these data the number of molecules at each point has been calculated to be two.

This means that the molecule of ice must be of the form $(H_2O)_2$ or H_4O_2. The full data and calculations will be published in the *Physical Review*. D. M. Dennison

Research Laboratory,
General Electric Co.,
Schenectady, N. Y.,
August 20, 1920

THE AMERICAN CHEMICAL SOCIETY. VIII

RUBBER DIVISION

W. K. Lewis, *chairman*
Arnold H. Smith, *secretary*

Discussion of report of committee on "Physical Testing."

A direct method for the determination of rubber hydrocarbon in raw and vulcanized rubber: W. K. Lewis and W. H. McAdams. It has been shown by a volumetric method involving a double titration that the bromine consumption, corrected for the observed substitution is a true measure of the actual amount of pure rubber hydrocarbon known to be present. Although the amount of substitution increases with the length of the bromination period, the addition corresponds quantitatively to the actual amount of pure rubber hydrocarbon present when the bromination time is from two to four hours. Experimental data is given to show that the actual per cent. of $(C_{10}H_{16})n$ in vulcanized soft rubber can be determined by a volumetric bromination method herein described, involving a second titration to correct for the substitution which accompanies the particular analysis by titrating in dim daylight, this substitution correction can be made very small.

The value of shoddy in mechanical rubber goods: J. M. Bierer. A chart was presented which gave the cost relations between scrap rubber and reclaimed rubber. The value of this reclaimed rubber was evaluated on a basis of tensile strength and compared to a corresponding priced new rubber. A line of demarkation through the center of the chart showed where it was more economical to use new rubber or reclaimed rubber.

The recovery of volatile solvents: W. K. Lewis. Solvents used in the rubber industry may be recovered by the use of any method such as absorption, compression or cooling. Ordinarily in the rubber industry the solvent vapor is diluted with a large quantity of air and in this case the absorption method is best. When such conditions are present so that one has concentrated vapors a compression method becomes available. Benzol used in pregnating cord tire fabric may be recovered with an efficiency of 90 per cent. by enclosing the impregnating apparatus and passing the vapors through an absorption tower. The danger of fire or explosion may be eliminated by passing flue gas into the apparatus.

On the determination of true free and true combined sulphur in vulcanizing rubber: W. J. Kelly. At present sulphur is considered as free and combined. Acetone soluble sulphur may be partly combined with resins, etc., as may also the sulphur insoluble in acetone, heretofore considered as combined with rubber. The total acetone extract is soluble in EtOH, but if EtOH saturated with sulphur is employed, none of the truly free sulphur will dissolve and hence can be separated from the remainder of the extract. Results show about 0.4 per cent. sulphur combined with resins, etc. About 85 per cent. of Heva resins are saponifiable and hence any resinous sulphur compounds insoluble in acetone may be soluble in alc. KOH. Acetone extracted sample is boiled 8 hours in 5 per cent. alc. KOH and about 0.26–0.30 per cent. sulphur extracted. Successive extractions do not increase this. Hence, the rubber is not being decomposed. These results are on pure gum and sulphur stocks and will be extended to compounded stocks later.

Analytical determination of the coefficient of vulcanization: S. W. Epstein.

Small amounts of magnesia and certain organic substances as accelerators: G. D. Kratz and A. H. Flower. The activity of small amounts of extra light magnesia as an accelerator was compared with the effect of similar amounts of certain organic accelerators. The load required to effect a given extension was found to be a fair measure of the rate of cure of the mixture which contained magnesia; however, this was not true for the mixtures which contained the organic accelerators. The accelerating activity of magnesia in small amount was found to be of secondary or contributory, character, acting in conjunction with, or in response to, certain extraneous substances, probably nitrogeneous, present in the rubber. The amount and nature of these extraneous substances was found to limit the activity of magnesia as an accelerator.

Diffusing power of pigments: W. K. Lewis and F. P. Baker. The diffusing power of pigments can be determined by measuring the weight of pigment per unit of cross sectional area necessary to obscure objects behind a suspension of the pigment, the result being expressed as square centimeters per gram or square feet per pound. The determination can be carried out in simple apparatus and results can be checked with accuracy. It is believed that the diffusing power is the most satisfactory measure of the fineness of a pigment, and as such is of obvious interest and value to the rubber trade.

The effect of compounding ingredients on the physical properties of rubber: C. Olin North. Compounding experiments in which from one to fifty volumes of filler, *i. e.*, gas, black, zinc oxide, etc., were added to 100 volumes of rubber are described. The values obtained for tensile strength, etc., are corrected back to the actual volume of rubber present and another set of curves drawn. Tensile strength calculated on area at rest is unfair to a soft stretching stock. Tensile at break is suggested as a better basis of comparison. This is obtained by multiplying usual tensile strength by final length and dividing by the original length times a correction factor, because of volume increase during a stretching. A visual picture of the physical structure of rubber, *i. e.*, network hypothesis based on the assumption that large colloidal aggregates function as elastic fibres and the smaller as plastic material is presented. Vulcanization probably locks up these fibers to form a network.

The microscopic examination of rubber and rubber products: Henry J. Masson and Irene C. Diner. The authors presented the results of their investigation in the line mentioned in the title. Magnifications of from 500 to 2,000 diameters were used. Best results were obtained at magnifications of about 800 diameters. The ordinary methods of metallurgy were resorted to, both oblique illumination and vertical illumination being used. Photomicrographs were shown at the meeting of various samples which had been examined.

Rubber chemistry from the colloidal viewpoint: Ellwood B. Spear. The mechanism of crystallization, condensation, polymerization and coagulation was discussed. Gelation is one type of coagulation. Selective adsorption is given as a reason for the increased tensile strength of compound rubber. This deals with the different surface energy of rubber and the various compounding ingredients.

LEATHER CHEMISTRY SECTION

Louis E. Levi, *chairman*
William Klaber, *secretary*

The true tanning value of vegetable tanning materials: John Arthur Wilson and Erwin J. Kern. A new method of tannin analysis is described which determines exactly what is called for in the generally accepted practical definition of tannin, namely, that portion of the water-soluble matter of certain vegetable materials which will precipitate gelatin from solution and which will form compounds with hide fiber which are resistant to washing. The analyses of 10 common tanning materials by the new method and by the official method of the American Leather Chemists' Association indicate that the latter method is in error to the extent of from 43 to 220 per cent. The new method gives reproducible results and is considered entirely practicable.

The neutral salt effect and its bearing upon leather manufacture: John Arthur Wilson and Edwin A. Gallun. The addition of neutral salts to the various liquors used in making leather is shown to have the effect of increasing the activity of all the constituents of such liquors, whether they be acid or alkaline. In the case of chloride salts, this was shown quantitatively to be due to removal of solvent by hydration of the added salt. The results of 37 experiments in chrome tanning with different kinds and proportions of neutral salts are given which throw considerable light upon the mechanism of chrome tanning.

The determination of sulfate in sulfonated oils: Erwin J. Kern. In the determination of uncombined sulfate in sulfonated oils, the use of organic solvents can be dispensed with, if the usual brine solution be replaced by a 10 per cent. solution of monosodium phosphate, which gives a clear separation of solution and oil in very few minutes. After boiling the oil with hydrochloric acid, total sulfate may be determined in the same way. The phosphate solution extracts all of the sulfate in each case, which may then be determined as barium sulfate in the usual manner. A saving of time is effected by the new method.

A new method for the determination of sulfuric acid in leather: Arthur W. Thomas.

Time factor in the adsorption of the constituents of chromi sulfate solutions by hide substance: Arthur W. Thomas and M. J. Kelly.

The conductivity titration of chrome liquors: ARTHUR W. THOMAS and S. B. FOSTER.

Physico-colloidal interpretations of the tanning and tawing procedures: I. NEWTON KUGELMASS.

The currying of leather for belting: EDWARD E. MARBAKER.

Chemical work in the tannery: LOUIS E. LEVI.

SUGAR SECTION

C. A. Browne, *chairman*
Fred. J. Bates, *secretary*

Chemical control in the beet sugar industry: S. J. OSBORN.

The testing of saccharimeters by means of the telescopic control tube: C. A. BROWNE. Uses of the control tube are described (1) for determining the errors of saccharimeter scales, (2) for comparing scales, (3) for determining sensibility of saccharimeters, (4) for testing ability to polarize accurately, (5) for determining influence of personal equation. The maximum scale error on good instruments was found not to exceed 0.04° v. The probable error of a single reading on a German saccharimeter was ± .05 and on a Bohemian ± .03 or an average of ± .04. Personal equation may produce a constant one way difference of ± .04 between different observers. Reversing the optical construction of saccharimeters was found to reverse the order of personal equation. Disputes about the values of normal weights no doubt result partly from personal equation.

Observations upon the use of different types of saccharimeters: C. A. BROWNE. Observations are given of the good and bad features noted in the practical use of saccharimeters of American, English, French, German and Bohemian manufacture. The advantages and disadvantages are presented of the open and closed construction types of instruments, of the various forms of polarizers, of different kinds of saccharimeter scales, and their comparative accuracy, and of differences in methods of illumination, trough construction and other details. As a result of his inspection the author believes the outlook for the manufacture of accurate saccharimeters in countries outside of central Europe is most encouraging.

The filteration of sugar-juices and syrups: WALTER L. JORDAN.

The clarification of cane juice without chemical treatment: F. W. ZERBAN. Previous investigators have found that nearly three fourths of the impurities which are removed by treatment of cane juice with heat and lime, can be taken out by filtration in the cold, and that therefore the chemical effect of the lime treatment plays only a small part in clarification with this process. It was also shown by the same investigators that the greater part of these impurities exist in the juice in colloidal form. Conclusions based on these facts are further developed in this paper, and it is pointed out that the effectiveness of the various chemical clarification methods at present in use may in their broad outlines be explained by colloid-chemical considerations. It is very probable that surface energy, and particularly adsorption, is the principal factor in these classification processes. It follows from these theoretical considerations that cane juice clarification may be brought about without the use of any chemicals whatever, but simply by the use of efficient adsorbents. Laboratory and factory tests have given strong evidence that this is actually the case, and it was found that in comparison with the sulfitation process, at least the same quantity of first sugar of greatly superior quality can be made by clarification with one half per cent. Filter-Cel, followed by treatment with 1 per cent. Norit, and filtering the juice in both cases, which is easily and rapidly done. The first molasses is so very light in color that the recovery of high-grade sugar can probably be materially increased, still leaving a molasses of higher market value than that made by the usual plantation methods.

The Hess-Ives tint-photometer and its use with raw sugars: GEORGE P. MEADE and JOSEPH B. HARRIS. The scale readings of the Hess-Ives Tint-Photometer are meaningless in themselves as they do not express directly the relative amounts of color. It was found that the scale readings for solutions containing 1, 2, 3, 4, etc. units of material run in powers of the reading for one unit, considering the scale readings as decimal fractions. This is due to the mechanical make-up of the instrument, and is true no matter which color screen or what class of material is used. Expressed algebraically, this relationship between the scale readings and the amounts of color becomes $y = K^x$, where y is any scale reading, K is the reading for one unit of material, and x is the number of units of material required to give the scale reading y. By means of this equation solved for x the color of two materials may be compared, given scale readings for equal quantities; or all scale readings may be compared to a standard. To avoid the repeated calculations, a table has been calculated which gives the units of color corresponding to each scale reading from 100 to 1. A convenient method for determining the color of raw sugars, using the table, is given together with results for various sugars.

The deterioration of Cuban raw sugar in storage: NICHOLAS KOPELOFF and H. Z. E. PERKINS. From the results indicated below, a correlation between the number of microorganisms and the moisture ratio is indicated which appears to make it possible to predict the keeping quality of a sugar by a preliminary bacteriological and a chemical analysis. Cuban raw sugars (with moisture ratios varying from .22 to .49) were stored under normal conditions in a large warehouse for 5½ months and analyzed chemically and bacteriologically. There was a loss in polarization at the end of this period, as well as at the end of one month, which was generally accompanied by a gain in reducing sugars. Likewise a gain in moisture content and reduction in the factor of safety was noted. There was a decided increase in total number of microorganisms after one month, which could be correlated within certain limitations with deterioration. Where there was a large initial infection, deterioration was rapid. In general there were more microorganisms in the middle of the bag than at the surface. Bags designated as wet, stained or having sugar light in color, deteriorated more rapidly than when drier, unstained or dark in color. In bags of sugar which are deteriorating rapidly, the surface deterioration is greatest, while in less rapid deterioration the middle of the bag seems to undergo greater decomposition. Deterioration was found to be proportionately greater over a longer incubation period than in one month.

The development of the polarimeter: NOEL DEERR. A brief account is given of the development of the polarimeter beginning with the earliest instrument of Biot and continuing with the subsequent improvements of Nicol, Ventzke, Mitscherlich, Soleil, Duboscq, Jellet, Cornu, Laurent, Lippich and others. The three major inventions in this development are the prism of Nicol, the quartz wedge compensator of Soleil and Duboscq, and the photometric end-point of Jellet. German science has contributed nothing elementary to this development, although the manufacture of polarimeters has been allowed to become almost exclusively Teutonic.

Changes in the analytical ratios of sugar during refining: A. F. BLAKE.

Boneblack and decolorizing carbons: W. D. HORNE. Investigators of Boneblack and decolorizing carbons should bear in mind the practical working conditions to be met by these substances. Boneblack or substitutes should exist in grains of 16 to 30 mesh and should be hard, very porous and high in absorptive power for iron as well as for coloring substances. Carbon is not necessarily a constituent, and a more easily cleansed and revivified substance is needed. Decolorizing carbons need to be more absorbent of ash and of red coloring matters such as caramel, and cheap enough to discard after using a few times.

The production of the gum, levan, by mold spores: NICHOLAS KOPELOFF and LILLIAN KOPELOFF. Mold spores contain an enzyme capable of forming gum in sugar solutions of all concentrations up to the saturation point. Pure gum was obtained by precipitation with five volumes of alcohol in alkaline solution and the specific rotation found to be about —40. Upon hydrolysis with acid, levulose was formed. Its melting point was about 200° C. The gum was considered to have properties identical with levan, previously noted in the bacteriological decomposition of sugars by Greig-Smith and Owen. A new method of determining levan and actual sucrose in sucrose solutions was established by using the invertase method (pure invertase solution prepared from yeast) in conjunction with the usual Clerget procedure. Some data have likewise been obtained which indicate the nature of the sugars from which levan is formed.

The determination of moisture in beet sugar factory products: V. L. AIKIN.

CHARLES L. PARSONS,
Secretary

(To be continued)

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