

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF INDUSTRIAL AND ENGINEERING
CHEMISTRY

W. K. Lewis, *chairman*

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The control of industrial heating processes: J. A. DOYLE. The paper will be based upon consideration of factors affecting the quality and cost of products subjected to the action of heat in the process of manufacture. Reference will be made to the influence of time as well as temperature in the conduct of such operations and the variable factors that affect the time and rate of heating and cooling. Further reference will be made to factors affecting the selection and use of various forms of fuel or electricity with suitable equipment, and of the necessity of considering the mechanical features incident to heating, cooling and handling, as well as the strictly thermal features incident to the thermodynamics of the problem.

Automatic volumetric analysis—carbon monoxide recorder: GUY B. TAYLOR and HUGH S. TAYLOR. An instrument for automatically making chemical analysis and recording the results is described. The instrument can be adapted to any case where two or more fluids can be mixed in regulated volumes, and the result of the obtained reaction of the fluids recorded by electrical conductivity, temperature rise, etc. Specifically the application of the apparatus to the analysis of flue gas for carbon monoxide is described.

Control devices employed in the high pressure testing of NH_3 catalysts: A. T. LARSON. Flow-sheet of one hundred atmospheres experimental synthesis NH_3 plant shown (slide). Need for close regulation of pressure and rate of flow discussed. Various forms of an electromagnetically operated valve are shown. Consists essentially of a valve seat cut in metal block; a valve stem moving in a guide; an adjusting spring for holding stem against seat; and an electromagnet for lifting valve stem off seat. Use of accessories such as gauges, manometers, relays, shown by slides. Flowmeter for gases under high pressure shown. Also compensating device for density balance employed in controlling composition of gas.

The absorption process for the recovery of gasoline from natural gas: J. B. GARNER. The

paper consists of (a) General description of the absorption process; (b) application of process to recovery of gasoline from dry natural gas; (c) conditions of operation of a large gasoline plant; (d) economies effected in plant operation; and (e) physical properties of natural gas gasoline.

The plastometer as an instrument for process control: EUGENE C. BINGHAM, H. D. BRUCE and H. D. WOLBACH. Recent work proves that the *viscosity* of colloidal solutions is not a physical constant as ordinarily measured, but varies with the shearing stress used, so that a certain paint showed a change in viscosity of 10 per cent. when the shearing stress was trebled. It appears that this difficulty is not limited to any one class of colloids, nor are high concentrations of the disperse phase necessary. The difficulty can be overcome by the use of the plastometer. We have, then, two apparently well-defined properties, *viz.*, *yield value* and *mobility*. Colloidal solutions at different concentrations fall into two types—*plastic* and *pseudo-plastic*—between which there seems to be a sharp distinction, dependent upon the character of the structure of the material. Moreover, some colloidal solutions, such as glue and nitro-cellulose, show a definite temperature from plastic solid to true liquid, which is the analogue of the melting point of crystalline substances. Finally the concentration of disperse phase at which the property of plasticity finally disappears appears to be well-defined and measurable and definitely related to the pore space and the volume of the dispersion medium.

A glass pressure gauge: S. KARRER. It is often desirable to measure the pressure of a gas or vapor which will react chemically with the materials out of which ordinary pressure gauges are constructed. An all glass gauge has been developed for this purpose and has been used successfully for several years. The gauge consists essentially of a thin glass diaphragm whose motion due to changes in pressures on it is detected by means of a suitable electrical contact. The unknown gas pressure on one side of the diaphragm is balanced by a known or measurable air pressure on the other side. Equality of these two gas pressures is indicated by the making or breaking of the electrical contact. Gauges having a range of several atmospheres' pressure and a sensitivity of $\frac{1}{10}$ mm. of mercury have been used.

The construction and selection of temperature and pressure instruments for automatic process control: S. S. ANDINSKY. There are three classi-

fications of instruments used in automatic process control: first, indication; second, recording, and third, controlling. Indicating types of instruments are used in determining experimentally and in actual production the exact temperature and pressure specifications to follow to obtain higher quality and maximum production at a minimum cost. Recording types of instruments are used to maintain continuous and permanent records of these readings, which records may then be filed for future reference. Controlling instruments are used to control these temperatures and pressures automatically. In this way there is the assurance of duplicating results. In many cases only by automatic control can certain temperature or pressure specifications be followed exactly.

Some phases of automatic process control: HERBERT A. CLARK. Process control during the initial stages of the development of the process is usually a matter of close observation on the part of the operator and careful hand adjustment to meet conditions as they arise. When the steps become known, the process is standardized and the control is made automatic as far as practicable. If the desired control is merely to keep the temperature constant, some type of thermostat is employed. Where the temperature must be varied in a predetermined way over a certain length of time, an instrument has been devised which automatically varies the temperature of the container at any desired rate, either constant or variable; holds the temperature at any point between certain limits for any desired time; removes the condensation in case of steam-heated apparatus; cools the container at any desired rate at the end of the process; stops the process at any desired point, and signals this fact to the operator.

Hydrogen ion methods as applied to process control: EARL A. KELLER. The increasing use of hydrogen ion measurements in the laboratory has opened a field for such methods in automatic process control. A brief description of an installation is given. Other automatic control methods utilizing electrical measuring apparatus have already been applied successfully, such as the temperature controller in oil-refining processes and in the making of illuminating gas. Electrolytic conductivity equipment has also proven very useful. The value of process control by signal indicating apparatus with manual operation is compared to control that is entirely automatic. A brief description is given of the conductivity equipment used for salinity measurements on battleships. A new method for measuring and

controlling turbidity is described, based on the characteristics of a photo-electric cell.

Cost accounting as a factor in the control of chemical processes: CHARLES WADSWORTH, 3D. Once accurate costs are obtained, they must be deftly used. There are many pitfalls for the executive who places blind allegiance in cost figures. Close contact with manufacturing plants is essential, and an understanding of manufacturing problems and manufacturing psychology is *sine qua non*. An intelligent limit can be placed on purchasing, prices and wages. The efficiency of each step in complicated manufacturing processes can be isolated, controlled and made more efficient. The knowledge of whether a product is making money or not enables the executive to control production and sales, especially as to quantities, and to direct emphasis to the most profitable enterprise. As the most accurate indicator of business health, technical men must become acquainted with cost procedure, unless they are willing to remain in positions subordinate to men with business training who understand cost procedure.

The removal of small amounts of CO from gases by passage through heated granular soda lime: ROBERT E. WILSON, C. A. HASSLACHER and E. MASTERSON. The problem of the complete removal of CO from gas streams is of importance in a number of industrial applications, particularly in the purification of hydrogen and nitrogen for the synthesis of ammonia. Several references and patents have mentioned the use of soda lime at high temperatures for the purpose, but practically no quantitative data is offered with regard to the removal of small amounts or the effect of the composition of the soda lime. This paper describes a series of experiments on gas containing 2 per cent. CO in N₂ at temperatures varying from 250° to 550° and using soda limes of varying composition. The results show that soda lime with high caustic soda contents are better than those too low, or than lime alone. The former give substantially complete removal of CO at around 400° C. Small amounts of moisture are helpful in increasing the efficiency but do not appear to be essential. Experiments in the presence of hydrogen are inconclusive because the hydrogen reacted slightly with the I₂O₅ used to determine CO. The fundamental reaction involved is apparently $\text{CO} + 2\text{NaOH} = \text{Na}_2\text{CO}_3 + \text{H}_2$.

The calculation and comparison of specific rates of corrosion in natural waters: ROBERT E. WILSON. The writer makes use of the fact that corrosion in practically all natural waters at tem-

peratures below 200° F. is substantially independent of the hydrogen ion concentration and is directly proportional to the oxygen concentration. *Specific* rates of corrosion are then calculated in terms of the weight of iron corroded per unit area, per unit time, per unit concentration of oxygen. Units are suggested for the specific rates of corrosion, and formulæ given for calculating these rates from data on (a) loss in weight of test pieces and (b) drop in oxygen content of water. By thus correcting for the effect of oxygen concentration, etc., it is possible to compare rates of corrosion under different conditions and determine the precise effect of velocity, temperature, etc. It appears that the specific rates of corrosion depend more on velocity than on any other single factor and that the composition of the metal and the hydrogen ion concentration are generally unimportant in under-water corrosion.

A new method of measuring corrosion under water. Investigation of effect of velocity: F. N. SPELLER and V. V. KENDALL. Subaqueous corrosion is nearly proportionate to the concentration of oxygen dissolved in water, which fact is used for measuring the amount of corrosion in the experiments described. Water is passed through a certain length of $\frac{1}{4}$ -inch, $\frac{1}{2}$ -inch and $\frac{3}{4}$ -inch commercial steel pipe, uncoated, and the corrosion is measured by the difference in concentration of dissolved oxygen. Time of contact was held constant by varying the length of pipe. Velocities from $\frac{1}{10}$ foot per second to 8 feet per second were obtained. Corrosion-velocity curves are given for each size pipe, for temperatures ranging from 60° to 170° F. Corrosion is found to increase with velocity in all cases, but at a decreasing rate. Rate of corrosion accelerates rapidly with rise in temperature over 90°, velocity and all other conditions being constant. This method of measuring corrosion is applicable to the investigation of the influence of other factors on subaqueous corrosion, such as composition of the metal, character of the water, etc.

The action of sodium silicate when used in soaps: A. S. RICHARDSON. The possible advantages of sodium silicate in soap have been studied under the following headings: Water softening action; detergent action without admixture of soap; and effect on emulsification power of soap. The soap-sparing effect of sodium silicate varies with the conditions of its use, being most pronounced at high temperature and in hard water high in magnesium salts, under which conditions the amount of soap conserved may be more than

the chemical equivalent of the sodium silicate used. Sodium silicate has probably no detergent action when used without soap, except in so far as free fatty acid is present in the wash. However, sodium silicate increases the emulsifying power of soap solutions, as shown by a decrease of the surface tension of the soap solution toward a mineral oil.

Counter-current digestion of wood by the soda process: R. T. HASLAM and W. P. RYAN. From a consideration of the law of mass action, the digestion of wood by the soda process seems to offer a field for the application of the counter-current principle. Ungerer, an Austrian chemist, patented the equivalent of such a process in 1872, but no record is found of its commercial application. Recent work has shown that by passing the soda solution in counter-current direction to the wood chips the time required for digestion can be decreased by one third to one half that of the usual batch process, that the yields on small scale equipments are from 2 to 10 per cent. lower, that a better bleaching pulp is obtained and that the alpha (resistant) cellulose content of the pulp is materially increased.

Factors influencing the efficiency of alkali-chlorine cells: W. P. RYAN, C. T. HARDING and R. P. RUSSELL. A study of the effect of effluent flow *vs.* current efficiency at four current densities shows that the efficiency increases rapidly with increased flow, approaching 100 per cent. asymptotically. A plot of current density *vs.* effluent flow at the guaranteed (92 per cent.) efficiency is of especial interest to plants forced to run at varying current densities because of the influence of seasonal changes on power supply. The performance of an Allen Moore cell was studied, and the results show that increasing the effluent flow increased the cathode current efficiency, the voltage and the energy efficiency, although the last decreases as high flows are reached. Increasing current density decreases the efficiency and increases the voltage at the rate of 0.01 volts per amp. per square root. For 92 per cent. current efficiency the salt conversion is very close to 50 per cent. For a given energy efficiency the flow is directly proportional to the current density. For a given current efficiency the flow is proportional to the current density above 75 amp. but falls off rapidly below that.

Physical properties of dental cements: PAUL POETSCHKE.

Filtration formulas: W. K. LEWIS. The formulas hitherto proposed for filtration in chamber

and leaf presses completely fail to apply in the case of sludges which are highly compressible and those to which filter-aids have been added. Careful experimental study of the problem has been made and empirical formulæ developed which are believed to be satisfactory for the problems of engineering design.

Behavior of compressible sludges during filtration: M. P. WOODWARD and W. J. EDMONDS. Careful study has been made of the resistance to flow of liquid through sludges of different types as a function of pressure, pressure gradient and time of filtration. On the basis of the experimental results fundamental differential equations have been derived. One method of solution of these equations has been suggested.

The solvent properties of acetone: R. F. REMLER. The paper takes up the following industrial consideration regarding acetone as a solvent; uniformity of the present grade of acetone from calcium acetate, boiling point and volatility, freezing point, inflammability, dehydrating properties, miscibility with other solvents, use as a coupling or bending agent between immiscible solvents, relative cost per gallon, physiological effects and recovery of vapors. The solubility of acetylene, cellulose acetate and cellulose nitrate, rosin and mineral oils, gums, resins, shellacs, animal and vegetable oils, fats and greases, waxes, asphalts and bitumens are discussed. Mention is also made of acetone in the dry cleaning and leather industry as a constituent of paint, varnish and carbon removers.

Rosin determination in pine products: A. H. VILBRANDT and JAMES R. WITHEROW. The determination of rosin in various mixtures, such as pine oils, wood creosotes and kerosene mixtures for materials used as fly chasers or in emulsions for disinfectant purposes is a matter of well-known importance. Results frequently reported by manufacturers and consumers are discordant. The writers have found, however, that the standard methods, with but slight modification for the prevention of emulsions, give results which are accurate easily within $\frac{3}{4}$ of 1 per cent. and sometimes much more accurate than this.

Some industrial uses of ozone: ERWIN W. FELKEL. The use of ozone in the industries has not been widespread due to two reasons, *viz.*, (1) A satisfactory source has not been obtainable, and (2) on account of the high cost of production. For the past several years ozonizers furnishing a large amount of ozone at a low concentration have been developed, and these machines have demonstrated their durability. The

advent of the commercial ozonizer has opened two fields for the industrial application of this gas: (1) in places where a small amount of ozone will accomplish the desired result and (2) in the production of products that sell for a sufficiently high price to justify its use. In the first class we have the bleaching and oxidizing of vegetable drying oils and the drying of paints and varnishes. In the second class is the production of certain aromatic aldehydes and the production of potassium permanganate. Small amounts of ozone at low temperatures bleach an alkali refined linseed oil almost colorless, while if the temperature be raised the major effect is one of oxidation. The drying of varnishes is also an effect of oxidation. This oxidation is autocatalytic and can be greatly hastened by the presence of exceedingly small quantities of ozone in the atmosphere of the drying room. The production of vanillin is a straight chemical reaction in which the ozonide of isoeugenol is made and subsequently reduced. The production of potassium permanganate is accomplished by oxidizing potassium manganate in alkaline solution.

Methanol from methane: RALPH H. MCKEE and STEPHEN P. BURKE. By passing methyl chloride mixed with steam over slaked lime at 375° C. there is obtained a 90 per cent. conversion into methanol (65 per cent.) and methyl ether (25 per cent.). By passing steam and methyl ether over aluminium oxide at 350° C., methyl ether is half converted to methyl alcohol. By reworking the residual methyl ether this conversion can be made complete. The presence of an inert gas, *e. g.*, methane, is not a hindrance to the process. All operations are carried through without pressure and can be arranged to work in a continuous operation. Accordingly we have now available to supplement our failing methanol supplies a process which incompletely chlorinates a high methane natural gas, hydrolyzes the methyl chloride content of same to methanol and methyl ether and reworks the methyl ether to give a final yield of methanol of 90 per cent. of the methyl chloride first made.

The examination of writing inks: F. F. RUPERT. There is need of a system of examination of writing inks which shall proceed on scientific principles and at the same time be related to the needs of the average user of ink, and this paper attempts to provide such a basis. The four qualities of writing inks most desired are color, permanency, stability and non-corrosiveness, and these should be given consideration in approximately equal degree. The relation of composition

of the ink to each of these properties has been studied experimentally, and briefly summarized results are given. The tests now in use by the Bureau of Standards and others are recommended, with modifications, with emphasis on the more practical tests. A system of rating giving equal weight to the four fundamental properties is suggested. Only iron tannate ink is considered in full, but the properties of other inks are discussed briefly.

Non-metallic inclusions: their influence upon ferrite segregation in steel: E. G. MAHIN and H. W. BORRS. In this paper is presented additional evidence to support the view that non-metallic inclusions in steel are centers of zones of segregation of soluble impurities, and that the segregation of these impurities is the primary cause of ferrite segregation. Giolitti's recent papers are discussed and his theory that only "oxidized" inclusions have any effect upon ferrite segregation is held to be untenable. Oxidation rings and sulfide halos have been studied and discussed in this connection, and photomicrographs are reproduced to illustrate the points at issue. H. M. Howe's conception regarding the mechanism of ferrite genesis is regarded as being correct for all steels except those cooling fairly rapidly from the liquid state.

The determination of various mono-hydric phenols by the phenol reagent of Folin and Denis: CARLETON HENNINGSSEN. The phosphotungstic-phosphomolybdic acid reagent of Folin and Denis offers a means for the quantitative determination of a number of mono-hydric phenols in dilute aqueous solutions. The nature of the color produced with these phenols fulfills most of the requirements of a colorimetric method. The intensity of the color produced is dependent upon the concentration of the particular phenol in pure aqueous solutions free from reducing agents. B-naphthol and isoamyl phenol can be used as satisfactory standards for color comparison and offer an advantage over the much used carbolic acid in that they are solids at ordinary temperatures and can be weighed direct with ease.

The acid value of varnishes: MARKS NEIDLE. The correct determination of the acid value of varnishes may be based upon two conditions: (1) The varnish must be of low viscosity so that on shaking with alcohol the distribution of the acid ingredient between the alcohol and the varnish solvent may quickly reach equilibrium; (2) If standard aqueous alkali is used for titrating, after having added alcohol, the final concentra-

tion of water in the alcohol layer should not be greater than 30 per cent. or low results will be obtained due to hydrolysis.

Propionic acid and ketones from whey: E. O. WHITTIER and J. M. SHERMAN. The factors affecting the propionic fermentation of lactose have been investigated and conditions determined whereby approximately 2.4 pounds of propionic acid and one pound of acetic acid may be obtained from five pounds of lactose in twelve days' incubation. A mixed culture of *Bact. Acidi Propionici* (d) and *Lactobacillus Casei* incubated at 30° C. for three days is used for the inoculation of the previously sterilized and buffered whey. The mixture of propionate and acetate obtained may be either converted into the free acids and refined or distilled to yield a mixture of acetone, methylethyl ketone and diethyl ketone.

Pittsburgh as an industrial center (historical): J. H. JAMES. The greatest of Pittsburgh's resources is bituminous coal, upon which is built the whole metallurgical development of the district. The glass industry began developing somewhat before the iron, and has had an uninterrupted growth, until to-day its tonnage makes this one of the greatest glass districts of the world. In iron development the stages were pig iron principally for foundry iron at first, puddled iron, crucible steel, Bessemer steel, basic open hearth steel. The fuel first used was charcoal, then beehive coke, then natural gas for basic open hearth steel, and to-day the trend is towards by-product coke, utilization of the coke oven gas in steel manufacture supplemented by producer gas from bituminous coal, offsetting the decline in natural gas. Secondary to the above group are the iron and steel fabrication industries and chemical industries. Most of the chemical industries are merely tributary to the iron and steel.

Governing factors on which paint consistency depends—pigments flocculation one of the most important: HENRY GREEN. The governing factors on which yield value and mobility depend are the viscosity of the vehicle, the pigment-vehicle ratio, the force of flocculation in the pigment-vehicle system and particle size of the pigment. As the force of flocculation in the pigment is the most important of the four factors, it is studied in detail. The paper contains much valuable information pertaining to paint manufacture.

Constants of rosin change after powdering: F. P. VEITCH and W. F. STERLING. Samples of various grades of rosin were powdered and kept in stoppered bottles. Analyses at the start and

after standing one week show a decided decrease in the acid and iodine numbers and a decided increase in the saponification number and melting point. The percentages of unsaponifiable matter remain constant. The results show that rosin should be kept in lump form and powdered immediately before the analysis is to be made in order to prevent changes in its constants.

The effects of treating materials and outdoor exposure upon the water resistance and tensile strength of cotton duck: T. D. JANELL and H. P. HOLMAN. Numerous samples of treated canvas were exposed to the weather for six months under conditions unfavorable to mildew and bacterial decay. Unexposed portions of the same samples after the same length of time showed little or no deterioration. With many of the treatments developed by the Bureau of Chemistry the treated canvas showed very high water-resistance after weathering. By adding certain bituminous materials or mineral pigments to treatments which, when used alone, gave the canvas low water-resistance after exposure, the water-resistance was considerably increased. With all of the treatments free from pigments the treated canvas gave after exposure tensile strengths lower than that of the untreated canvas after exposure. The addition of mineral pigments to certain waterproofing preparations which caused decided weakening of the canvas when exposed to the weather materially reduced such effect in every instance and in some cases the treated fabric after exposure was stronger than the untreated fabric after exposure. The results indicate that the addition of mineral pigments to waterproofing preparations is beneficial since they reduce the weakening effect of solar light and heat without reducing water-resistance.

A new form of precision hydrometer: C. W. FOULK. This hydrometer consists of a glass float moving freely in a glass tube carrying a suitable scale. Between the float and the lower end of the tube a light chain hangs in a catenary curve. The float is ballasted so as to be in approximately submerged floating equilibrium in the liquid to be tested. The final adjustment to exact equilibrium is automatically made by the action of the chain, and this position of the float is then read on the scale. With a properly calibrated instrument density determinations accurate to one unit in the fourth decimal place can be made in a couple of minutes.

Chemical corrosion of iron silicon alloys: A. K. SMALLEY. The desirability of using iron silicon

alloys as universal resistant materials for chemical construction and wherever there is a possibility of chemical corrosion has been firmly established. Their manufacture demands the use of the best grades of material, the best foundry practice and careful metallurgical control. Silicon contents should be about 14.5 per cent. If it is lower the acid resistant qualities of the metal will be affected, and if it is higher the strength is lessened and many manufacturing difficulties are encountered. Other specifications are given in the paper.

Furfural resins: CARL S. MINER, JOHN P. TRICKEY and HAROLD J. BROWNLEE.

Distillation of dilute ammonia solutions: G. GALINGAERT. In very dilute solutions ammonia does not follow Henry's law, the volatility being progressively less as dilution increases. In consequence the complete removal of ammonia from ammonia water mixtures is rendered difficult. Careful experimental determinations of the constant of Henry's Law demonstrate that the deviation is due to dissociation and indicate that in extreme dilutions there exists a constant boiling mixture.

Causticization of soda ash: J. HARROP. Experimental determination is reported of the influence of time, temperature and the amount and character of lime used in causticizing dilute soda ash solutions upon the degree of conversion and the rate of settling of the resultant sludge. The significance of the results in design and operation of causticizing plants is indicated.

Decomposition of nitrates: W. K. LEWIS and G. J. GREENFIELD. The thermal decomposition of sodium nitrate into nitrate was studied in order to secure data on the temperature coefficient of the reaction rate constant of a completely homogeneous reaction at elevated temperatures. This data was obtained, and it was furthermore demonstrated that the conversion of nitrate to nitrite is reversible, the reaction equilibrium shifting to the nitrate side as temperature increases. In consequence the reaction rate, after the reaction has progressed to an appreciable extent, is decidedly retarded by the reverse reaction. The decomposition itself is monomolecular, but the character of the reverse reaction has not yet been determined.

Potash from kelp. VIII—Theoretical considerations pertaining to the preparation of potassium chloride from kelp brines: J. W. TURRENTINE and H. G. TANNER. Kelp brine contains, after rectification, potassium and sodium chlo-

rides in the ratio of 20 : 7. These being the principal constituents, the problem of manufacturing potassium chloride therefrom is that of the separation of potassium and sodium chlorides. This is accomplished by alternately evaporating and cooling, the former precipitating the sodium salt, and the latter the potassium salt, advantage being taken of the wide difference in the temperature coefficients of solubility of the two. The cooling is accomplished by boiling in vacuum. The equilibria obtaining and their manipulation for the most convenient operation of the system and the manufacture of potassium chloride of desired purity have been studied from the phase rule point of view. Compositions at the various points of concentration have been determined, and methods of calculating these have been developed and applied to the practical operation of the evaporating and crystallizing processes.

The chemical control of the Mexican cotton boll weevil: LEHMAN JOHNSON. The U. S. D. A. method of dusting cotton plants with calcium arsenate is an effective means of control, but difficult, beyond the intelligence and skill of the average cotton farmer. None the less, in the absence of any easier or more successful method up to this time it deserves the endorsement of the American Chemical Society as an excellent piece of research work and the society's encouragement to simplify, standardize and make more general the application of the method, probably needing a special organization and a large body of trained inspectors and coaches in the method. Comparison is drawn with Mississippi River flood prevention.

DIVISION OF CELLULOSE CHEMISTRY

Harold Hibbert, *Chairman*

G. J. Esselen, Jr., *secretary*

Chemistry of Wood—VI: Results of analysis of heartwood and sapwood of some American species: G. J. RITTER and L. C. FLECK. The comparative chemical composition of heartwood and sapwood of ten American species is given in the paper. The results show that in general the cellulose and the lignin are higher in the sapwood of the conifers, but that these same constants are higher in the heartwood of the deciduous species. The higher yields of cellulose and lignin in the sapwood or in the heartwood of a given species are accompanied by lower yields in extractives.

The acetolysis reaction applied to cellulose isolated from a number of commercial woods: LOUIS E. WISE and WALTER C. RUSSELL. Cellu-

lose was isolated from beech, birch, maple, aspen, oak, pine, balsam, cedar and hemlock by alternate chlorination and sodium sulfite treatments until free from lignin. The cellulose was then converted to "normal cellulose," which was subsequently subjected to acetolysis. In each case appreciable amounts of cellobiose octaacetate were isolated and identified.

Factors influencing the properties of wood cellulose as isolated by the chlorination method: MARK W. BRAY and T. M. ANDREWS. Certain series of pulps made by keeping all cooking conditions as constant as possible except time gave values for alpha, beta and gamma cellulose that did not lie in proper relation to each other. Unless the chlorination conditions are uniform in the preparation of cellulose from these pulps the character of the cellulose is affected. Therefore, a study was undertaken of the conditions which affect the character of the cellulose as expressed in the per cent. alpha, beta and gamma cellulose. It was found that increasing the temperature and time of chlorination (over-chlorination) increases the percentage of non-resistant cellulose in cellulose derived by the Cross and Bevan method. There is very little beta cellulose in pulps or wood before it is chlorinated for the preparation of cellulose, except in decayed material. The action of the organisms of decay in some cases is similar to that of chlorination on the character of cellulose. The copper number of cellulose is a measure of the resistance of cellulose toward 17.5 per cent. sodium hydroxide solution, and also of the amount of over-chlorination. The data indicate that beta and gamma cellulose have the same copper number.

The ratio, $\frac{\text{copper number of the cellulose}}{\text{per. cent. beta plus gamma cellulose}} = \text{constant.}$

From the relation of the copper reduction capacity of beta and gamma cellulose, the data indicate that within every three $\text{C}_6\text{H}_{10}\text{O}_5$ complexes there is one aldehyde group.

An improved method for the determination of alpha, beta and gamma cellulose: MARK W. BRAY and T. M. ANDREWS. A volumetric method for the determination of alpha, beta and gamma cellulose based upon the titration of the organic material in Cross and Bevan cellulose has been worked out. The separation of the resistant from the non-resistant cellulose is carried out by treatment with 17.5 per cent. NaOH, filtered by suction or centrifuged and washed. The alpha cellulose is dissolved in 72 per cent. H_2SO_4 made up

to 100 cc. in a granulated flask, an aliquot of which is oxidized with standard $K_2Cr_2O_7$ solution; the excess $K_2Cr_2O_7$ is titrated with ferrous-ammonium sulphate solution. The alkaline filtrate is divided into two equal portions. One portion is acidified with dilute H_2SO_4 , causing the beta cellulose to precipitate. An aliquot of the clear solution is oxidized as in the alpha cellulose determination for the estimation of gamma cellulose. The other portion of the alkaline filtrate is used for determining beta plus gamma cellulose. The value for beta cellulose is arrived at by subtracting the result of the gamma cellulose determination from that of the beta and gamma determination. The volumetric method gives a direct means for the estimation of these three constants in determining the character of the cellulose. Filtration and washing difficulties of the gravimetric determination are practically overcome. This method is more accurate and can be carried out much more rapidly than the gravimetric method of Cross and Bevan. Check determinations can be made without repeating the Cross and Bevan determination for preparing cellulose, which procedure is necessary in the gravimetric method.

The gelatinization of lignocelluloses: A. W. SCHORGER. It has been found that lignocelluloses when ground in dilute alkaline solutions attain a high degree of dispersion. The resulting gelatinous product when allowed to dry forms, without pressure, a dense, horny mass having a specific gravity of 1.4-1.5, which is three to five times greater than the apparent specific gravity of the original wood. The peptonizing action of alkali is particularly marked in the case of the hardwoods in comparison with the conifers, the difference being apparently due to the greater hemicellulose content of the former. The cereal straws gelatinize even more readily than woods by the above treatment.

*A study of the methoxyl distribution in the products of the soda cook of jack pine (*Pinus divaricata*):* S. S. AIYAR. This paper is a continuation of the work on the distribution of methoxyl in the products of wood distillation previously reported. As the period of cook is lengthened the methoxyl in the pulp gradually falls to a minimum after two hours' cook at maximum pressure. Thereafter the loss of methoxyl is not very appreciable. The liquor in its turn gains the methoxyl corresponding to the loss in the pulp so that all the methoxyl in the wood used is found in the products at the end. The volatile methoxyl derivatives in the liquor reach a maxi-

mum in half an hour after attaining maximum pressure, and then their quantity falls. There seems to be a reversal of the equilibrium as the strength of caustic falls and more woody matter is dissolved in the lye. The figures for the lignin and methoxyl contents of the pulp calculated to percentage on the lignin and methoxyl content of wood run parallel. This seems to be another confirmation for the theory that all the methoxyl is associated with the lignin.

Mannose from white spruce cellulose: E. C. SHERRARD. When white spruce wood is hydrolyzed with dilute acid at atmospheric pressure the quantity of cellulose removed corresponds to the quantity of sugar produced. Since no mannan can be isolated from the wood by the usual methods the mannose is probably present as a manno-cellulose and not in the adsorbed state. Otherwise, it is difficult to advance an explanation of the removal of a quantity of cellulose corresponding to the sugars produced. The paper directs attention to the presence of mannose as a product of the hydrolysis of white spruce cellulose and also to the fact that this sugar is distributed through the alpha, beta and gamma celluloses. While the mannose is quite easily removed by means of dilute acids a part of it withstands the action of alkali and is even found in cellulose reprecipitated from zinc chloride-hydrochloric or cuprammonium solutions. Mannose has been found in the solutions resulting from the hydrolysis of white spruce cellulose prepared by the Cross and Bevan method, and from soda, sulfate and sulfite processes.

Experimental work on the development of a theory of the protection of wood by preservatives: E. BATEMAN and C. HENNINGSSEN. Practical methods of preserving wood against the attack of low forms of life require the injection of some material which either inhibits or kills the attacking organism. A working hypothesis on the protection of wood by preservatives is proposed. It states that wood preservative must possess sufficient solubility in water to produce a solution of lethal concentration. When injected into wood as an oil solution, the active ingredients are distributed in the ratio of their solubilities in water and oil. The paper, which includes new data on the solubilities, solubility coefficient and toxicity of mono-hydric phenols, offers experimental proof of the theory.

Notes on the rosin-sizing of paper. I. The reactions between aluminium sulfate and sodium resinate (rosin size) solutions: ALFRED TINGLE. The experimental results obtained may be sum-

marized as follows: When solutions of these compounds are mixed in stoichiometrical proportions, precipitation of alumina and rosin is complete. When a considerable excess of aluminium sulfate is used the precipitate contains no resinate but consists of free rosin acids with less than their equivalent of free alumina. At certain concentrations all the alumina remains in solution, rosin acids only being precipitated. Rosin acids precipitated in this way ("Rosin B") are not in the same physical condition as when precipitated by mineral acids. Addition of mineral acids to this modification of rosin changes it to the more common form ("Rosin A"). "Rosin B" is probably spongy rosin very thoroughly interpenetrated with water.

Notes on the rosin-sizing of paper. II. The process in the beating engine and at the wet end of the paper machine: ALFRED TINGLE. As commonly carried out the reaction in the beater results in the deposition of rosin in the form of "Rosin B" (see preceding paper) on the fibre with less than its equivalent of alumina. Most or all of the remaining free alumina is precipitated as the result of subsequent dilution. That alumina plays no essential part in the sizing is shown by the fact that paper can be successfully sized under such conditions that no alumina can be deposited. Rosin acids can be precipitated even by sulfuric acid in a condition closely resembling "Rosin B" if at the same time another precipitate is formed which will serve to keep the rosin finely divided. In such circumstances the rosin has sizing power. Investigation of the changes in size as paper dries are required.

New methods for measuring the effects of temperature and humidity on the dimensions of paper: HAROLD S. DAVIS. Where paper is used for printing purposes its expansion or contraction between imprints may cause blurring. It is, therefore, of great importance to have a knowledge of the magnitude of the changes in dimension and of the rates at which they take place. A new apparatus is described in which the humidity and temperature are susceptible to easy control and in which the changes in dimensions of different samples of paper may be accurately measured.

Copper numbers of cotton linters: W. F. HENDERSON. A brief description of the source and properties of the material used is given. Samples were treated with various kinds of acids of increasing concentrations, and after washing and drying the copper numbers of the linters were determined. In the cases of strong acids a rapid

increase was noted in the copper values, but in the cases of weak acids very little change occurred. Alkalies were used in the same manner, and while the absorptive power of the linters increased, the reducing power remained practically constant. Curves are shown for each series of determination.

Change of viscosity in viscose: W. F. HENDERSON. Linters were treated with increasing concentrations of nitric acid under uniform conditions and afterwards the samples were washed and dried. These products were converted into viscose under exactly similar conditions, and the viscosities of the solutions were measured. A very sudden drop in viscosity was noted as is indicated by a curve which is to be shown.

The determination of the viscosity of cupro-ammonium solutions: W. O. MITSCHERLING.

The manufacture of standard cellulose: W. O. MITSCHERLING.

Report of committee on the preparation of standard cellulose.

Report of committee on analytical methods. I. Methods of analysis of cotton cellulose.

Report of viscosity committee.

Symposium on the nature of wood cellulose: LOUIS WISE, B. JOHNSON, J. D. RUE, E. C. SHERARD and others.

Adsorption of salts by cellulose: WILDER D. BANCROFT. Though they merge one into another, we can consider four cases—miscellaneous salts, bases and acids, mordants and substantive dyes. (1) We get a water-ring in filter paper with salts of copper, lead, mercury, etc. We get peptization of cotton by ammoniacal copper oxide, zinc chloride, barium iodide, etc. (2) Barium, strontium, calcium and lead hydroxides may be adsorbed so strongly by filter paper from dilute solutions as to introduce analytic errors. In mercerization caustic soda is adsorbed and changes the structure of the cotton; but no compound is formed. Mineral acids show no appreciable adsorption at moderate concentrations by titration method. (3) Cotton takes up alumina and chromic oxide only from colloidal solutions. In presence of tannin alum is decomposed. Tannin is adsorbed; but must be fixed by antimony, because it is peptized so readily by basic dyes. (4) Sodium and barium salts of substantive dyes are adsorbed as such. Being colloidal solutions the adsorption is increased by electrolytes which decrease the stability; and is decreased when these electrolytes coagulate the dye.

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