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SPECTROGRAPHIC ANALYSIS AND APPLICATION AT BOEING AIRCRAFT COMPANY OF SEATTLE

By THOMAS N. ROSS

Material Testing Laboratory, Inspection Department, Boeing Aircraft Company, Seattle, Washington

The science of spectrographic analysis is one of those that began with Newton.

It was in 1666 that the old master conducted the experiments with prisms by which he demonstrated that white light contained all the colors of the rainbow and that the rainbow could be recombined to produce white light again.

Before the spectroscope gave rise to the analytical tool which is the modern spectrograph, however, it was necessary for subsequent workers to discover that not all spectra are continuous rainbow bands, but that some are systems of scattered lines, which represent extremely narrow wavelength ranges; that the lines are produced by the vapors of definite chemical elements made luminous by thermal or electrical excitation; that the spectrum continues beyond the range of visual perception; that the spectrum can be recorded photographically, both within and far beyond the visible range; and finally, that the photographic record can be measured by objective photo-electric means.

The centuries between Newton's and our time were filled with great discoveries which frequently renewed the hope that spectral analysis could soon be reduced to a quantitative science, yet it was not until the years immediately preceding the last war that photographic and photo-electric measurements became sufficiently exact to make spectrographic methods acceptable for industrial quantitative work.

At the present time, the applied science is advancing swiftly on the following basis:

Each element produces light in a number of wavelengths when properly energized in the gaseous state. An electrical discharge is commonly employed, both to vaporize the material being analyzed and to excite the spectra.

The different wave lengths of light produced are separated by means of a prism or "grating" after passing through a narrow slit, so that an optical image of the slit is multiplied by the number of wavelengths present in the light and dispersed in corresponding regions of the spectral band. The multiple images are photographed simultaneously and form the familiar lines of the spectrum.

By standardizing electrical, optical, and photographic conditions, it is possible to obtain spectrum photographs of such high reproducibility that the photographic line densities bear a calculable relationship to the concentrations of the elements producing each spectrum. These densities

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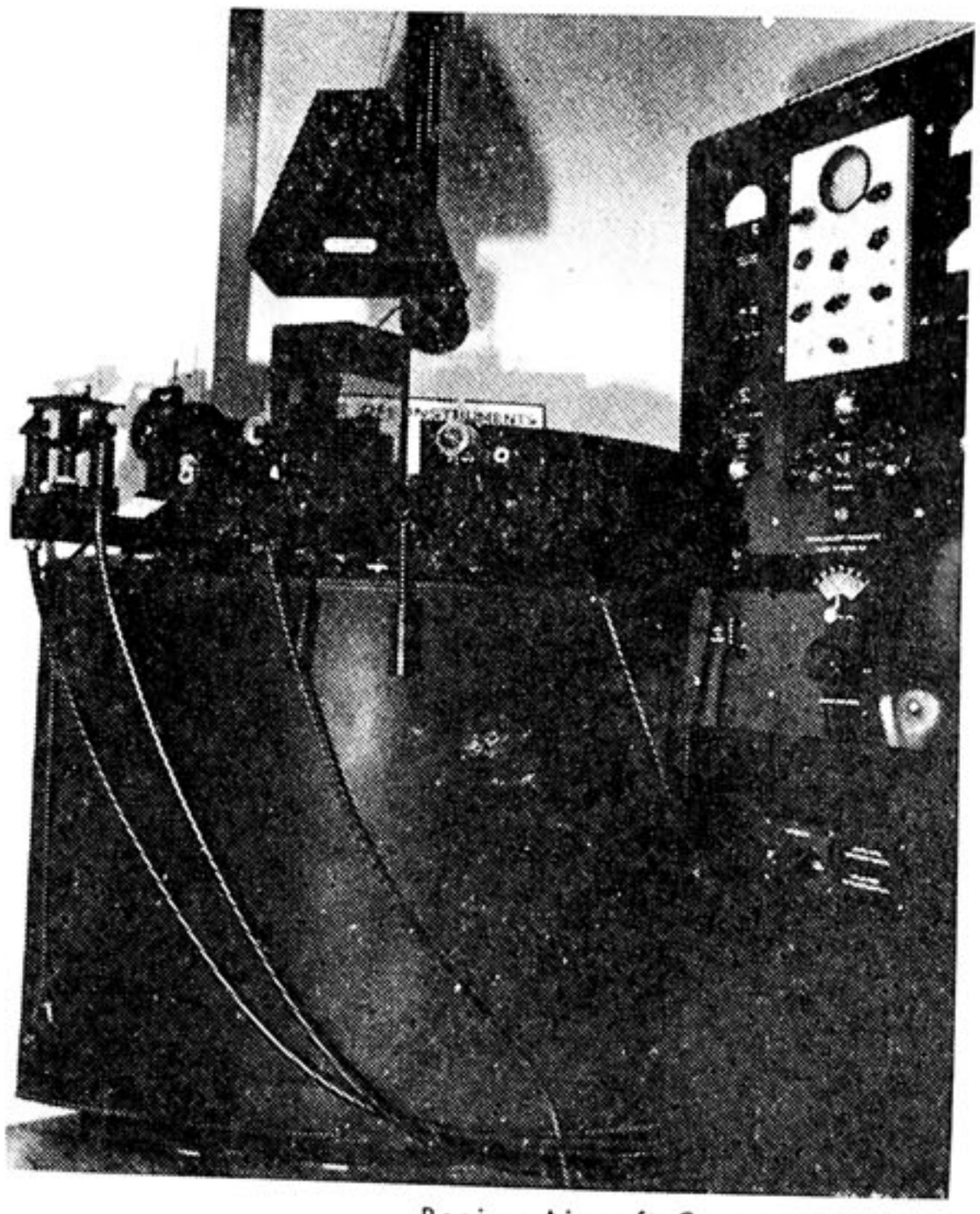

Boeing Aircraft Company Photo

A Multisource Unit [right] and Spectrograph as installed in the Material Testing Laboratory of the Boeing Aircraft Company's Inspection Department in Seattle. The part on Petrey stand at extreme left is being analyzed non-destructively by direct spark excitation.

December Meeting

PUGET SOUND SECTION OF THE AMERICAN CHEMICAL SOCIETY

Friday • Dec. 20, 1946

Registration 1:00 p.m.

RESEARCH CONFERENCE

[For details see opposite page]

Two Sections — Both Starting at 1:30 p.m.

BAGLEY HALL — 1:30 p.m. to 3:50 p.m.

Room 140—Section A

PHYSICAL, INORGANIC AND BIOLOGICAL

Dr. H. V. Tartar, Chairman

Room 236—Section B

ORGANIC AND INDUSTRIAL

A. J. Norton, Chairman

MAIN SPEAKER

4:00 p.m. — Room 140 — Bagley Hall

DR. JEROME F. SAEMAN

Chief Chemist, Willamette Valley Wood Chemical Co.

SUBJECT

"Reactions Involved In Wood Saccharification"

★

REFRESHMENTS AND SOCIAL HOUR IMMEDIATELY FOLLOWING THE MAIN ADDRESS

RESEARCH CONFERENCE TO BE FEATURE OF DECEMBER MEETING

A very fine two-section meeting followed by a main speaker has been organized for the afternoon of December 20. Following are details of the program:

1:00 p.m. Registration, Lobby, Bagley Hall

1:30 p.m. SECTION A—PHYSICAL, INORGANIC & BIOLOGICAL

DR. H. V. TARTAR, University of Washington, Chairman.

Room 140—Bagley Hall.

1:30 p.m. E. C. LINGAFELTER and L. H. JENSEN, University of Washington.

"*X-Ray Crystallographic Studies of Organic Sulfonates III—The Monohydrates of Certain Sodium 1 — Alkane Sulfonates.*"

1:50 p.m. LARRY SACKS, HILDA DANIELS and J. L. MCCARTHY, Pulp Mills Research Project.

"*Determination of Fermentable Sugars and Fermentability of Sulfite Waste Liquor.*"

2:10 p.m. R. D. SPRENGER, College of Puget Sound.

The Structure of the Antibiotic Citrinin."

2:30 p.m. H. V. TARTAR and F. E. MCKENNA, University of Washington.

"*Studies on Hemiacetal Formation in Alcohol-Aldehyde Systems.*"*

2:50 p.m. R. W. MOULTON and N. P. ANDERSON, University of Washington.

"*Adsorption of Hydrocarbons on Activated Charcoal.*"

3:10 p.m. E. R. NORRIS and J. C. MATHIES, University of Washington.

"*Preliminary Studies on Yellow-fin Tuna Pepsin.*"

3:30 p.m. G. H. ROHRBACK and GEORGE H. CADY, University of Washington.

"*Preparation of Fluorine Perchlorate from Fluorine and Perchlorate Acid.*"

*See abstract of this paper page 21.

1:30 p.m. SECTION B—ORGANIC AND INDUSTRIAL

A. J. NORTON, Consulting Chemist, Chairman.

Room 236—Bagley Hall.

1:30 p.m. W. R. MOFFETT, Chief Chemist, K. W. GERSTMAN, Chemist, and R. L. BREWSTER, Chem. Engr., Western Division. Casein Co. of America.

"*Formaldehyde in Manufacture and in Use.*"—Brief description of manufacture and experimental data on stability, analysis and other factors of importance in use.

1:50 p.m. W. G. WESTOVER and H. K. BENSON, University of Washington.

"*A Spectrophotometric Study of Nitroso-Lignins.*"

2:10 p.m. D. E. PENNINGTON and D. M. RITTER, Pulp Mills Research Project.

"*Characterization of a Purified Lignin*

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(Continued from page 7)

Sulfonic Acid by Free Diffusion Analysis."

2:30 p.m. Q. P. PENISTON and J. L. MCCARTHY, Pulp Mills Research Project.

"*Lignin Sulfonic Acid I—Purification by Continuous Dialysis.*"

2:50 p.m. GENE V. BAXTER, Adhesive Products Co.

"*Comparison of Industrial Control Methods for Determination of Formaldehyde.*"

3:10 p.m. R. S. GREAVES and R. W. MOULTON, University of Washington.

"*Phosphate Fertilizer from Fused Olivine—Phosphate Rock Mixtures.*"

4:00 p.m. Both sections convene in Room 140, Bagley Hall, to hear the main speaker:

DR. JEROME F. SAEMAN, Chief Chemist. Willamette Valley Wood Chemical Co.
"*Reactions Involved in Wood Saccharification.*"

5:00 p.m. Refreshments and social hour.

Our Main Speaker . . .

DR. JEROME F. SAEMAN

We are fortunate in having for our main speaker Dr. Jerome F. Saeman. Dr. Saeman was born April 10, 1916. He obtained his Ph.D. from the University of Wisconsin in 1942. He was employed at the U. S. Forest Products Laboratory as a graduate student and after graduation, as a staff member. Chief work at the Forest Products Laboratory was on the hydrogenation of lignin, and on theoretical and practical aspects of wood hydrolysis and the utilization of wood sugar.

Dr. Saeman traveled in Germany from May to November, 1945, as a Scientific Consultant to the Foreign Economic Administration, studying wartime advances in the chemical utilization of wood. He is now serving as Chief Chemist for the Willamette Valley Wood Chemical Co.

Following is a brief abstract of Dr. Saeman's address:

Studies carried out in recent years have shown that two first order reactions are involved in wood saccharification; one, the reaction by which cellulose is converted to sugar; the other, a simultaneous reaction by which sugar is destroyed. The reaction rates are comparable in magnitude, but they change at different rates with variations in acid concentration and temperature.

The determination of the various constants involved clearly established the conditions favoring high yields of sugar.

This work presents an interesting case of the application of chemical kinetics to a practical industrial problem. In addition, the work gives promise of being useful in the chemical characterization of cellulose.

SPECTROGRAPHIC ANALYSIS

(Continued from page 5)

are measured photo-electrically for recognized lines peculiar to each element of an unknown sample, and the computation is then performed by reference to line densities previously found in samples of known composition.

The most recent development dispenses with the photographic step, being based on direct photo-electric integration of line intensities during excitation of the spectrum, but this refinement is not yet applicable in laboratories where quantitative and qualitative work must be performed alternately with a variety of materials.

The photographic method, though less rapid, remains the best for common industrial uses—namely, quantitative determination of metallic elements in alloys, and it is this method that is used by the Boeing Aircraft Company in Seattle.

The equipment used in the Boeing laboratory, aside from specialized minor accessories, is of A.R.L.-Dietert design and manufacture.

The principal units are the grating spectrograph, the Multisource excitation unit, the developing machine, film washer and film dryer, the comparator densitometer, and the calculating board.

This equipment was originally installed in a temporary location in March, 1944, and was moved to its present permanent location in November, 1945.

The permanent installation embodies features generally found to contribute to stable and efficient operation, such as an air-conditioned room and installation of the spectrograph so that films may be removed from the camera directly into the darkroom.

In addition to these widely applied details of spectrographic installation, several minor variations on the original equipment have been found necessary.

For example, the original contacting thermometer controlling the developing solution temperature has been replaced by a Fenwal thermo-regulator, which has been found much more reliable. The developing tray, originally of cast iron,

(Continued on page 10)

OUR COVER PHOTO

Courtesy of

NORTHWESTERN MUTUAL FIRE ASSOCIATION

"BEAUTIES OF PUGET SOUND NATIONAL FORESTS IN WINTER"

This photo appealed to us on the basis of it being symbolic of the Christmas Season.

JANUARY MEETING

January 24, 1947

A. C. S. Tour Speaker

DR. W. ALBERT NOYES

University of Rochester

SUBJECT

Organic Photochemistry

SPECTROGRAPHIC ANALYSIS

(Continued from page 9)

has been replaced by a stainless steel tray, thus eliminating a corrosion problem which resisted previous efforts to overcome it by means of paints and platings.

Aside from these minor changes, and certain additions, the apparatus has been used as received, and has given excellent service. The Multisource unit, in particular, has been found to afford excellent control of excitation which permits a critically damped spark to be used, minimizing, though not completely eliminating, the influence of metallurgical history of samples upon line-intensity ratios.

Discharges from the Multisource unit fall into two broad classes called by the manufacturer "arc-like" and "spark-like."

The first type of discharge is produced when the analytical gap is broken down (discharge initiated) while current is flowing through the half-wave rectifier contained in the unit. This condition, designated as "phase 0°" in the qualitative section of Table II (at the end of this article), permits a current to flow which is limited only by the resistance circuit containing the analytical gap. In practice, the analytical sample is subjected to many cycles of this discharge over a measured period of time, usually at least twenty seconds.

Boeing Spectrographer Albert Mowery reads a comparator-densitometer, which locates critical lines of spectrums and measures densities for Inspection Department quantitative determinations. Film calibration curve is plotted on board at right. Slide rule type calculator at left facilitates direct reading of percentage composition for commonly-used alloys.

The critically damped "spark like" discharge is obtained by setting the initiator discharge 180 degrees out of phase with the action of the rectifier tubes so that the rectifier current flows into a condenser provided for the purpose and is released across the analytical gap during the following half-cycle of the alternating-current input while the rectifier is inactive. The resistance of the analytical circuit in this case is adjusted to such a value that the discharge from the condenser takes place in a minimum of time without oscillation, as implied by the definition of critical damping. This brevity of discharge cycle seems to be the important condition for minimizing effects arising from differences of microstructure characteristic of alloys which have been differently formed and treated. In this case also, the discharge continues over a measured period of seconds at the 60-cycle input frequency.

In aluminum and magnesium alloys, it has been found possible to use single systems of working curves for castings, forgings, extrusions, sheet, etc., which was not possible when excitation conditions other than the critically damped Multisource discharge were employed. The only serious irregularities encountered have arisen when dealing with vendors other than the source of the standards. At present an investigation is under way to isolate, if possible, the perplexing factor that prevents working curves which are developed using aluminum alloys supplied by one producer from being applied to the corresponding products from other sources.

The comparator-densitometer has been used entirely without modification, and has performed reliably ever since its original installation.

In order to obtain greater convenience and accuracy in the calculation of line intensities, the Boeing laboratory has followed the same course as other industrial laboratories, finding it necessary to modify and supplement the conventional calculating board. Substantial improvement was obtained by elevating the sur-

face from its original nearly horizontal plane to an angle of approximately forty-five degrees, by projecting points on the working curve downward to a straight base line, and by polishing the vertical scale to transparency and scribing a reference line underneath by means of which the underlying horizontal scale can be read without parallax.

After an extensive period of comparison of the relative accuracies of analyses, performed with and without background corrections, it was decided to abandon these corrections for all types of materials except brasses and bronzes. The corrections were retained for the copper-base alloys because the wide variety of alloying elements, which may vary from very low to high concentrations, produces correspondingly variable backgrounds in all regions of the spectrum commonly used in analysis.

Having dispensed with background corrections, the next logical step was to reduce the working curves to sliderule form, and this has been done for aluminum alloys, magnesium alloys and steels.

Materials for analysis are, of course, most commonly received in the form of standard shapes, and as partially or completely finished parts. In order to make the tests non-destructive in as many cases as possible, and also in order to minimize the time and facilities used in sample preparation, the flat-surface sparking technique with a 120 degree conical graphite electrode has been made the basis of all quantitative work.

The required flat surfaces are prepared by a variety of procedures suited to the original form of the samples, a quarter-inch diameter area being considered the minimum for normal accuracy of results.

Massive sections from bar and heavy tubing are simply ground or filed flat so as to expose a section at right angles to the axis. Bars that are originally too small are prepared when possible by upsetting like a rivet head or by doubling them back upon themselves and filing a flat surface. Thin-walled tubes are crushed to an elliptical form, or flattened completely, and then filed as deeply as is practicable.

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SPECTROGRAPHIC ANALYSIS

(Continued from page 11)

Rough forgings and castings are ground or filed where flash or gates and risers appear so as to expose interior sections of the metal, as all hot-worked surfaces seem to be enriched or depleted in certain elements, and hence unreliable for analysis.

Magnesium almost always appears depleted in the surface of aluminum alloy forgings and castings, while manganese appears high on most steel surfaces that have been hot-rolled or forged. Other elements show impaired reliability in analysis, though less tendency to systematic error, when the spectrographic discharge impinges upon hot-worked surfaces or layers of metal immediately underlying such surfaces.

The use of files and abrasives is not considered to be the ideal way to prepare specimens, as the multiple cutting edges of such implements tend to clog and carry contaminating materials from one specimen to another. However, precautions are taken in this respect and analyses seem to be affected only slightly by the non-uniformity of surface textures produced.

Qualitative work is accomplished with an arc-like Multisource condition, the unknown sample usually being placed in a high-purity graphite cup* which is completely burned away by the discharge. If the sample material is in solution, the lower end of the electrode is placed in a Bunsen flame and heated until the solution boils away readily when introduced drop-by-drop. This process is continued until a visible residue appears in the cup, or until about a hundred drops have been boiled to dryness. Since concentration and even the essential nature of the specimen may frequently not be known in advance, the first exposure often serves only to indicate whether more or less material should be used for best determination of all constituents. Paste-like samples can usually be dried to a solid in the analytical cup without powdering, but wherever a finely divided material results (or when the sample is already in flake or powder form) gum arabic is used to hold it in the cup. Solid metallic unknowns, when obviously not belonging to the classes of alloys for which quantitative techniques have been developed, are also analyzed by means of the arc-like discharge, but in this case without use of a cup electrode, the sample usually being large enough to be held normally by means of the arc-spark or Petrey stands.

Occasionally a job is done with absorption spectra, in which case an incandescent light source is used and a step-sectored spectrum is placed adjacent to the absorption spectrum. This affords means for establishing four match-points at the ends of each transmission band so that simple absorption patterns can be reduced to semi-quantitative terms. Obviously, a more elaborate technique would be needed for complex systems of absorption bands.

In normal operation, the average performance of the spectrograph results in production, reading and computation of data from one film in two hours. This usually involves forty-five quantitative determinations at the rate of nine spectra per film and five determinations per spectrum. Time per determination is thus under three minutes. This time can, and has been, halved by using a mass production technique in which several films were being processed at the same time. Maximum speed attainable by this measure is set first by the capacity of the comparator-densitometer, which operates at a relatively constant speed, and secondly, by considerations of relative urgency of particular jobs, which may necessitate concentration of attention on a single spectrum out of its proper order. When elapsed time, rather than time per determination, is the prime consideration, a film bearing a single spectrum can be exposed, read, and the results computed in less than an hour, the greater

(Continued on page 14)

*The use of ordinary carbon electrodes has been abandoned for both qualitative and quantitative work because certain impurity elements, among which Titanium is notable, are so plentiful as to mask significant amounts of these materials in the unknown.

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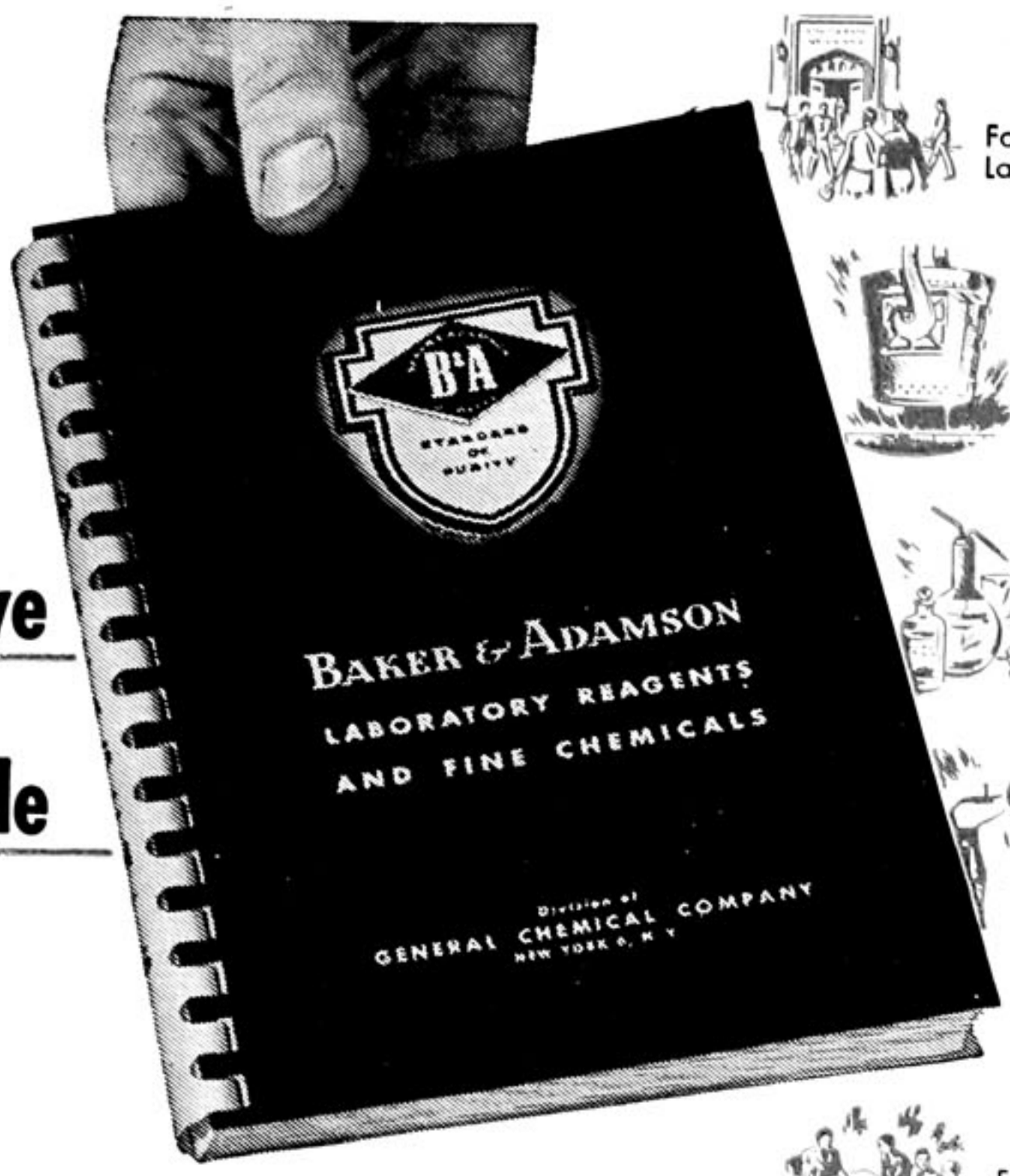

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SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

SPECTROGRAPHIC ANALYSIS

(Continued from page 12)

part of the time being consumed in film processing since Eastman Spectrum Analysis No. 2 film is used and clear, permanent films do not result with reasonable reliability if the processing is hastened. The reason for using this film rather than the faster No. 1 film is that the wide latitude and relatively uniform contrast permit all determinations for a single sample to be obtained from a single spectrum. These advantages offset the longer processing time, particularly since it is not always possible to anticipate the intensity level at which the spectrum of a sample in an unusual form will appear.

Accuracy of results is adequate for positive identification of the many alloy types entering into aircraft construction. Questionable cases are settled by check analyses run by conventional wet chemical methods. Except for irregularities such as have already been noted with alloys from unstandardized sources, or in situations where segregation of constituents is severe, results can usually be relied upon to fall within +10% of the quantity of minor constituent present. Thus, if a sample contains, for example, .5% Mg, the result may fall anywhere between .45% and .55%. Typical of the best results are those obtained with wrought aluminum alloys containing copper between .02% and .30%, in which case the copper is consistently determined within 2% of the quantity present. Obviously, as the amount of minor constituent diminishes, the absolute accuracy of the determination increases until the limit of spectrographic sensitivity for the particular element is reached. Therefore, it is interesting to note that the absolute accuracy of the spectrograph is at its best in many cases where chemical accuracy is hardest to attain.

The greatest difficulty from segregation, aside from surface effects, occurs in brasses and bronzes, particularly with lead contents above 5% and with iron in any concentration whatever. Manganese, wherever found, seems to give rise to variable calibration curves which, how-

(Continued on page 18)

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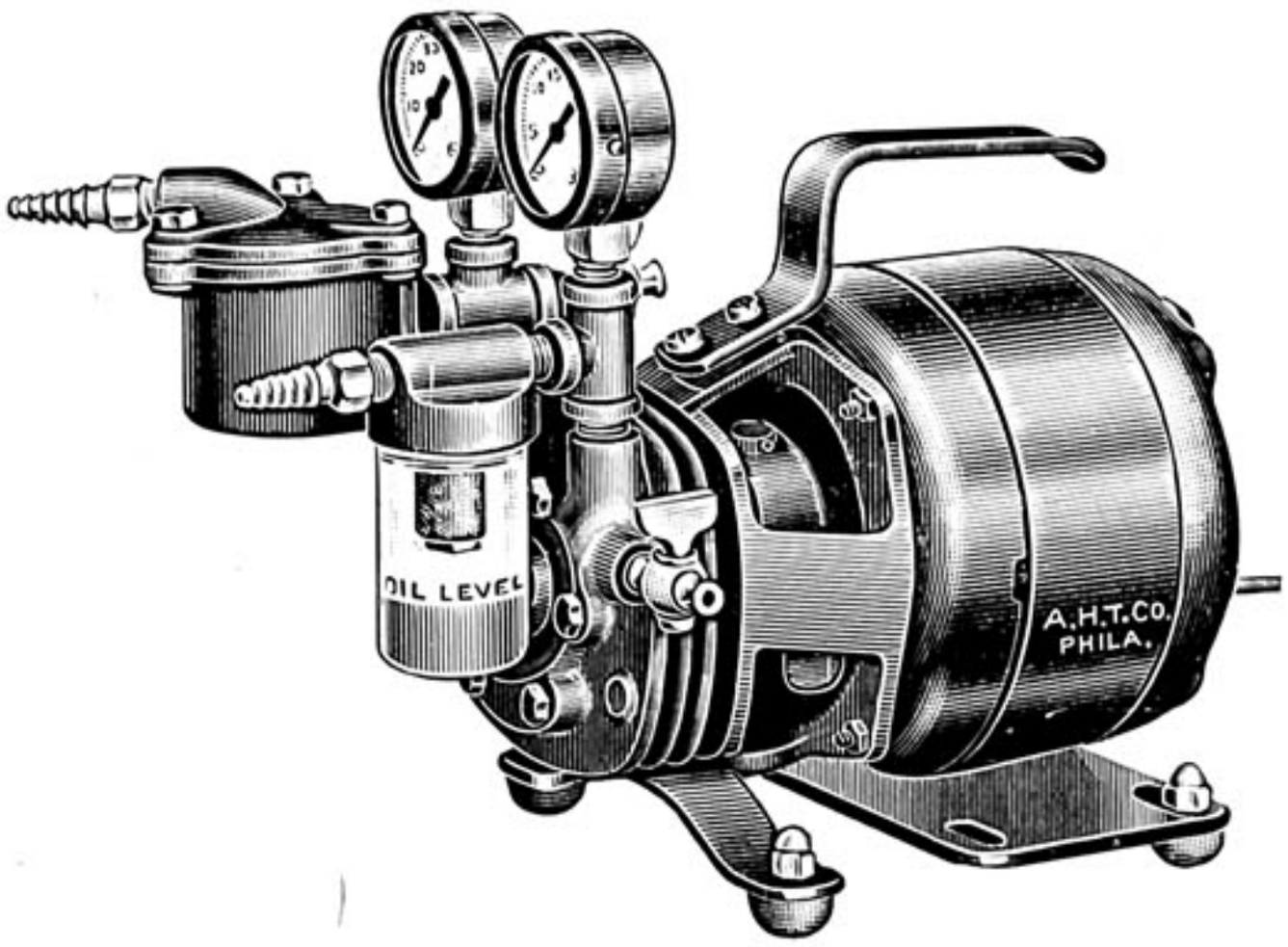

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The combined filter, muffler and trap on pressure side is enclosed in cast iron; cartridge can be removed for cleaning or replacement. The combined oiling and air filtering device on vacuum side is enclosed in glass for convenient observation of oil level.

Specifications: speed 1725 r.p.m.; maximum pressure 20 to 30 lbs. per sq. in.; free air approx. 1.3 cu. ft. per minute; operates four small blast lamps; maximum vacuum 27 inches of mercury; power consumption 250 watts; net weight 32 lbs.

1033-G. Gast Portable Rotary Air Blast and Suction Apparatus, A.H.T. Co. Specification, as above described, complete with pressure and vacuum gauges, thermal overload circuit breaker, filters, carrying handle and 10-ft. cord with snap-switch and plug. For 115 volts, 60 cycles, a.c. **$39.50**

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News Items . . .

1947 Officers of Puget Sound Section

In accordance with the article of by-laws referring to the election of officers, the nominations for the various officers was submitted by the nominating board at the October meeting (Oct. 29). No nominations were made from the floor and the nominations of the board were approved as read.

The following were elected and will assume office January 1, 1947, for a period of one year:

Chairman, Herbert R. Erickson; Vice-Chairman, Joseph L. McCarthy; Secretary, Collis W. Bryan; Treasurer, Q. P. Peniston; Councilors, George H. Cady, T. S. Hodgins, A. J. Norton, R. W. Harrison.

Appointments for the various committees will be made shortly by the new chairman and will appear on the Directory page of the January issue of the Puget Sound Chemist.

Hazelquist Returns from Visit to Scandinavian Pulp & Paper Mills

S. E. Hazelquist, chemical engineer with Weyerhaeuser Pulp Division, Longview, has just returned from an extended trip to pulp and paper mills in Norway and Sweden. Hazelquist, who is a graduate of the University of Washington, gave an interesting portrayal of this tour at the recent meeting of the Pulp and Paper Supts.

Dr. McCarthy and Dr. Tartar On Corrosion Panel

At the December 3 meeting of TAPPI in Everett, Dr. J. L. McCarthy directed a panel discussion of corrosion problems in the pulp and paper industry. As an introduction to the subject Dr. H. V. Tartar spoke on theoretical aspects of corrosion from a physical chemical standpoint.

Henry Becker, who is a chemistry graduate of University of Washington, now with Soundview Pulp Co., presented a Shibley Award Paper at this meeting under the title, "The Determination of Beta and Gamma Cellulose."

Death Takes Dr. Paschall

Dr. Benjamin S. Paschall, 67 years old, passed away at his home, 1520 38th Ave. N., on November 25.

Dr. Paschall was a member of the Puget Sound Section of the American Chemical Society. He was born in Doylestown, Pa., and came to Seattle 40 years ago. He was a graduate of the University of Pennsylvania and was for a time instructor in medicine at the University of Washington. As asthma and hayfever specialist, he opened a medical manufacturing laboratory and clinic six years ago at 1524 30th Ave. W.

Gerald Alcorn Is 1947 Chairman Am. Pulp & Paper Mill Supts.

Gerald F. Alcorn (BSc in Ch.E. U.W. circa. 1927) was elected chairman of the Pacific Coast Division of the American Pulp and Paper Mill Superintendents Association at their annual meeting held in Seattle, November 22 and 23. Mr. Alcorn is an active member of the A.I. Ch.E. and until recently was chairman of the Washington-Oregon Section. He will be in charge of Weyerhaeuser's Kraft Pulp operations at Longview when construction is completed.

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SPECTROGRAPHIC ANALYSIS

(Continued from page 14)

ever, may be compensated in any particular case by direct comparison of the unknown with a standard.

The present staff of the spectrographic laboratory consists of one group leader and two spectrographers. Essential qualifications are a technical background with emphasis on the physical sciences, either theoretical or applied, and the most essential trait — other than good natural ability in intellectual effort—is objectivity of interpretation as applied to the data obtained from the spectrograms.

The following tables summarize the standard physical, optical and photographic conditions as used at Boeing Aircraft Company, designers and builders of the B-17 Flying Fortress, the B-29 Superfortress and the double-deck Stratocruiser and Stratofreighter:

TABLE I

Exposure Conditions for Quantitative Analyses Using Spark

(Discharge Point 90°—All Cases)

MAGNESIUM ALLOYS

Elements determined—Cu, Al, Zn, Si
Slit opening 6
Grating doors 6.5
Capacity in Circuit 5 MFD
Inductance in Circuit 100 Micro-henries
Resistance in Circuit 10 OHMS
Prespark Time 10 seconds
Exposure Time 30 seconds
Cylinder Lens (Used in all cases)
Electrode 120 degree cone carbon
Gap 2 MM (Petrey Stand)
Phase 180° (Init. Voltage—High) Spark 940V

ALUMINUM ALLOYS

Elements Determined—Si, Fe, Cu, Mn, Mg, Zn, Cr
Slit Opening 6 Prespark—10 seconds
Grating Doors 7.5* Exposure—30 seconds
Capacitance 5 MFD Lens—Cylinder
Inductance 100 Micro-henries
Resistance 10 OHMS Gap 3MM
Phase 180° Petrey Stand

STAINLESS and ALLOY STEELS

Elements Determined—Mo, Si, Cr, Ni, W, V, (CB and Ti Qualitatively) Mn
Slit Opening 6 Prespark—10 seconds
Grating Doors 5 Exposure—20 seconds
Capacitance 4 MFD Lens—Cylinder
Inductance All Gap—3MM
Resistance 10 OHMS Petrey Stand

COPPER, BRASS and BRONZES

Elements Determined—Zn, Cr, Ni, Mn, Al, Si, Fe
Slit Opening 6 Prespark—10 seconds
Grating 5 Exposure—30 seconds
Capacitance 5 MFD Lens—Cylinder
Inductance 100 Micro-henries
Resistance 10 OHMS Gap 3MM
Petrey Stand

**In sparking samples, it is found that excessive resistance in the sample set-up or due to odd shapes or lightness of material can be the cause of a faint spectrogram unless a greater amount of light can be transmitted to the film. Experiments with different positions of the grating doors have shown that, as long as sufficient light reaches the film, the results are quantitatively acceptable. Therefore, it has become accepted procedure in this laboratory to increase the exposure by opening the grating doors when the sample indicates that a subnormal exposure might otherwise result. Changing the TIME of exposure does vary the results, however, especially in the case of the more volatile elements in the alloys.*

TABLE II

Exposure Conditions for Qualitative Analyses Using Arc

Slit Opening 2 Phase 0°
Grating Doors 10 Time—Complete Consumption of Sample
Capacitance 4 MFD Stand—Arc-spark
Inductance All Electrodes—Cup & Flat Carbon
Resistance 200 OHMS Gap 2.5 MM

TABLE III

Film Development

3 minutes in Eastman D-19 at 70°F.
Short Stop—30 sec. in 1 part Glacial Acetic in 33 parts H_2O
7½ minutes in standard Hypo
Wash in water at least 3 minutes
Dry 2½ minutes

NEWS ITEMS . . .

(Continued from page 16)

Two Chemical Engineers Acquire Local Testing Lab. and Establish Consulting Service

A new technical service for Seattle and the Pacific Northwest is announced by a recently formed organization, Northwest Laboratories, Hartford Building, 2nd and James Streets, Seattle, Washington. Equipment and facilities of the Northwest Testing Laboratories have been purchased and have become the physical and chemical testing division of the firm. Concrete design and laboratory work for the construction field will be continued.

New fields to be entered are applied research and development, chemical and vitamin analysis, chemical engineering consultation, equipment engineering, and process development. It is the general aim of Northwest Laboratories to shape

(Continued on page 21)

Utilization Of Electric Power In Chemical Industry

Abstract of an address by J. N. Carothers, Chief, Industrial Analysis Section, Bonneville Power Administration, at the November 12 meeting of the Washington-Oregon section of the American Institute of Chemical Engineers.

Mr. Carothers reviewed the electrochemical developments of the southeastern states over the past twenty-five years. During this time a great growth was experienced by this industry. The production of ferrosilicon, the manufacture of basic slag, the formation of graphite and its use for electrodes, the utilization of phosphate rock for the various phosphate fertilizers all occurred during this period. The establishment of the Tennessee Valley Authority greatly aided this development.

He then went on to compare the Northwest, with its potential electric and mineral resources, with this other section of the country. Our basic resources include low cost electric power, favorable geographic location and climate, phosphate rock reserves, timber, coal, various minerals, and many others. Each of these in turn were reviewed and discussed.

The speaker felt that the Pacific Northwest had three major deficiencies which held back the development of a heavy chemical industry. These three were, first, the lack of a good grade of coking coal; second, the lack of high grade silica, and, third, the shortage of a high quality limestone. He also commented on the fact that recently a high grade silica deposit had been discovered in southern Idaho.

After the address many interesting questions were put to the speaker and various points of interest to different members of the section were discussed in greater detail.

Student Activities . . .

Ammonii Socii

The past month for Ammonii Socii has been quite full of activity in that a large class of initiates were taken into the organization at a formal initiation on Saturday, November 9. The class was composed of eighteen chemistry and chemical engineering students from the University of Washington.

An initiation dance was held the following Saturday night in the American Legion hall, at E. 50th St. and Roosevelt Way. The object of the dance was to acquaint new members with the old, and was accomplished very successfully.

Due to the closing of the University on Tuesday, November 19, because of our unusual snow, the scheduled meeting for that date was postponed until Tuesday, December 3.

—Boyd Snyder

Phi Lambda Upsilon

The Epsilon chapter of Phi Lambda Upsilon at the University of Washington held its initiation banquet on November 23, 1946, at the Laurelhedge. Among the fifty present were the fourteen new initiates: J. Turner, R. Hogg, J. Wallstrom, L. Miner, H. Dunlop, B. Brown, F. Skewis, K. Koe, F. Weisenborn, D. Bartholomew, T. Beck, W. Sandholtz, R. Barnes and G. Ordway.

After dinner Dr. R. Thayer, the guest speaker from the College of Economics and Business, reviewed the development of labor unions in this country with main emphasis on J. L. Lewis and the coal strike. Following the talk a discussion concerning labor unions and management was held.

—Tom Secrest

A.I.Ch.E. Student Chapter

On November 12, under the auspices of the Student Chapter of the American Institute of Chemical Engineers, Industrial Analysis Section, J. N. Carothers, Chief, Bonneville Power Administration, gave an interesting talk to a large group of student chemists and chemical engineers. Mr. Carothers addressed the group on the subject of "Placement and Opportunities for Chemical Engineering Graduates."

Mr. George Thayer, Superintendent of Production Control of the Seattle Gas Co., addressed the group on Thursday evening, December 5.

Iota Sigma Pi

The new pledges of Iota Sigma Pi are: Florence Cohenour, Mary Eccles, Eloise Giblett, Althea Glines, Francis Greef, Carol Johnson, Klarise Lere, Myrtle Logue, Dorothy Munce. The initiation banquet will be held sometime in January. Besides the plans for this event, Oxygen chapter is anticipating a visit from the National President, Dr. Pauline Beery Mack, who will be honored at a special meeting on December 5.

NEWS ITEMS . . .

(Continued from page 18)

their program to the needs of the growing Pacific Northwest.

Thomas H. Williams and Charles V. Smith, partners of the firm, come to this area from Dayton, Ohio. Both men are well qualified in their respective fields. Williams was formerly associated with the second largest commercial laboratory in Ohio for twelve years. He has had wide experience in materials testing, concrete design, analytical chemistry, and process development. In addition, he taught materials testing at the University of Dayton, and was retained as a consulting chemist and process engineer by several industrial firms. He holds a B.S. degree in Chemistry from the University of Dayton and is a registered Chemical Engineer. Smith has twelve years' experience in applied research and development in capacities of research engineering and director of research for several large concerns in the fields of plastics, powdered metallurgy, optics, equipment and process development. He holds B.S. and M.S. degrees in Chemical Engineering from the University of Illinois and has numerous patents to his credit. He is also a registered Chemical Engineer.

A third partner of wide experience in process development is to join the firm in the near future.

Adhesive Control Acquired By American Marietta

Mr. James F. Hodges, the President of the Adhesive Products Company, recently announced the sale of their controlling interest in their company to the American-Marietta Company of Chicago. This transaction was accomplished by means of an exchange of stock, so it will have no effect on the operations of the company, with the same personnel continuing to serve their customers under the direction of Mr. Hodges.

The American-Marietta Company also owns two paint companies in Seattle, the Schorn Paint Manufacturing Company and the Solastic Products Company. At the present time additions are being made to the Spokane Street plant of the Schorn Paint Manufacturing Company which will enlarge their facilities considerably.

R.C.I. Acquires CWS Plant

Another chemical plant was added to the Pacific Northwest roster recently when the acquisition of the U. S. Army Chemical Warfare Service plant at Seattle was announced by Mr. Henry Reichhold, Chairman of the Board, of Reichhold Chemicals, Inc. At the present time extensive alterations are underway and it is anticipated that the plant will be in production by January, 1947. The complete line of Reichhold products will be manufactured at this plant, but emphasis will be placed on those materials used by the plywood, paper and protective coating industries. In addition complete service and development laboratories will be set up to serve these industries.

STUDIES IN HEMIACETAL FORMATION IN ALCOHOL ALDEHYDE SYSTEMS

By H. V. Tartar and F. E. McKenna

Abstract of a paper to be presented before the Physical, Inorganic and Biological Section at the Research Conference Meeting of the Puget Sound Section, ACS, Friday afternoon, December 20.

The freezing points of solutions of methanol, propionaldehyde and their hemiacetal in benzene and diphenylmethane were determined. The dissociation constant of the methanol-propionaldehyde hemiacetal has been determined at the freezing point of benzene and the freezing point of diphenylmethane. The change in heat content of the dissociation has been calculated. The densities and dillectric constants of dilute solutions of methanol, of propionaldehyde and their hemiacetal in benzene have been determined at 25°C. under anhydrous conditions. The dipole moments of the alcohol and aldehyde have been calculated from dillectric constant and density data. The dipole moment of the hemiacetal has been calculated from dielectric constant and density data, making use of its dissociation constant.

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