kilovolts, into the electrostatic analyzer section where energy focusing occurs.

The mono-energetic beam of ions, varying in mass, leaves the electrostatic analyzer along parallel paths, while ions having different energies leave along different paths.[3]

The pre-selected energy-focusing beam now enters the magnetic field and the ions are magnetically focused along a plane according to the square root of their mass to charge ratio ( $\sqrt{m/e}$). Once the ions are separated magnetically according to their individual masses, they impinge upon an ion sensitive photoplate placed parallel to the magnetic focal plane.[4] The exposed photoplate is then removed through the vacuum locks into a light tight carrier and then taken into the dark room for developing.

The photoplate is then developed and the mass spectrum from the sample interpreted. The utilization of a photographic plate provides a permanent means of recording the total ion spectrum from a mass range of approximately 6 to 270 mass to charge units (m/e).

## Trace Element Analysis In Coal and Related Samples

One advantage of the spark source mass spectrometer is that it utilizes a small amount of sample. This fact can be a benefit when sample size is limited, but is a disadvantage when tonnage quantities are to be represented by a spark source trace element scan. Representative sampling of solid fuels for trace

**Continued on page 22**

### Typical Trace Element Analysis of South Eastern Coal

**Concentration in ppm Weight**

| Element | Conc. | Element | Conc. |
|---|---|---|---|
| Uranium | 3 | Nickel | 15 |
| Thorium | 5 | Cobalt | 8 |
| Lead | 5 | Iron | Major |
| Thallium | <0.1 | Manganese | 25 |
| Mercury | 0.13* | Chromium | 30 |
| Erbium | <0.2 | Vanadium | 40 |
| Dysprosium | <0.3 | Titanium | Major |
| Terbium | 0.3 | Scandium | 6 |
| Gadolinium | 0.4 | Calcium | Major |
| Europium | 0.3 | Potassium | Major |
| Samarium | 0.7 | Chlorine | 30 |
| Neodymium | 3 | Sulfur | Major |
| Praseodymium | 2 | Phosphorus | Major |
| Cerium | 25 | Silicon | Major |
| Lantharium | 10 | Aluminum | Major |
| Barium | 300 | Magnesium | Major |
| Cesium | 0.7 | Sodium | Major |
| Iodine | 0.2 | Fluorine | ≪ 160 |
| Antimony | 0.3 | Boron | 20 |
| Tin | 0.4 | Beryllium | 0.4 |
| Cadmium | 0.7 | Lithium | 4 |
| Molybdenum | 10 | | |
| Niobium | 3 | | |
| Zirconium | 40 | | |
| Yttrium | 20 | | |
| Strontium | 450 | | |
| Rubidium | 7 | | |
| Bromine | 1 | | |
| Selenium | 0.6 | | |
| Arsenic | 2 | | |
| Germanium | 0.4 | | |
| Gallium | 12 | | |
| Zinc | 15 | | |
| Copper | 25 | | |

*By Flameless Atomic Absorption

**(Table I)**

Continued from page 20

analysis is therefore an extremely critical area. No trace analysis can represent a large scale sample unless great attention is paid to proper procedures of sampling and sample preparation.

In the analysis of coals, the typical procedure would include size reduction of the sample to −200 mesh. A portion of the coal, generally 100 mg, is then mixed with an equal weight of high purity compactable graphite. An internal element standard, normally indium, is added along with a few drops of re-distilled ethyl alcohol. The mixture is slurried with re-distilled alcohol in an agate mortar and pestle. The sample graphite slurry is taken to dryness using infrared lamps. The procedure is then repeated, slurrying and drying, until a homogeneous electrode mixture is assured.

The sample-graphite mix is then packed into holes drilled into a specially cleaned polyethylene slug, which is then inserted into a metal die and subjected to about 18 tons of pressure. The sample-graphite mix is thus formed into electrodes which can then be mounted in the source for sparking.

The procedure as described is followed when samples are of a solid, easily grindable nature. When other by-products of coal are encountered as samples, such as tars and light hydrocarbon liquids, additional sample preparation must be introduced.

Sample preparation procedures for tars and light hydrocarbons must be designed to produce the sample graphite electrodes which are suitable for mounting in the source of the mass spectrometer. The samples contained in the graphite mix must have a relatively low vapor pressure at temperatures of approximately 200°C. If heavier tars are encountered, the procedures must be adapted to produce a material which can be prepared for spark source examination.

One relatively new technique would be the production of an ash using a Low Temperature Plasma Asher (LTA). Use of an LTA for coal tars minimizes the loss of the more volatile trace elements since the temperature of the oxygen plasma rarely exceeds 150°C. The LTA also has the advantage of concentrating elements into very small portions of ash. If ultra trace elements (in the ppb range) are needed, this is a very desirable technique.

Lighter hydrocarbon tars, which volatize in the −20°C to 150°C range, are more difficult to handle. Generally, these types of samples are carbonized or "ashed" in a normal laboratory furnace in which the temperature of the furnace does not exceed 350°C. This procedure, when used with low boiling hydrocarbon samples, almost certainly leads to loss of some volatile trace elements.

After producing a carbonized residue, or ash, as the case may be, the sample electrodes are prepared in the same manner as outlined in coal sample preparation.

Aqueous samples are prepared by mixing a 20 mL aliquot of sample with 0.2 g of graphite in a quartz mortar, adding 10 $\mu$g of indium, the internal standard element, along with a few drops of re-distilled alcohol and evaporating the alcohol and water from the mixture with an infrared lamp.

In general, the simpler the sample preparation, the better. Additions of reagents and chemicals are to be minimized when a trace element survey is desired because of the inevitable contamination problems.

## Sample Analysis

The prepared sample pins are mounted in the source of the mass spectrometer. A source vacuum pressure of at least $1 \times 10^{-6}$ Torr is maintained during sparking. A series of decreasing exposures, i.e. 100, 60, 30, 10, 6, 3, 1, 0.6, 0.3, 0.1, 0.06, 0.03, 0.01, 0.006, 0.003, and 0.001 nancoulombs (nC), totaling 210nC, is deposited on a photographic plate. This produces a permanent spectrum for interpretation.

The mass spectrum produced on the photoplate is a summation of the elemental components of the electrode. The density of a spectral line is related directly to the concentration of the component at least over a concentration range of $10^5$:1 as proven by Hannay and Ahearn.[5] Therefore, by running a series of decreasing exposures, the relative concentration of elements from major through trace can be established by knowing the concentration of the internal standard added during sample preparation.

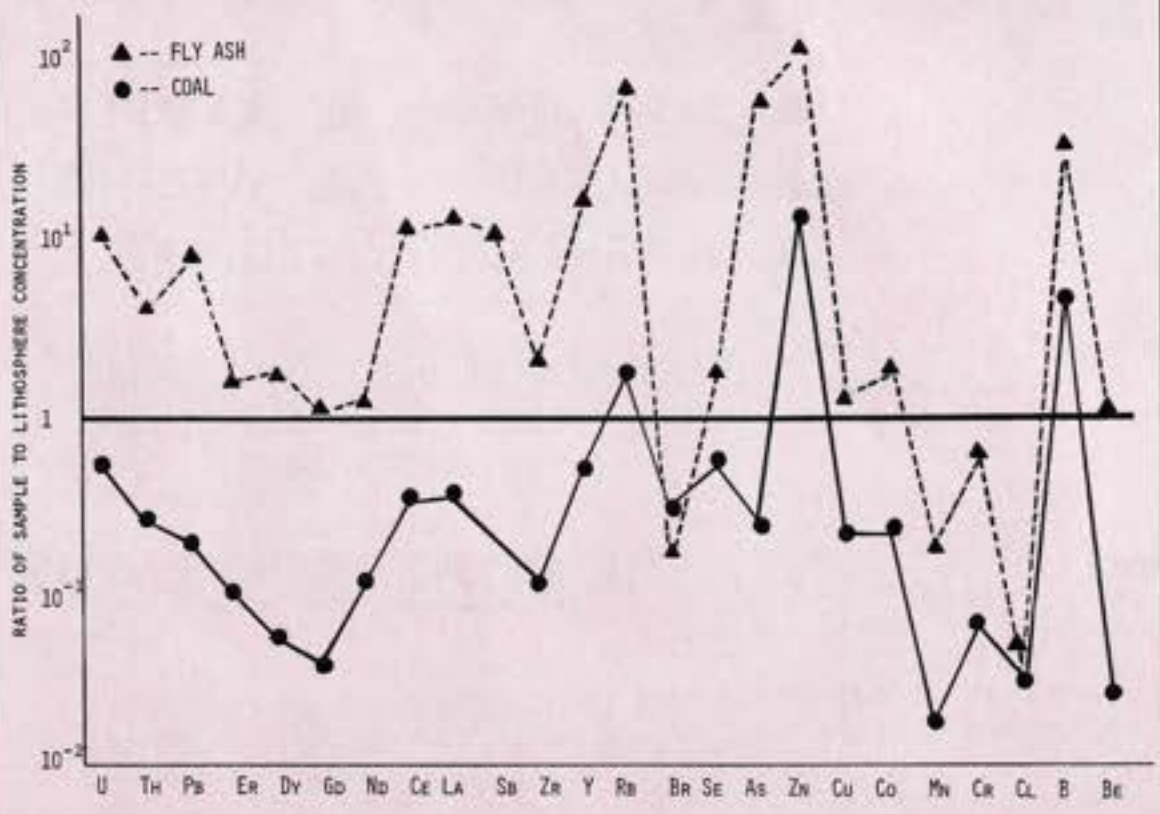
In a spark source mass analysis, all naturally occurring elements, with the exception of helium and hydrogen, are found within the m/e range of 6 to 270. Under normal conditions, most elements in solid fuels can be determined with detection limits of 50-to-100 parts per billion.

One exception to the "most elements" is, of course, mercury. Almost all forms of mercury, including the element, are volatile under sample preparation procedures for spark source mass analysis.

Continued on page 24

**FIGURE II**

**Relative concentrations of elements in coal and fly ash normalized to the lithosphere.**



# The Efficiency Experts...


**An efficiency expert does not necessarily have all the information. The key is how to get it.**

**At Standard Instrumentation, we provide the coal testing industry around the world with innovative, highly sophisticated yet practical products for gathering accurate coal-testing information.**

**The Efficiency Experts...**

- The **NOVA-COAL 1** is an integrated set of software and testing methods that maintains data files, schedules work, automatically calculates results, and prints out final reports through electronic processing and control of equipment. The benefits include reduced labor costs, decreased equipment needs, improved accuracy and immediate calculations.
- The **FA57 Automatic Ash Fusion System** is the first apparatus allowing the operator to start the system and walk away. The automatic start, furnace control, video and computer operation and printed test results add up to increased productivity and accuracy requiring no special personnel.
- The fully automated **D14 Coal Dilatometer** significantly increases the rapidity, ease and reliability of analyses. Rapid heating and cooling, uniform results, and the elimination of operator error are among the efficiency benefits.
- The **P11 Plastometer**, also fully automated, provides reliability and frees the laboratory analyst from most routine, time consuming operations because it requires no attention.
- **Fred, he works for you.** Fred can now become more efficient and productive by using innovative, fully automated, and proven equipment from Standard Instrumentation.

**For information, circle No. 13**

## Where Quality Instrumentation Is Standard.

# STANDARD INSTRUMENTATION INC.

A SUBSIDIARY OF STANDARD LABORATORIES, INC.

**3322 Pennsylvania Ave., Charleston, W.Va. 25302 304/345-4727**

## Typical Trace Element Analysis of Fly Ash from South Eastern Coal (Table II)

Concentration in ppm Weight

| Element | Conc. | Element | Conc. | Element | Conc. | Element | Conc. |
|---|---|---|---|---|---|---|---|
| Uranium | 40 | Europium | 4 | Strontium | Major | Titanium | Major |
| Thorium | 70 | Samarium | 10 | Rubidium | 250 | Scandium | 150 |
| Bismuth | 1 | Neodymium | 45 | Bromine | 0.5 | Calcium | Major |
| Lead | 140 | Praseodymium | 35 | Selenium | 2 | Potassium | Major |
| Thallium | 15 | Cerium | 500 | Arsenic | 400 | Chlorine | 30 |
| Mercury | 0.09* | Lanthanum | 200 | Germanium | 16 | Sulfur | Major |
| Tungsten | 1 | Barium | >1000 | Gallium | 80 | Phosphorus | Major |
| Hafnium | 2 | Cesium | 15 | Zinc | 110 | Silicon | Major |
| Lutetium | 0.4 | Antimony | 10 | Copper | 130 | Aluminum | Major |
| Ytterbium | 3 | Tin | 70 | Nickel | 70 | Magnesium | Major |
| Thulium | 0.5 | Cadmium | 3 | Cobalt | 60 | Sodium | 1000 |
| Erbium | 4 | Molybdenum | 48 | Iron | Major | Fluorine | 150 |
| Holmium | 7 | Niobium | 50 | Manganese | 250 | Boron | 10 |
| Dysprosium | 10 | Zirconium | 900 | Chromium | 300 | Beryllium | Major |
| Terbium | 3 | Yttrium | 600 | Vanadium | >1000 | Lithium | |
| Gadolinium | 6 | | | | | | |

*Flameless Atomic Absorption

**Continued from page 22**

### Photoplate Interpretation

Photoplate interpretation for a trace survey is carried out using the "just disappearing line" method. The use of a photoplate allows simultaneous detection of all ion spectra. Also, spectra can be recorded at the highest available resolving power of the instrument. Reproducibility of the photoplate response can be as good as ±3% to ±5%. The use of the photoplate allows the recording of spectra without prior knowledge of the sample, i.e., in some cases unexpected interferences in the spectra would lead to erroneous results using other forms of ion detection.

However, there are disadvantages to the use of a photoplate which must be recognized by the analyst. The photoplate is non-linear and takes a longer time to interpret than other forms of ion detection. Lower absolute sensitivity, photographic halo, and background effects can also be significant.

Photoplates can give a different response to high m/e ions as compared to lower m/e ions. However, this difference in response is normally taken into account by the use of relative sensitivity factors for elemental determinations.

A precision value that a client is normally interested in is the total precision of the method on trace analysis from sample to sample. The sample to sample variation observed at the Instrumental Analysis Division, in a coal matrix, is not better than ±100% and is probably in the range of ±100% to ± 200% at a parts per million (ppm) concentration level utilizing the visual "just disappearing line" technique.

However, it should be remembered that a multi-element survey technique must be rapid enough to allow reasonable analytical results to be returned for minimum expenditure of time and money. The "just disappearing line" technique for spark source mass spectrographic photoplates does allow rapid determination of a maximum number of trace elements for minimum expenditures.

The accuracy of the spark source mass analysis is, of course, related directly to trace element standards in a given matrix and the ability to repeat an analysis with precision in relation to a known standard. It is generally agreed that the spark source value can be within a factor of 3 to 5 times the absolute elemental concentration at the ppm level.

### Typical analysis

Typical element concentrations found in coal are illustrated in Table 1. An analysis of elements found in the fly ash, resulting from a combustion process, utilizing the same type coal found in Table 1, is given in Table II. The mercury is analyzed by a flameless atomic absorption method. The fluorine values reported by spark source mass spectrography should be confirmed by alternate wet techniques.

A normal spark source analysis will not report elements in concentration range greater than 1000 ppm weight and are only indicated in a routine analysis as >1000 or as "major component". A variety of other analytical methods exist which can determine more precisely the concentration of major elements in coals and other fossil fuels.

### Comparison of Trace Elements Found in the Lithosphere

Figure II is a comparison of some trace elements of environmental interest, determined by spark source mass spectrography in the coal and fly ash samples from Tables I and II, compared to literature values of the same elements found in the lithosphere.[6] The abscissa of the graph is in terms of concentration of the element found ratioed to the concentration normally found in the lithosphere. The elements are given along the ordinate in order of decreasing atomic mass. All elements found in the sample are not reported and only a selected set of elements is illustrated.

By presenting the trace data in this fashion, it can be readily seen that many of the trace elements found in the bulk coal samples are below the normal lithosphere concentration. While it is also very clear that the fly ash resulting from this coal type is above the trace elemental level of the lithosphere, it is also apparent that the concentration of many trace elements occurring in the fly ash have increased due to the combustion of the organic matrix. The general shapes of the two plots from coal and fly ash are remarkably similar.

### Summary

The spark source mass spectrometer can be utilized by fossil producers as a survey tool for the determination of almost all naturally occurring elements. Its high sensitivity and comprehensive element coverage can be applied to great advantage in surveys for environmental impact statements and trace element monitoring coals and coal by-products, and effluents from fossil fuel consumption plants.

### References

[1] A. J. Dempster, MDDC 370, U.S. Dept. of Commerce, Washington, D.C., 1946.

[2] N. B. Hannay, Rev. Sci Instr., 25-644, 1954.

[3] R. I. Reed, Editor, "Modern Aspects of Mass Spectrometry," pg. 85, Plenum Press, New York, 1968.

[4] G. A. Errock, "Mass Spectrometry," Academic Press, New York, pg. 1, 1964.

[5] N. B. Hannay and A. J. Ahearn, Anal. Chem., 26 to 1056, 1954.

[6] N. A. Lange, Editor, "Handbook of Chemistry," 9th edition, Handbook Publishers, Inc., Sandusky, Ohio, 1956.

[7] M. L. Jacobs, S. L. Sweeney, and C. L. Webster, "Keystone Coal Industry Manual," 1975.

[8] M. L. Jacobs, "Evaluating Spark Source Mass Spectrometry in the Analysis of Biological Samples," NIOSH Research Report, HEW Publications No. (NIOSH) 75-186, May, 1975.

*M. LEROY JACOBS, Ph.D. is Divisional Manager of the Golden, Colorado Instrumental Analysis Division of Commercial Testing & Engineering. He received a Doctor of Philosophy, majoring in inorganic chemistry, from Colorado State University in June, 1970.*

The movable wall, experimental coke oven is not only versatile but it can help produce a better quality coke with less expense commercially.

# REBUILDING AN EXPERIMENTAL MOVABLE WALL COKE OVEN

C.T. INGRAHAM
R. A. RICE

WESTMORELAND COAL CO.
GALLAGHER COAL
RESEARCH CENTER

Two of the problems that have plagued the coking industry for years are determining the correct coal blend to charge to the oven to make a suitable coke product and insuring that any coal blend that is charged to the oven should not exert a pressure on the coke oven walls of more than two pounds per square inch.

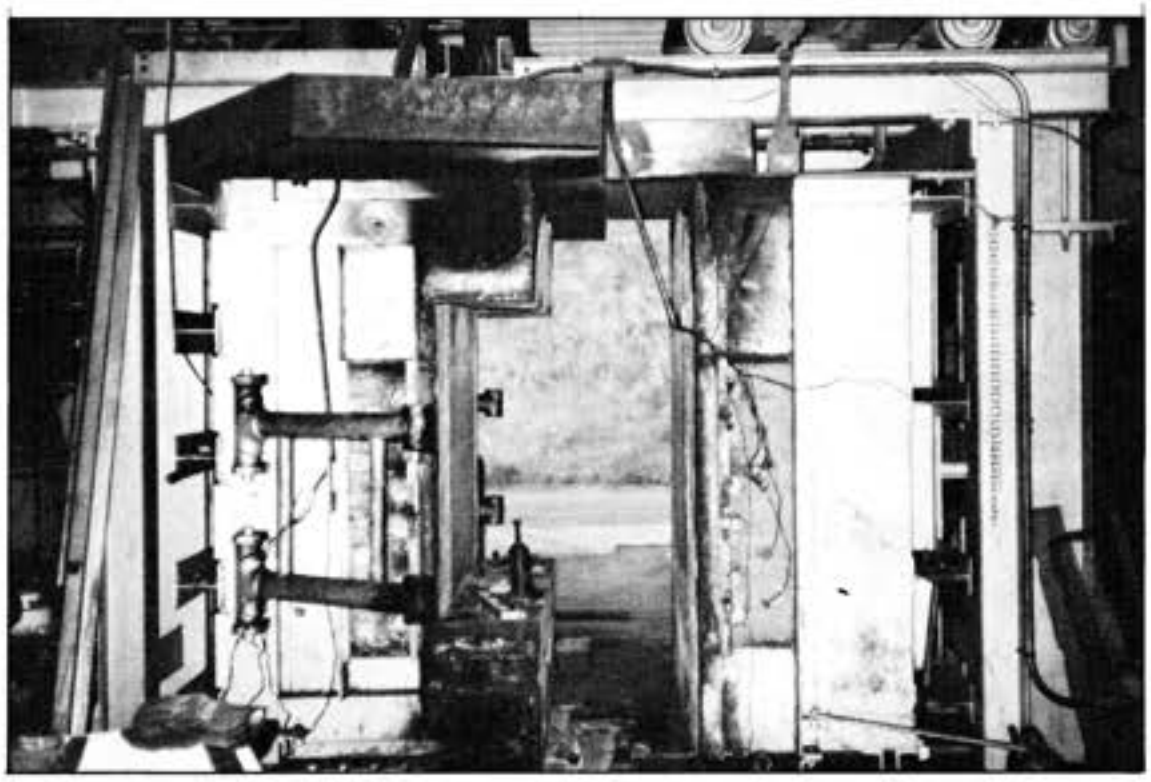
One of the approaches to these problems is the use of the Movable Wall Experimental Oven. Over the past 25 years experimental coke ovens have existed at major steel and coal company laboratories. During this time many changes have been made to improve the reliability of the coke produced by these ovens. Without these results, it would not have been possible to develop the quality coal blends that are presently being used to produce commercial grade coke. Test ovens which generally produce 300 to 400 pounds of coke are capable of producing reliable measures of pressure generated during the coking process and producing a quality of coke that simulates the physical and chemical charateristics of commercial coke.

A typical experimental coke oven that is being used has a capacity of 500 to 700 pounds of coal charge and is normally heated by either natural gas or electricity. The particular design of the oven which is used at the Gallagher Coal Research Center is electrically heated by 12 globars which afford the exact control of flue temperature that is needed to favorably compare with the various commercial oven designs.

The oven has one movable wall and one fixed wall with the pressure being measured by a single point load cell on the movable wall. It was purchased from the U. S. Government approximately five years ago. Consequently, Gallagher did not have the opportunity to incorporate any of our own designs that could

**Continued on page 26**

**Movable wall of oven before rebuild (1)**



**Oven with movable wall rolled away (2)**

Continued from page 25

have improved the efficiency and simulation to a commercial size oven.

The experimental coke oven contained silicon carbide inner walls, with these walls adjacent to the coal charge. Silicon carbide has an excellent heat transfer, and helps to reduce the amount of power needed for the coking process. Other types of experimental ovens use silica brick for the inside walls. These ovens are generally heated with natural gas for economy and kept at a constant flue temperature during the experimental run. Before it was decided to rebuild our 13 1/2 inch wide oven to a full scale 18 inch width, a study was made of each type of wall to determine the wall that would be most satisfactory for our purposes.

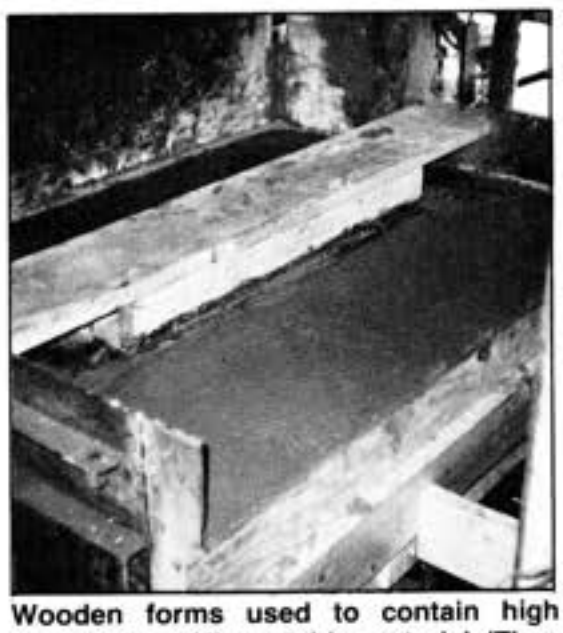
It was decided that since the oven had operated successfully with the silicon carbide walls and electrically heated flues, Gallagher would rebuild the oven using the same type of walls. This decision was influenced by the facts that we did not have a source of natural gas at the laboratory and that if silica brick was used as the inner walls, the amount of power needed to heat the oven would be too expensive.

Another advantage of the silicon carbide wall is its resistance to spalling and cracking when the temperature of the experimental oven passes through the refractory critical temperature zones. This oven is not used continuously, and therefore, it is a definite advantage to be able to cool the oven down when there is not enough test work to justify its operation. Also with this type of wall, it is necessary to program the flue temperature through the entire coking process. However, past experience with this oven and similar ovens has demonstrated that the heating program does in fact approach very closely the actual commercial oven heating sequence.

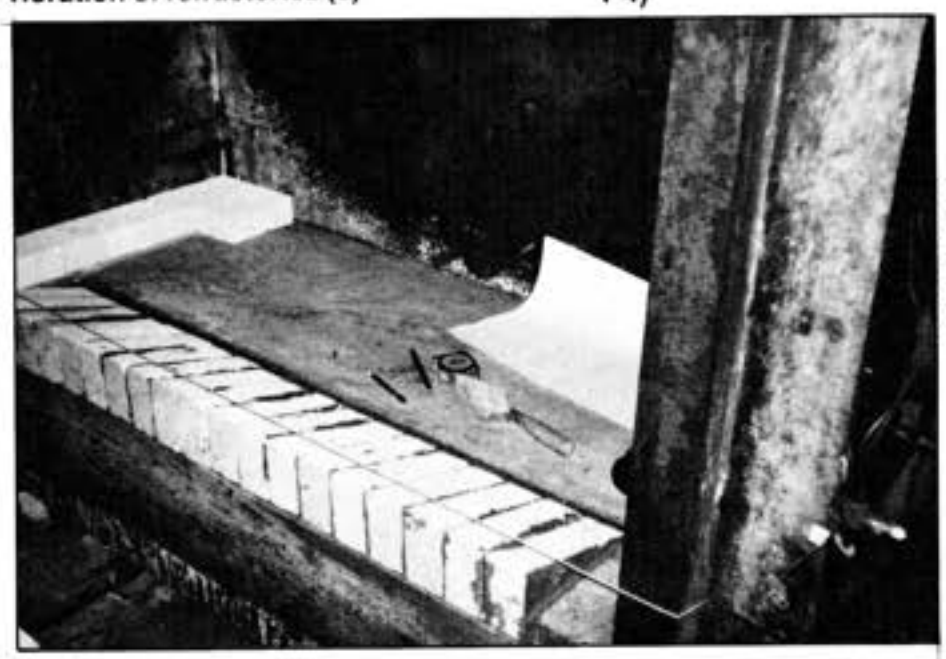
Some of the advantages of the experimental coke oven can best be explained by its versatility. A variety of coal blends can be coked without the fear of damage to the oven by highly expanding coals or peak pressures. Without the use of this oven, coke plant operators could only use coal blends that had been proven over the years to be safe. The oven also gives the operator the opportunity to insert in the coal blend individual coals that would produce a better quality coke less expensively.

The rebuilding and updating of the experimental coke oven was initiated in September, 1980. The oven had originally been placed into operation in 1965 and had performed numerous test runs during that period. Because of the age and deteriorating condition of the

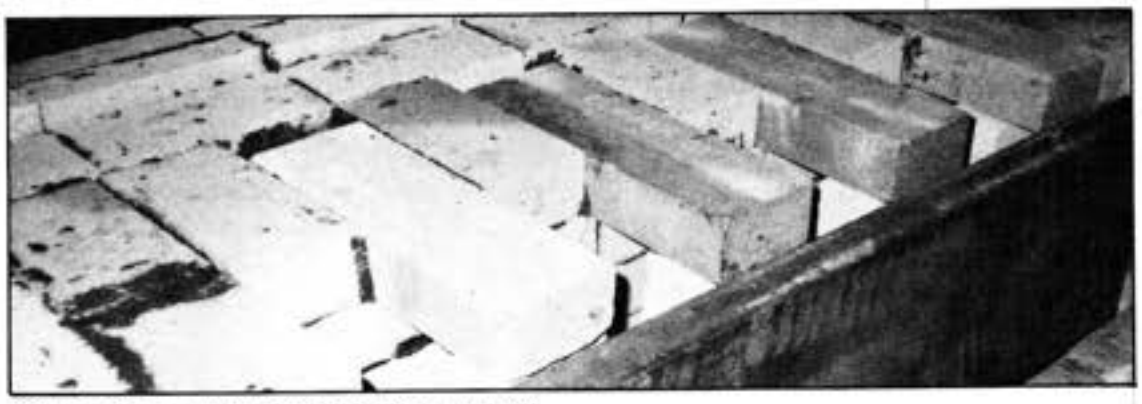
**Old brick up to tier 23 indicating the deterioration of refractories (3)**



**Wooden forms used to contain high temperature (4) castable material (Tiers 1-4)**



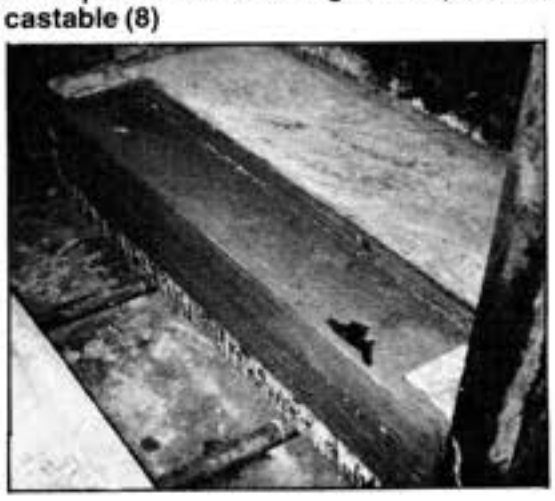
**Cut skew brick ready for installation of first wall plate (5)**



**Kicker brick for support of wall plates (6)**

**Stainless steel greased hanger for suspension of the arch (7)**

**Floor plate readied for higher temperature castable (8)**



refractories, a program was established for rebuilding and increasing the oven width to 18 inches. (Figure 1)

A rebuild of this nature presented an excellent opportunity to incorporate several improvements in design which would lead to a more efficient operation. A review of all information indicated that to improve the overall efficiency, three essential areas of design change would be required:

(1) The oven width would be increased to 18 inches;

(2) The quality of the refractories would be upgraded; and

(3) The charging system would be improved.

A market research of refractory products indicated that a great cost savings and a large increase in temperature rating could be obtained by replacing certain expensive refractory brick with high temperature castable refractories. The areas that were selected for the use of castables were the arch, tiers 1 — 4, and the sole plate.

The final area that required improvement was the charging system. Previous experience indicated that the present diameter of the charging stack would be insufficient for handling the larger volume of coal charged. It was determined that the charging stack would need to be increased from 5 1/4 inches inside diameter to 8 inches inside diameter.

The increased diameter of the charging stack provided an additional benefit. Previously, coal volatiles were removed from the carbonization chamber by using a separate exhaust stack that was incorporated into the oven arch. The use of an additional stack added weight to the arch and produced stress cracks. It was decided that an additional 6 inches inside diameter steel pipe would be welded to the charging stack at a 45 degree angle which provided the necessary exhaust port for all volatile gasses and eliminated some of the weight of the original stack.

The oven's doors were removed first, allowing the movable wall to be fully extended and secured in place. (Figure 2) The oven refractories were then removed one tier at a time with special attention being given to photographing each tier for future reference. (Figure 3)

Fabrication began with the addition of a 4 1/4 inch steel plate to the frame enclosure of the oven arch. This represented an over-all width of 17 3/4 inches and the remaining 1/4 inch would be accounted for by using a 1/4 inch gasket between the movable and fixed walls. Once the metal fabrication was completed, wooden forms were constructed for the casting of the first four tiers with a suitable castable. (Figure 4) Tier 5 required skew brick to be installed for the foundation support for the silicon carbide wall plates. Skew brick could have been ordered, but required 12 — 18 weeks for delivery. Therefore, all bricks were cut at Gallagher. The skew bricks were arranged on top of the castable so as to produce an angle of support for the silicon carbide wall plates. (Figure 5)

The completion of tier 6 formed the foundation for the bottom of the flue chambers. The remaining tiers of the flue chamber would require globar terminal shapes which were to be made from a formable plastic refractory.

The installation of tiers 7 — 10 formed the first portion of the flue chamber and permitted the installation of the first silicon carbide wall plate. The kicker bricks were installed next. The brick formed a support for the silicon carbide plates and extended into the flue chamber, to cause the heated flue air to circulate in a pattern that would heat all of the silicon carbide walls evenly. (Figure 6) The remaining tiers 24 — 27 were installed to produce a void in which the arch could be cast.

Wooden forms for the suspended arch were constructed and stainless steel anchors were suspended within the forms and firmly secured to a steel channel that was attached to the top of the oven's metal casing. Prior to installing the castable, the charging stack and all metal anchors had a heavy coat of grease applied. The grease on the anchors and charging stack would volatilize when the oven was heated, producing an expansion joint for the metal. (Figure 7)

The castable was poured and reached a stability point which permitted the drilling of 1/8 inch holes, 3 inches into the bottom of the arch, to permit excess water to drain from the castable. The remaining tiers — 28, 29, and 30 — were installed and acted as an insulating barrier to keep heat loss at a minimum and improve the over-all efficiency of the oven.

Previously, the floor of the carbonization chamber had consisted of a 2 inch thick silicon carbide plate. However, a replacement plate was not available at that time. Therefore a wooden form was constructed within the oven in which a suitable castable material would be poured to serve as the floor of the oven. Care was taken to allow for 1/8 inch expansion on both ends and also along the side that came into contact with the fixed wall. (Figure 8)

The last part of the rebuild was the installation of the castable for the doors. The doors were to be comprised of two different castables: a high temperature castable for temperature stability, backed by a light-weight castable used to reduce the over-all weight of the doors.

The oven was now ready for the pre-operation bake-out. This was accomplished by inserting gas lances into the flue chambers and bringing the flue temperature to 250 degrees F at a rate of 10 degrees per hour, which eliminated the moisture of the castables and refractories. All 12 globars were then installed and power was turned on. The temperature increased at a rate of 25 degrees F oer hour. This was continued until 1,000 degrees F were reached at which point the rate of rise was increased to 50 degrees F per hour and continued until 1,800 degrees F were attained.

At 1,800 degrees F, the oven doors were opened and the interior inspected. All castable refractory materials, including the suspended arch and floor of the oven, were in excellent condition. There were not any expansion or contraction cracks visible and the silicon carbide plates were locked into a sealed position, preventing any volatile escaping into the flues.

This rebuild project was accomplished in six months by utilizing the personnel and facilities at Gallagher Research Center. Normally a project of this size, when contracted by an independent firm, would have not received the same degree of attention to details and precision given by Gallagher personnel during the rebuilding of the oven. The oven has now been in operation for approximately 10 months without any major refractory repair and is expected to remain in operation under these conditions for at least 10 years.

**C. T. Ingraham**

**R. A. Rice**

*C. T. INGRAHAM is director of research, Gallagher Coal Research Center at Crab Orchard, West Virginia for Westmoreland Coal Co. Ingraham received a bachelor's degree in chemistry from Ohio University in 1955 and studied for a master's degree at East Tennessee State University.*

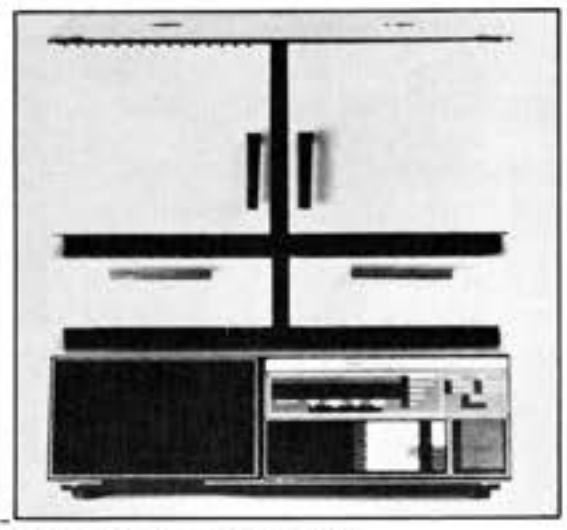
*R. A. RICE is assistant to the director of research at Gallagher Coal research center, with experience in the supervision and operation of The Center and the evaluation of metallurgical coals through the use of the Movable Wall Experimental Coke Oven. He is a graduate of the University of Charleston with a bachelor's degree in science.*

# COAL QUALITY PRODUCTS

The current state-of-the-art instrumentation for coal analysis. Many of the products reviewed here will be shown at the 1982 Coal Testing Conference.

If your business has a new product of interest to the coal testing industry, send a release to *The Journal of Coal Quality*, 3322 Pennsylvania Ave., Charleston, WV 25302. (304/343-5185). Include a brief description of the product and a black & white photograph if possible. Releases will be used as space permits.

Please enclose a $15 check for handling costs for the reader's service card. Deadline for product news for the March issue is January 22. Deadline for the June issue is April 15.



**Model 490 Coal Analyzer**

cess up to 80 samples in a single day's run, for a savings of 1½ man-days per 80 samples run. And Coal Analyzer results meet or exceed repeatability and reproducibility requirements of ASTM method D3172, the Proximate Analysis of Coal and Coke.

Utilizing the latest microprocessor technology, the Analyzer automatically controls heating temperature and rate, atmosphere, and duration of run. It displays results on large LED readout and prints results of all four determinations, sample ID number, and initial sample weight at end of each run.

A compact, self-contained unit, the Coal Analyzer contains oven, furnace, desiccator, and microprocessor modules. It incorporates a continuous LED digital display, printer, and BCD output. The unit also comes equipped with an interface for the Mettler A-30 high-speed balance for automatic sample weight entry.

**For information, circle No. 18**

**Ohio Thermal Model OCA-FI**

COLUMBUS, Ohio — *Ohio Thermal's* Model OCA-F1 furnace is specifically designed for the ashing of coal samples at temperatures up to 1000 degrees C (1800 degrees F).

The unique chamber design gently passes fresh, preheated air over the ashing area (6 inches wide by 10 inches deep by 4 inches) by natural convection, without the need for artificial air movement.

The furnace has double wall construction for operator comfort and safety and it is provided with an exhaust duct for outside venting.

**For information, circle No. 21**

PITTSBURGH, Pennsylvania — *Fisher Scientific's* Model 490 Coal Analyzer analyzes a single sample for % moisture, volatiles, ash, and fixed carbon.

Fisher will exhibit the coal analyzer at the 1982 Coal Testing Conference.

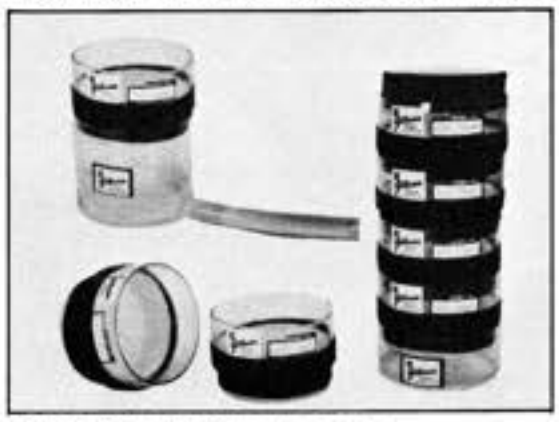
More economical to use than alternative methods, the Model 490 can pro-

WORTHINGTON, Ohio — Non-metallic 3 inch-diameter sieves are now available from *Gilson Company, Inc.*, for laboratory sieving operations where metallic contamination must be avoided, or for other special applications.

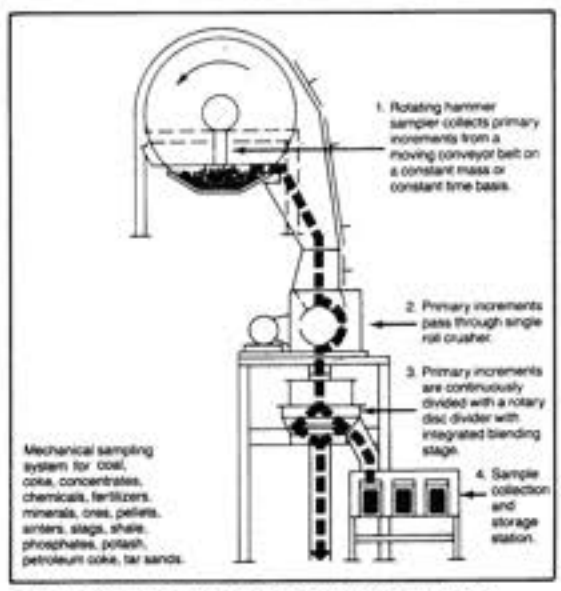
The new Gilson 3 inch sieves have durable clear polycarbonate frames with polyester mesh. They are available in U.S. Sieve Series openings #50 through #400, and finer mesh sizes to 17 μm. Sieve construction provides sealed nesting of the sieve stack. Sieve covers and pans are available.

For wet sieving, the transparent frames of the Gilson sieves permit visual monitoring of liquid levels, and an optional wet-test pan with drain can be substituted for the regular dry-sieving pan.

**For information circle No. 19**



**Gilson 3-inch diameter sieves**




**Example of Tema sampling system**

*Tema-Siebtechnik's* mechanical sampling equipment and systems are designed to produce unbiased samples of coal, coke, minerals and ores in accordance with ASTM standards.

The sampling equipment is one of several Tema products to be exhibited at the 1982 Coal Testing Conference.

Tema's Rotating Hammer Sampler is a new design. It's simple, economical and has the ability to remove unbiased samples from the top of a moving conveyor. The primary increments from the conveyor are fed into a low speed, single roll crusher and crushed to minus 1/4 inch, then continuously divided with a Rotary Disc Divider with an integrated blending stage. A Sample Collection and Storage Station collects and retains the final sample.

**For information circle No. 25**

**Please turn to page 30**

## PRODUCT INFORMATION

Use this card to request more information about any of the products advertised in this issue. Circle the number that appears on the ad, product description or literature mentioned and drop the card in the mail. Expires April 1.

Name _____ Title _____

Company Name _____

Address _____

City _____ State _____ Zip _____

INFORMATION SERVICES WINTER, 1981

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |

Please check one only:

- ☐ Laboratory
- ☐ Utility
- ☐ Manufacturer
- ☐ Consulting/Engineering
- ☐ Coal producer
- ☐ Coal user
- ☐ Coal export/import
- ☐ Coal sales
- ☐ Academic/research
- ☐ Government

_____ Other.

Please ☐ add ☐ leave my name on mailing list.

## SUBSCRIPTIONS

If you are not receiving your own copy of THE JOURNAL OF COAL QUALITY, you may qualify for a subscription. Fill out the following form. Paid subscriptions are $14 per year (U.S.) $20 (U.S.) (Foreign).

Name _____

Title _____

Firm _____

Address _____

City, State, Zip _____

☐ Nature of your job _____

☐ Degree _____

☐ Product or service provided by company _____

_____

☐ Bill me for one year ☐ $14 U.S. ☐ $20.00 (U.S.) Foreign

if I do not qualify for a subscription to CQ.

## COMMENTS

**WHAT did you think about this issue of THE JOURNAL OF COAL QUALITY?**

1. Please circle the number that best describes each article.

| | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| Research | 1 | 2 | 3 | 4 | 5 |
| International | 1 | 2 | 3 | 4 | 5 |
| Low rank coals | 1 | 2 | 3 | 4 | 5 |
| Standards | 1 | 2 | 3 | 4 | 5 |
| Interlaboratory quality control | 1 | 2 | 3 | 4 | 5 |
| Mass spectrography | 1 | 2 | 3 | 4 | 5 |
| Experimental coke oven | 1 | 2 | 3 | 4 | 5 |
| Trade notes | 1 | 2 | 3 | 4 | 5 |
| About people | 1 | 2 | 3 | 4 | 5 |
| Product Gazette | 1 | 2 | 3 | 4 | 5 |
| Editorial | 1 | 2 | 3 | 4 | 5 |

2. Did the contents of this issue meet your expectations?
Totally Close enough Not enough Not at all

3. How useful will the product information be to you?
Very useful Useful Not useful Not at all

YOUR NAME (please print) _____ TITLE _____

COMPANY _____

# The 10 Second Cost-Efficient Coal Sample.

Ten seconds...that's all it takes to get a representative sample of stationary coal with the PSI Auger Sampling System.

This fully bias tested and custom designed sampling system complies with all applicable ASTM standards.

With vertical auger penetration, both our portable and stationary units offer you a highly accurate and economical way to fulfill your sampling needs.

**Call us. After all, time is money.**

## PRECISION SAMPLERS, INC.

PSI

A SUBSIDIARY OF STANDARD LABORATORIES, INC.

3322 Pennsylvania Ave.,
Charleston, W.Va. 25302
304/343-5173

For information, circle No. 14

**Other PSI features include:**

**-flexible financing (lease, lease-purchase, or purchase agreements).**

**-total increment processing**

**-designed for use in railroad cars, trucks, barges, or stockpiles**

**-a variety of refuse handling designs**

# CQ PRODUCTS

**Standard Instrumentation FA57 Automatic Ash Fusion System**

CHARLESTON, West Virginia — Standard Instrumentation, Inc., a subsidiary of Standard Laboratories announces a new product, the *FA57 Automatic Ash Fusion System,* an automated ash fusion-temperature determination apparatus which allows unattended testing by the operator. Standard Instrumentation is a Coal Testing Conference exhibitor.

Computerization and video processing technology allows the operator to insert the ash cones into the furnace, start the system and walk away. The furnace control option provides proper idle, start and end temperatures, with a 15 degree per minute rate of rise during the test. A printed paper tape is available at the end of the test showing the different temperatures of the various fusion stages for each individual sample. A video monitor is available to the operator for optional progress checks throughout the test and regulators are built into the system allowing selection of either reducing or oxidizing atmospheres.

**For information, circle No. 24**

KNOXVILLE, Tennessee — Brad Wheeler, director of the Applications Laboratory at *EG&G Ortec,* has written an applications report about a new X-ray fluorescence analytical method for coal and coal ash. The process utilizes the TEFA™ III X-ray fluorescence analyzer from EG&G Ortec.

With the analyzer, Wheeler said, "Coal users can accurately analyze coal and coal ash for up to 30 major elements and trace elements to improve plant operation and efficiency and coal ash disposal."

The method also eliminates the need for wet chemical procedures and the handling of acids or other hazardous materials for accuracy and safety.

Wheeler is a member of the ASTM D-5 Committee which is developing standards for the X-ray fluorescence analysis of coal and coal ash. The standard for coal ash is expected to go before a subcommittee for balloting before a May meeting of ASTM. The standard on coal is presently in the round robin testing stage.

**For report circle No. 28**

**Parr A513A Quartz Liner**

MOLINE, IL — Extensive studies by Peter C. Lindahl of the Exxon Production Research Company have shown that a quartz-lined Parr 1108 oxygen bomb provides a rapid and accurate method for treating coal samples to determine trace amounts of Be, Cd, Cr, Cu, Pb, Mn, Ni, V and Zn by atomic absorption spectrophotometry.

Lindahl is a scheduled speaker at the 1982 Coal Testing Conference, and will present his paper, "An Oxygen Bomb Combustion/Atomic Absorption Spectrophotometric Method for the Determination of Trace Elements in Coal."

Parr will exhibit at the 1982 Coal Testing Conference and plans 2 workshops.

The quartz-liner comes with platinum electrodes. The removeable quartz cup for the oxygen bomb (with cover) may be used in any 1108 Parr oxygen bomb to hold combustion products. A data sheet and reprints of Lindahl's paper are available from Parr.

**For information circle No. 22**

**Mettler PC220 & PC2200 balances**

HIGHTSTOWN, New Jersey — The PC220 and PC2200 electronic precision balances offer *Mettler DeltaRange®* versatility at the lower-capacity end of the weighing range encountered in lab and industrial applications. These new balances round out a family of DeltaRange models that run from lower capacity units on up to a 36 kg balance.

Mettler will exhibit at the 1982 Coal Testing Conference.

The PC220 offers a 180 g capacity with 0.01 readability, while the PC2200 weighs up to 2100 g readable to 0.1. Both balances accept the Mettler GC301 Application Input Device, a palm-size control unit making the following preprogrammed routine processes available: counting of small parts, determination of net totals, serial weighings towards zero, and determination of weight changes in percent or in grams.

The PC220 and PC2200 are available with the 03 Data Output which can be factory installed or ordered and installed at any later date, which allows various peripheral instruments to be connected to these new PC balances.

**For information circle No. 20**

BECKLEY, West Virginia — A microcomputer-based instrumentation and control system, the first of its kind specifically designed to provide optimum circuitry efficiency in heavy media coal preparation systems, has been introduced by Envirotech Coal Services of Beckley, West Virginia.

The technically advanced system employs state-of-the-art microprocessor circuitry to increase clean coal yield and reduce variability of ash content through precise control of feed viscosity to the heavy media system. In addition, it

**Please see page 31**

# PROFESSIONAL SERVICES

## Testing Laboratories

**BARBOURSVILLE TESTING LABORATORY**

SAMPLING - TESTING - ANALYSIS
CONCRETE - AGGREGATES
COAL - WATER - WASTEWATER
SOILS COMPACTION

1-304-736-3971

6345 Mud River Road
P. O. Box 43
Barboursville, W. Va. 25504

COMMERCIAL TESTING
& ENGINEERING CO

CONSULTING CHEMISTS & ENGINEERS
MAIN OFFICE CHICAGO, IL

Appalachian region

| | |
|---|---|
| Charlerois, Pa. | 412/483-3549 |
| Byesville, Ohio | 614/685-2565 |
| Crossville, Tenn. | 606/248-4205 |
| Pikeville, Ky. | 606/432-2511 |
| Jeff, Ky. | 606/439-1313 |
| Clarksburg, WV | 304/623-3329 |
| Charleston, WV | 304/925-6631 |
| Ceredo, WV | 304/453-6682 |
| Middlesboro, Ky. | 606/248-4205 |

**COMMONWEALTH TECHNOLOGY, INC.**
2520 Regency Road, Suite 104
Lexington, Kentucky 40503
606-276-3506

Environmental and Natural Resources
Consulting and Analytical Services
(Testing • Monitoring • Engineering • Hydrology
• Biology • Geology • Soil Science)

PUT TRI-STATE TESTING TO THE TEST

Tri-State Testing's well-trained and experienced staff can handle virtually any coal assignment—quickly and efficiently.

We give fast and reliable **coal sampling and analysis service**. We've expanded into new facilities to offer **soil and water sampling and analysis** needed for mining permits. Our field services include **bias testing, weighing, and inspecting as well as sampling**. Customized reports are prepared for **washability studies** and **core evaluations**. Ask for **third party sampling and analysis** or give us any other assignment.

Tri-State Testing—where you can be assured of reliable results for all your lab needs.

TRI-STATE TESTING

Tri-State Testing Co., Inc
3321 Winchester Avenue
Ashland, Kentucky 41101
(606) 329-3824
(304) 369-6249
West Virginia Division
Danville, W.Va

## Computerization

**INTEGRATED SYSTEMS INC.**

Alan E. White
President

Custom computer service • lab instrument computerization • computerized energy management and environment control systems • contract new product development

105 Azalea Road
Elkview, WV 25071
304/965-7945

## Engineering & Consulting

**MINING AND GEOLOGICAL ENGINEERS**

400 Oliver Building
Mellon Square
Pittsburgh, PA 15222
(412) 562-1770
Telex No. 866361

**JOHN T. BOYD COMPANY**

Denver, Colorado
(303) 861-4339

Huntington, West Virginia
(304) 697-5504

Houston, Texas
(713) 658-8961

New York, New York
(212) 370-1819

# CQ PRODUCTS

**Continued from page 30**

provides computational capabilities, automated report generation and video graphic displays.

The system is easy to operate and designed to provide essentially uninterrupted performance for improved plant operating reliability, with a potential system payback of from 6 to 12 months.

**For information, circle No. 17.**

*Wadsworth Testing Laboratories, Inc.*, has published a new brochure outlining its environmental and materials testing capabilities, including fossil fuel and coal analysis. Wadsworth Testing laboratories maintains a complete coal testing program composed of proximate and ultimate analysis, ash fusion, mineral analysis of ash, and free swelling index. Wadsworth Testing Laboratories, Inc. was established in 1938 and is a member of the American Council of Independent Laboratories.

**For information circle No. 20**

### Comment? Write CQ.

What did you think about the articles in this edition of **The Journal of Coal Quality?** Have a comment? Did you agree or disagree?

What's on your mind?

Write **The Journal of Coal Quality** about the contents in this issue, or about any issue or subject concerning the coal quality industry. We'll print the best responses in the next edition of CQ.

Send your letters to: The Journal of Coal Quality, 3322 Pennsylvania Avenue, Charleston, WV 25302. Authors must sign their letters. Please include your phone number. Short, tightly-worded letters are preferred.

# INDEX TO ADVERTISERS

# ABOUT PEOPLE

COLUMBUS, Ohio — The Columbus Testing Laboratory Engineering Co. announces the addition of *Patrick Gallagher* to its technical staff. Gallagher was previously chief of the Abandoned Mine Reclamation Program for the Maryland Department of Natural Resources, Bureau of Mines. He will head CTL's Mining Division and has extensive experience in all aspects of mining, including mine reclamation, permits, mine plan design, refuse disposal and drainage control structures.

CTL will open an office in northern West Virginia. This office will not only provide mining services, but also offer services in the other areas of CTL's expertise.

Drummond Coal Co. has made several appointments in its coal quality division.

*Barry W. Kirkpatrick* was named Assistant Quality Control Manager at the main offices in Jasper, Alabama. *Ronald H. Tubbs* is the Lab Supervisor at the Jasper laboratory. *Rick Bryant* is now Laboratory Supervisor at Drummond's Sayre, Alabama facility.

Drummond has also finished construction of a new modular preparation plant at Kellerman for recovering coal fines. A new prep plant and barge loading facility at Short Creek is scheduled to be opened in 1982.

HUNTINGTON, West Virginia — Huntington Steel & Supply Co., announces the formation of a new subsidiary, ESI: Engineered Systems Inc. to produce and market modular coal processing equipment. The plants will utilize new technology in the cleaning and weighing of mined coal.

*T. Richard Koehler* of Huntington Steel is President of this new company. Koehler comes to this position after 25 years in the steel supply industry in Huntington and Wheeling, West Virginia.

*Edward Wickenhofer* has been named as Vice President of Sales.

*Douglas Maxwell* is Vice President.

SALT LAKE CITY, Utah — Norwest Resource Consultants Inc. has added Jerry E. Vaninetti to its staff as Manager of Exploration Services. Vaninetti will work out of Norwest's Salt Lake city office.

Vaninetti has worked 10 years with several Western utility companies. At Norwest, he will be responsible for coal exploration and development geology, economic evaluations of coal deposits and coal utilization evaluations, said D. F. Symonds, President.

Koehler

Wickenhofer

Maxwell

Fields

BECKLEY, West Virginia — Richard W. Bland of Beckley has formed a company to provide consulting services in coal preparation, specializing in technical, economic evaluations of coal properties, prep plants and materials handling facilities.

Bland brings 10 years of experience to Richard W. Bland Inc. He is a former contracting and design engineer for Lively Manufacturing and Equipment Co. The West Virginia University graduate is a member of the NSPE, AIME and the Rocky Mountain Coal Mining Institute.

For information, circle No. 29

Pittston has announced several changes in management appointments. *John E. Nypaver* has assumed the position of vice president of industrial engineering and technical services. *Charles Ellis* has been named director of technical services.

BECKLEY, West Virginia — Eastern Associated Coal Corp. has added *Richard J. McNeely* to its staff as general manager-coal preparation and quality.

PITTSBURGH, Pennsylvania — J. T. Boyd Co. has announced the election of *Harman Van Houten* as Vice President. Houten recently retired from Joy Manufacturing Co. and has extensive experience in the mining and mining equipment industry.

CHAMPAIGN, Illinois — *Carl Kruse* is in charge of the coal analysis laboratory, coal cleaning research and beneficiation of industrial minerals at the Illinois State Geological Survey's newly remodeled Applied Research Building.

Kruse became head of the Survey's Section of Minerals Engineering during 1980. The remodeled Research Building was dedicated in October, 1981. It is called one of the finest facilities for coal testing and research in the Midwest

Kruse conducts research in coal analysis, particularly instrumental or automated analysis, coal structure and chemical desulfurization of coal. He is co-developer of a new charring process. A patent is pending on the process, which has the potential for producing a clean solid fuel from high-sulfur Midwestern coal.

ASHLAND, Kentucky — Dan R. Fields has joined Columbia Coal Gasification Corporation as manager, coal marketing. Fields will be responsible for expanding Columbia's coal sales in domestic and export markets.

Before joining Columbia he had been vice president of public relations for the West Virginia Coal Association since October, 1976 and has worked for 10 years in journalism and public relations related positions in West Virginia and Kentucky.

CHARLESTON, West Virginia — Standard Laboratories Inc. has announced three appointments.

*Homer Coombs* was named corporate Manager-Business Development to introduce Standard to national and international clients. He will also serve as Manager of the Mid-America Division.

*Dick Kelly* will head a new division, the Technical Services Division, which specializes in consulting services.

*Marvin C. Davis* is the new assistant lab manager of Standard's Charleston, West Virginia lab.

Kruse

Vaninetti

Coombs

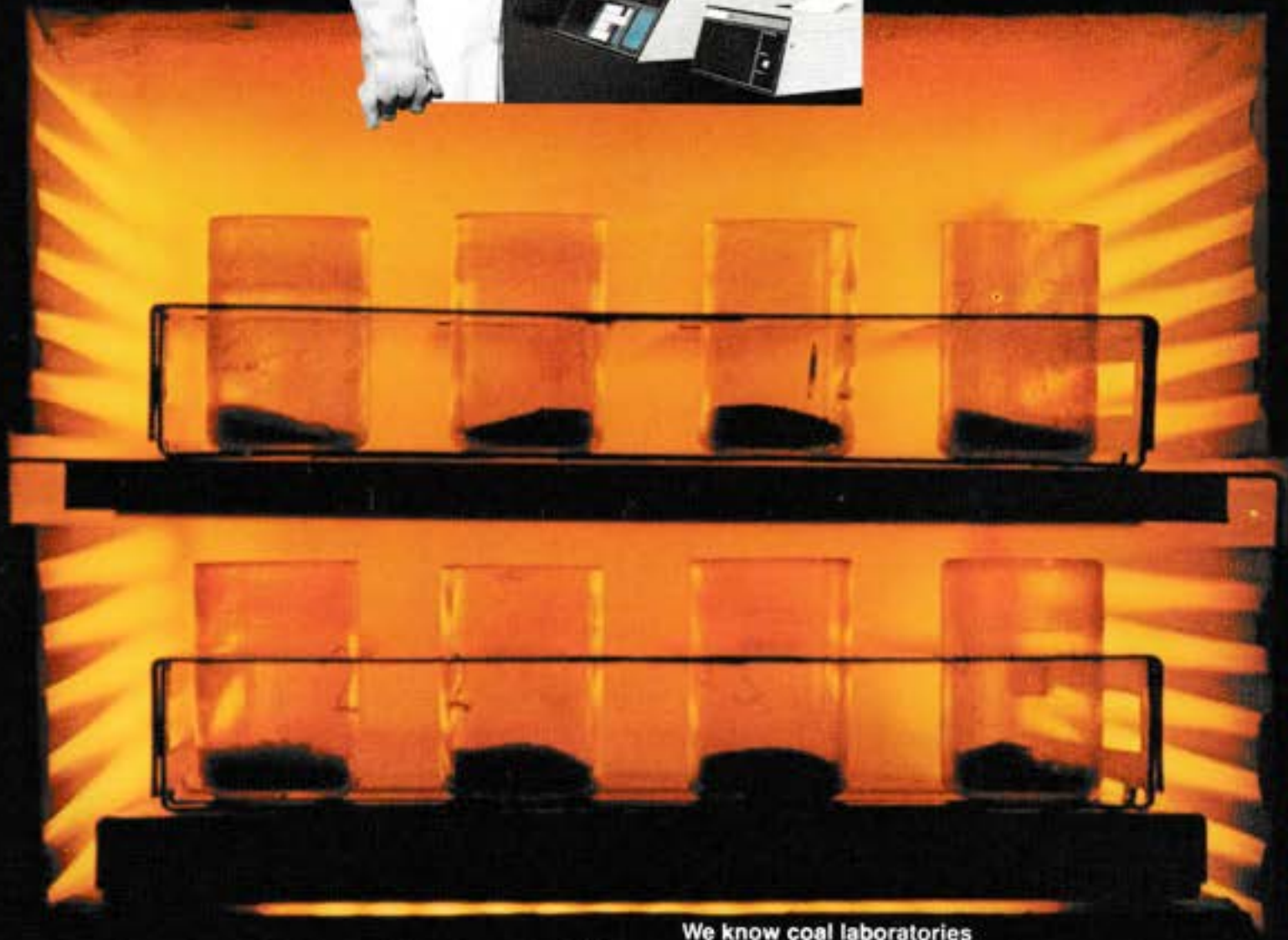
Kelly

# You're looking at the hottest new idea for coal analysis in years

It's the Fisher Model 490 Coal Analyzer. The fastest, most economical approach ever to determine moisture, volatiles, ash and fixed carbon on the same sample. Lets you handle up to **80 proximates in a single working day.** With results that meet (or are better than) the repeatability and reproducibility requirements of ASTM D3172 for proximate analysis.

Model 490 supplies everything you need, yet requires just over 4 sq ft of benchtop. Temperature, heating rate, atmosphere and time are automatically controlled by the unit's microprocessor. Calculations, too, are taken care of. Then all results are printed out, logically, under the appropriate sample number.

The crucible's eye-view of the analyzer's furnace gives you an idea of what we're talking about. For a better idea, send for a free bulletin today.



We know coal laboratories

**Fisher Scientific Company**

711 Forbes Avenue
Pittsburgh, Pennsylvania 15219
(412) 562-8543

For information, circle No. 15

# AUTOMATIC CALORIMETER

## LECO®'s AC-200...

**Combining microprocessor technology with the isothermal method.**

- Rapid—up to 15 determinations in one hour using a three-vessel system
- Automatic—charge the bomb, place it into the instrument, and touch the start button
- No Water Handling—eliminates operator error.
- Direct Reading—calories, BTUs, or joules per kg.
- Accurate—equals or surpasses all methods applicable to coal and oil.

***CONTACT LECO® TODAY!***

LECO®

LECO CORPORATION 3000 Lakeview Ave., St. Joseph, MI 49085, U.S.A. Phone: (616) 983-5531

Offices: California (714) 957-8227 • Texas (713) 931-0000 • Pittsburgh (412) 776-4891 • Canada (416) 624-6933 • Mexico City (905) 658-1877
Sydney, Australia (02) 648-0231 • Rio de Janeiro, Brazil 284-0997 • Manchester, England 061-483-6154 • Paris, France 993-9800 • Munich, West Germany (089) 9031076
Heerlen, Netherlands 045-317575 • Madrid, Spain 734-2151 • Johannesburg, South Africa 906-8306 • Stockholm, Sweden (08) 83 72 40

For information, circle No. 16