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I Oxidative degradation of cellulose-acetate rayon II Thermal degradation of some cellulosic textiles by steam

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I. OXIDATIVE DEGRADATION OF CELLULOSE-ACETATE RAYON

II. THERMAL DEGRADATION OF SOME CELLULOSIC TEXTILES BY STEAM

by

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INTRODUCTION

Oxidative Degradation of Cellulose-acetate Rayon

Although cellulose-acetate rayon has been manufactured commercially for more than two decades, little has been published concerning its action with bleaching agents and that which has appeared has been contradictory. This study of the effect of the oxidizing agents, aqueous potassium permanganate, acidic potassium permanganate, sodium peroxyborate, neutral calcium hypochlorite, and sodium N-chloro-p-toluenesulfonamide, is therefore of practical interest. It also provides a basis for comparing the action of these oxidants on cotton cellulose, regenerated-cellulose rayon, and cellulose-acetate rayon, inasmuch as a similar study, begun in 1937, had been made in this laboratory of the first two textiles.

Thermal Degradation of Some Cellulosic Textiles by Steam

Although steam is used widely for processing and sterilizing cellulosic textiles, there are few quantitative data available as to the degradation it produces. This study of the action of steam at various temperatures on the copper number, weight, and wet strength of unbleached cotton cellulose, bleached cotton cellulose, regenerated-cellulose rayon, and cellulose-acetate rayon compares the behavior of these textiles under the same experimental conditions.

REVIEW OF LITERATURE

Oxidative Degradation of Cellulose-acetate Rayon

Although oxidation is common practice in textile processing, nowhere is it of greater importance than in bleaching. Both oxidative and reductive bleaching were known to ancient peoples, but, while some reducing bleaches are still used, oxidants are predominantly employed now. Several comprehensive reviews of the history of bleaching are available (240, 242, 266, 495), but a brief survey is pertinent.

Early history of bleaching; substitution of sulfuric acid for sour milk

Chinese historians maintain that cotton was bleached as early as 2300 B.C. (144). The first method of bleaching was that by atmospheric oxidation. Briefly, this procedure involved alternate steeping of the textile in an alkaline bath and exposure of it to the action of sun and air before "souring" or neutralization of the alkaline impregnation. For centuries the process of bleaching remained essentially the same with sour milk the acidic reagent for neutralization. The first attempt to put bleaching on a scientific basis was the substitution of sulfuric acid for sour milk, a change which reduced the time of bleaching from eight to four months (1, 238, 240). There is some disagreement as to when and by whom this substitution was proposed; it has been attributed to the

Scots in 1728 and 1770 (242, 480), to a Dr. Home of Edinburgh about 1750 (238) or to a Dr. Roebuck of Edinburgh (390). According to Higgins (240), Dr. Home in 1750 suggested the substitution of sulfuric acid for sour milk and Dr. Roebuck's contribution was a cheaper manufacture of this acid.

Isolation of chlorine and its first use in bleaching

The isolation of chlorine in 1774 by Scheele led, largely because of the efforts of Berthollet (238, 266), to a limited use of this gas and its aqueous solutions in bleaching, but control of concentration was difficult and poor results aroused the animosity of bleachers. Strangely, the view persists that bleaching with atmospheric oxygen is the ideal method and that other oxidants are used solely for saving time and labor. The German literature of laundering, especially after the first World War, is filled with controversy as to the advisability of using "oxygenated" soaps or chlorine-bearing compounds or of depending upon air and sun for bleaching (66, 68, 73, 114, 122, 148, 190, 193, 224, 225, 226, 243, 281, 289, 290, 292, 317, 323, 327, 397, 443, 479, 511). Hauser (221) has described textiles bleached by the sun in Central America as falling apart approximately three times as fast as those washed with "oxygenated" soap.

The Tennant Patent for bleaching powder

January 23, 1798 Tennant secured a patent for the absorption of chlorine by various alkaline-earth carbonates or oxides in the presence

of water, but the patent was rescinded after litigation proved that the method had been used by others for several years. In 1799 Tennant secured a patent for the absorption of gaseous chlorine by lime (239, 390). This bleaching powder was used almost exclusively for a century. The LeBlanc process made chlorine more cheaply available, Faraday's liquefaction of chlorine facilitated its transportation, and in 1888 liquid chlorine was produced commercially by Badische Anilin und Soda Fabrik. The electrolytic production of chlorine further cheapened it and extended its use (503).

Sodium and potassium hypochlorite

Berthollet, one of the first to advocate the use of chlorine in bleaching, prepared eau de Javelle, named after its original place of manufacture, by passing gaseous chlorine into aqueous potassium carbonate. Later, sodium carbonate was substituted and the product called eau de Labarraque, but now the term eau de Javelle is applied to either solution (319). Sodium hypochlorite is used extensively in bleaching, especially in laundries; in 1928 it was stated that bleaching powder was not used in modern laundries (380). Sodium hypochlorite is usually prepared at the bleachery by the electrolysis of sodium chloride (44).

Other sources of available chlorine

Available chlorine from sources other than bleaching powder and hypochlorites has received considerable attention. Recently sodium

chlorite has been widely advertised (85, 128, 334, 398, 464, 465, 490, 517); it is said (a) to be stable up to 150° C. in contrast to the hypochlorites and bleaching powder which are used at low temperature in order to avoid formation of chlorate, (b) to have an oxidizing power equivalent to 130 per cent available chlorine, and (c) to be especially useful, inasmuch as chlorite is used in acid bath, for bleaching cellulose-acetate rayon and matte silk. Other sources of available chlorine include those in which the chlorine is organically combined, such as tert-butyl hypochlorite (79, 253, 328), N-alkylpyridinium hypohalite (354), succinchloroimide (522), N-chlorosulfonamides (485), the sodium salt of N-chloro-p-toluenesulfonamide, and N,N-dichloro-p-toluenesulfonamide. The sodium salt of N-chloro-p-toluenesulfonamide or its mixture with soap powders is sold in England as Washington Bleach and in Germany as Aktivin, Bedos, Chloramine-T, Chloramin-Heyden, Chlorazene, Dakin's Antiseptic, Gansil, Glekosa, Kaltbleiche, Mannolit, Mianin, Purus, Pyrgos, Tochlorine, Tolamine, and Zauberin (5, 114, 148, 150, 226, 502); N,N-dichloro-p-toluenesulfonamide is sold as Peraktivin (120, 153, 154).

Sodium N-chloro-p-toluenesulfonamide

Sodium N-chloro-p-toluenesulfonamide was first described in 1905 by Chattaway (148, 153, 426) and used during the first World War by Dakin as a disinfectant for water (148). Its mild oxidizing action is shown by the fact that the solid will oxidize a primary alcohol only to an aldehyde (426). It is in no sense a competitor of the inorganic sources

of chlorine because it does not bleach to a full white; it has been recommended only for mild bleaching where complete removal of color is not essential such as in boiling of laundry, as a preliminary to dyeing, for printing, for removal of stain, and for disinfection (5, 114, 120, 149, 151, 210, 330, 479). It has been especially recommended for bleaching regenerated-cellulose rayon readily degraded by inorganic sources of available chlorine (5, 151, 222, 479). In the presence of acid it forms the dichloro compound, a more active bleach (5, 153, 154). Aktivin has been recommended for solubilizing starch and for desizing cotton and rayons (5, 152).

Mechanism of reaction between active chlorine and cellulosic textile

Recent work on compounds yielding active chlorine has included a study of the mechanism of reaction between chloriniferous compound and cellulosic substance (12, 102, 138, 273, 274, 275, 344, 352, 377, 439, 444, 509). The proteins of the raw cotton are thought to be cleaved to amino acids and the latter deaminated to form ammonia which is chlorinated to chloramine. After-yellowing of chlorine-bleached cellulosic fibers is supposedly due to the presence of chloramines.

Dissociation constant of hypochlorous acid; pH and catalysis in bleaching

The dissociation constant of hypochlorous acid has been reported as 6.7×10^{-10} (368), 1×10^{-8} (324), 3.01×10^{-8} (202), and 3.7×10^{-8} (111). The importance of pH in bleaching with hypochlorite has been

stressed repeatedly (7, 23, 59, 83, 88, 93, 138, 181, 207, 241, 332, 342, 421, 461, 519); the pH at which greatest damage to cellulosic fiber occurs has been generally agreed to be seven, and oxidation in acidic baths has been found slower and less severe than that in alkaline baths. Certain metals and their alloys and metallic salts and oxides are known to accelerate the decomposition of chlorine-bearing compounds; among these catalysts are cobalt, copper, iron, manganese, nickel, titanium, and zinc; monel metal, however, is resistant to the action of chlorine (98, 288, 293, 349, 423, 483). After it was found that the oxidation of cotton cellulose with hypochlorite was accelerated by certain reduced vat dyes, the reaction of colored substances normally present or artificially incorporated was studied (43, 115, 438, 440, 441, 482).

Concentration of chlorine in bleaching baths

Concentration of bleaching bath has been varied according to the fiber and degree of whiteness desired; usual concentrations have been solutions 0.25° to 0.50° Baumé or Twaddel which correspond approximately to tenth-normal solutions. Concentrations 0.01 to 0.6 per cent active chlorine on the weight of the textile have also been recommended (15, 30, 80, 105, 262, 398, 428, 483).

Discovery and history of hydrogen peroxide and sodium peroxide

Although hydrogen peroxide was identified in 1818, eight years after the discovery of sodium peroxide by Thénard and by Gay-Lussac (217, 266, 396, 406), its introduction into textile industry for bleaching silk (266, 507),

about 1878, was not immediately followed by wide adoption because of its high price, instability in solution, and cost of transportation. In 1884 the use of hydrogen peroxide was described as a "new method of bleaching"; the use of barium peroxide with stabilizers such as alkaline borates, ammonium chloride, salts of fatty acids, and silicates was also described (358). Although it has been stated that Koechlin was the first to bleach cotton with hydrogen peroxide when in 1888 he showed that cotton was satisfactorily whitened if the peroxide was used with sodium silicate and sodium hydroxide, the bleaching of cotton and linen with hydrogen peroxide had been described as the safest method known as early as 1886 (48). In 1889 Koechlin used hydrogen peroxide with calcined magnesia (298, 299, 300, 395, 507) and Justin-Mueller bleached cotton with barium peroxide (266). It was early recognized that hydrogen peroxide, with water as the sole by-product of reaction, was an ideal oxidant, but its adoption in bleaching came late. Acid used to stabilize solutions slowed bleaching and salts as stabilizing agents were undesirable because of their action on the textile. While sodium peroxide was more economically transportable than hydrogen peroxide, it suffered from the same disadvantage of requiring stabilizers and the additional disadvantages of forming salts on neutralization and of being dangerous to handle because of vigorous reaction with water or organic compounds (38). As time passed the availability of concentrated solutions of hydrogen peroxide increased its use; the electrolytic preparation of thirty and forty per cent hydrogen peroxide of great stability, transportable in glass carboys, aluminum drums, and tank cars, has made hydrogen peroxide a keen competitor of the chlorine bleaches (403, 519). The latest development is continuous peroxide bleaching (99, 100, 417).

Other sources of oxygen in bleaching

Many substitutes for sodium peroxide and hydrogen peroxide have been suggested. These include dichromate, dithionite, perborax ($Na_2B_4O_8 \cdot 10H_2O$), percarbonate, peroxyborate, peroxydisulfate, peroxymonosulfuric acid (Biancal), perphosphate, and persilicate (26, 70, 110, 116, 118, 135, 170, 186, 228, 287, 313, 341, 367, 369, 403, 449, 450, 456, 476, 520); the persulfates are generally stated to have oxidizing without bleaching action (70, 295, 326). Among the organic oxygen-yielding compounds which have been suggested for bleaching are the monoperhydrate of urea ($3(NH_2)_2CO \cdot H_2O_2$) (459), the diperhydrate of urea ($(NH_2)_2CO \cdot 2H_2O_2$) (466), and perhydrates of acetamide, asparagine, betaine, hexamethylenetetramine, mannitol, pinacol, succinamide, urethane (143, 367), and oxygen-yielding alkyl sulfates such as Ondel W-20 (228).

Catalysis in bleaching with peroxides

The presence of enzymes, metallic salts of aluminum, chromium, copper, iron, manganese, molybdenum, and tungsten, and metallic gold, mercury, platinum, and silver has been reported as extremely deleterious in peroxide bleaching (9, 76, 106, 107, 119, 134, 143, 155, 172, 180, 216, 264, 277, 304, 322, 325, 346, 348, 382, 492, 525); metals, including aluminum, lead, magnesium, nickel, tin, titanium, and zinc, alloys such as monel metal and 18-8 stainless steel, and cement and wood have been described as satisfactory for equipment in peroxide bleaching (3, 9, 63, 141, 188, 216, 304, 322, 325, 350, 382, 504). Stainless steel has been said to be resistant to

corrosion but to destroy a lather of soap (49). Proposed stabilizers and compounds for improving bleaching properties of peroxide solutions include ammonium hydroxide, aluminum oxide, dried amorphous silicon dioxide, colloidal silicic acid, sodium hydrogen carbonate, boric and phosphoric acids, tin salts, barium, cadmium, calcium, magnesium, and zinc silicates, sulfates, or stannates, acetone and other aliphatic water-soluble ketones, casein, gelatine, glue, grey cotton, soap, polyhydroxy compounds such as dulcitol, mannitol, and glucosides, hydroxylated compounds of the aromatic series such as β-naphthol, resorcinol, hydroquinone, chlorohydroquinone, and guaiacol, organic acids such as aminosulfonic, barbituric, benzoic, iso-butylenenaphthalenesulfonic, citric, fat, lactic, lysalbic, oxalic, protalbic, resin, salicylic, tannic, tartaric, and uric, and their salts, and miscellaneous compounds such as acetanilide, esters, Igepon-T, and lauryl sulfate (45, 63, 78, 86, 87, 155, 163, 164, 172, 176, 187, 211, 230, 231, 250, 260, 280, 285, 304, 314, 322, 339, 346, 364, 383, 387, 419, 425, 448, 466, 467, 468, 476, 484, 492). Acetanilide, acet-p-phenetidine, aniline, antipyrine, and phthalimide have been listed as "catalyst poisoners" (163).

Concentration of peroxide used in bleaching

Concentrations of peroxides used in bleaching have varied widely, according to textile, desired whiteness, temperature, and pre-treatment (13, 16, 50, 51, 109, 179, 255, 316, 381, 391). For bleaching rayon sodium peroxide has been recommended in concentration of one pound in 100 pounds

of water (0.25 N) at 60 to 70° C. for thirty to forty-five minutes (179). Hydrogen peroxide has been used in concentrations from 0.1 gram of oxygen per liter (0.0125 N) for rayons (497, 498) to one-normal solutions for chappe silk and wool (27, 177, 318)). Sodium peroxyborate has been employed in solutions 0.01 N to 0.35 N for bleaching rayon (28, 51, 192, 219, 381, 501).

Sodium peroxyborate

Sodium peroxyborate has been used for light bleaching as with powdered soap, for removal of stain, and for bleaching delicate fabrics of lace and velvet (8, 58, 67, 170, 246, 261, 279, 284, 335, 374, 378, 389, 455, 463, 500, 508, 521); borax formed upon hydrolysis of peroxyborate has not been considered deleterious to textiles (261, 454); sodium peroxyborate has been proposed for degumming silk when an oxidant is desired (470). It has been suggested as a replacement for sodium peroxide in the laboratory because it is safe and of equal potency (6). Sodium peroxyborate was once considered a perhydrate (139) which yielded hydrogen peroxide in solution; however, a solution containing quantities of boric acid, hydrogen peroxide, and sodium hydroxide equivalent to sodium peroxyborate has been found to decompose more rapidly (320). Various commercial soap powders such as Persil, Clarax, Ozonit, and Perborin M contain this salt, while the salt itself is sold as Perborin (335, 500).

Potassium permanganate

Potassium permanganate was first used as a bleaching agent by Tessie du Motay in 1866 (266). It has since received sporadic attention but has

never attained any importance in the textile industry, probably because of its greater price as compared with chlorine- and oxygen-bearing bleaches (37, 183, 194), although it has sometimes been used for removal of stain and for bleaching fine laces and unions (140, 245, 258, 282, 312, 329, 366, 422, 442, 475, 478, 510). The use of potassium permanganate has been said to result in yellowing, perhaps because of the presence of calcium or iron salts (183, 488). Alkaline solutions of potassium permanganate have in general been considered very degrading to cotton (286, 291, 336, 337, 375) although Dorée and Healey (124) found the reaction between cellulose and potassium permanganate minimal at pH 9 and the products of reaction different on either side of this pH. The use of hydrochloric acid has usually been avoided in bleaching with permanganate because the chlorine released in the reaction between the acid and permanganate was believed to tender the textile (286), but Dutoit (132) has recommended the use of hydrochloric acid with potassium permanganate. Concentrations of permanganate from 0.001 to 0.006 M have been used in bleaching of textiles (329, 366), although higher concentrations have been used for removal of stain.

Comparison of bleaching with hydrogen peroxide or sodium peroxide and bleaching powder or hypochlorite

Bleaching with peroxides and bleaching with inorganic hypochlorites are generally competitive processes and opinion differs as to the merits of each. As late as 1923 Trotman (478) stated that cotton is bleached almost exclusively by compounds of chlorine. Since the wide adoption of

peroxide it seems preferred for bleaching cotton (77, 229, 232, 305, 343, 357, 386, 418) because of the better or more permanent whiteness and greater strength of the residual textile, although occasionally there is a statement that hypochlorite is preferable or more widely used (46, 52, 53). An accurate statement that can be made is that after proper bleaching no difference can be determined between a textile bleached with active chlorine and the same textile bleached with peroxide (64, 499). Rayon and staple rayons have been said to be weakened and more delustered by bleaching with hydrogen peroxide and per-salts than with chlorine bleaching liquor, but some authors have preferred hydrogen peroxide for bleaching rayon (17, 129, 265). A softer hand has been claimed for oxygen-bleached rayon than for that bleached with active chlorine (229), but nitrocellulose rayon has been said to have a harsher hand when bleached with oxygen than when bleached with bleaching powder (129). Chlorine bleaches have been said to have the disadvantage of rendering the textile liable to yellowing, while peroxide yields a permanent white (39, 191, 418, 460). The use of hydrogen peroxide as an antichlor is increasing, inasmuch as a permanent white may thus be obtained for cellulosic textiles bleached with chlorine (39, 303, 357, 412). Another disadvantage of chlorine bleaching has been that the bath should be used cold to avoid formation of non-bleaching chlorate, whereas peroxide has been preferably used at elevated temperature (117, 418, 460). Peroxide-bleached textiles have been said to require less rinsing than those bleached with active chlorine (306).

Comparison of bleaching with sodium peroxyborate and sodium N-chloro-p-toluenesulfonamide

Just as for intensive bleaching sodium and hydrogen peroxides compete with the hypochlorites and bleaching powder, on a smaller scale sodium peroxyborate and sodium N-chloro-p-toluenesulfonamide are competitive oxidants in the field of mild bleaching. Both of the latter have been recommended for household use (183, 293, 370, 494, 518), but each compound has its ardent adherents, and especially in Germany after World War I there was much discussion about the relative merits of each, with honors apparently equally divided (66, 68, 73, 114, 122, 148, 169, 190, 193, 224, 225, 226, 243, 281, 289, 290, 292, 317, 323, 327, 397, 443, 511). Both may be used in warm treatment, but whereas sodium peroxyborate is largely decomposed in a short time at the boiling temperature of water, Chloramine-T may be boiled without loss of active chlorine and may, in fact, be recrystallized from boiling water (114, 148, 443). Sodium peroxyborate is more satisfactory in removal of stain (66, 68, 114, 283). Chloramine-T has the advantage that it is not sensitive to catalytic decomposition by copper (148, 397), although Brauer (68) scoffed at the idea of catalytic decomposition of peroxyborate by copper; he washed cotton with Persil (a powdered soap containing sodium peroxyborate), with curd soap, and soap powder and observed but little greater loss in strength by the Persil-washed fabrics than by those washed with curd soap or soap powder. Both Chloramine-T and sodium peroxyborate have been said to solubilize starch (283), but only the latter has been said to yellow it (114).

Oxidation of cellulosic substances

While the literature concerning oxidation of cellulose is voluminous, little has appeared about the oxidation of cellulose acetate. A description of the preparation of the ester was published by Schützenberger in 1865 (429, 430). Acetylation of cellulose to study its degradation was used subsequently by several workers, but cellulose acetate itself did not reach commercial importance as a fiber until almost sixty years after its discovery (244). Cellulose-acetate "silk" was first patented by Lederer in 1906 (81), but its adoption as a textile fiber was delayed by difficult dyeing.

Although "chemical" bleaching was practiced almost a century earlier, and although it was known that bleaching with active chlorine frequently was injurious to textiles, there was no concerted effort to study oxidation in connection with bleaching until Witz described "oxycellulose" in 1882 (103, 104, 171, 427). His work was a powerful stimulus to investigation and one finds in the literature from that time to the present numerous references to the subject. Excellent reviews are available (42, 95, 112, 113, 178, 213, 340, 431, 486). Despite the voluminous literature, little is known of mode of oxidation, and it is generally considered that oxidized cellulose is a complex mixture of unchanged cellulose and the products of its oxidation. Kalb and Falkenhausen (269) oxidized with potassium permanganate cellulose dissolved in cuprammonium solution and found evidence that glucuronic acid was formed while the product was still of high molar nature. Jackson and Hudson (256, 257) have shown that oxidation of cellulose with periodic acid brings about cleavage of the bond between

carbon atoms two and three and oxidation of these alcoholic groups to aldehydes. Kenyon, Yackel, and Unruh (487, 524) have oxidized cellulose with nitrogen dioxide and noted selective oxidative action of primary alcoholic groups; the oxidized cellulose was characterized by higher copper number, retention of fibrous structure, and lack of friability. They concluded that little degradation occurred and ascribed the high copper number to hydrolysis. Although there has been much speculation as to the mode of reaction between oxidant and cellulose, these are the only reactions which are known specifically.

Quantitative estimation of reducing power of cellulosic substances

Much work has been devoted to determining the extent of oxidation of cellulose. Witz noted that "oxycellulose" had reducing properties, the basis of the most commonly used test for degradation. This test is, however, complicated, since other forms of degraded cellulose - "hydrocellulose", "photocellulose", and "pyrocellulose" - also show enhanced reducing power. The most common method for determination of the reducing power of cellulose is the copper number, defined as the number of grams of copper reduced from the bivalent to the univalent state by one hundred grams of cellulose. Although this reducing power is usually ascribed to aldehydic functions, Rath and Rademacher (400) have stated that reduction of silver has shown carboxylic groups involved, while Staudinger and Eder (458) have found that hydroxyl groups of cellulose also reduce copper.

Schwalbe was the first to place the determination of reducing power of oxidized cellulose and "hydrocellulose" on a quantitative basis (432, 433,

434). His method was, briefly, to heat the cellulosic substance with Fehling's solution under rigidly prescribed conditions, filter, and determine the copper reduced by electrolysis after oxidation with nitric acid. The value so obtained included reduced copper and absorbed, unreduced copper; a determination made without heating gave a measure of the absorbed copper. The empiricism of this method made reproduction of results in various laboratories difficult, although concordant values were obtained by any one investigator. There have been almost as many modifications of the method as there have been experimenters working with the copper number; these modifications have in general taken one or more or three forms: (a) alteration of apparatus, time of heating with Fehling's solution, or method for determining the blank; (b) substitution of other compounds for potassium sodium tartrate, and (c) variation of method for determining the reduced copper.

The first type of modification is relatively unimportant and is largely intra-laboratory; for example, the absorbed copper may be removed by treatment with Rochelle salt before oxidation with nitric acid and electrolysis (24), or time of cooking with Fehling's solution may be altered (29).

The second type of change has led to a schism in the ranks of experimentalists. In 1921 Braidy (61) and Koehler and Marqueyrol (301) independently proposed the substitution for Fehling's solution of a mixture, consisting of sodium carbonate and sodium hydrogen carbonate, of sufficient alkalinity to retain the copper in solution. In 1924 Clibbens and Geake (90) studied critically the use of Fehling's solution and the bicarbonate-carbonate mixture and concluded that the latter was much more reliable,

but they later recommended Fehling's solution for substances of high copper number like wood pulps (91) and also proposed that all methods for determination of copper number be prefixed with the name Schwalbe in recognition of his contribution. The Schwalbe-Braidy method has been recommended because it gives a low and constant blank, the copper number of a given sample reaches an approximately constant value after two hours, changing the volume of solution does not change the copper number within experimental error, and ratio of copper (II) sulfate to bicarbonate-carbonate solution is found to be unimportant until the concentration of copper (II) ion is six times that recommended by Clibbens and Geake (75, 263, 302, 345, 414, 514). The substitution of citric acid for Rochelle salt has received little attention (513); nor has the use of copper (II) thiocyanate in the presence of sodium carbonate been adopted (297).

Almost all methods for volumetric determination of copper have been studied in their application to copper number. In 1915 Pilkington (384) used titanium (III) chloride to titrate the filtrate from the reduction in order to obviate the long electrolytic determination of copper in the Schwalbe method. In 1919 Hägglund (199) dissolved the copper (I) oxide formed in the reduction of Fehling's solution in a mixture of iron (III) sulfate and sulfuric acid and titrated the reduced iron with potassium permanganate. This method is now used widely in the paper industry and to a slight extent in the textile industry (147, 200, 201, 206). The use of acidic iron (III) salt and potassium permanganate was independently suggested in 1920 by Knecht and Thompson (297). Estimation of copper by titration with potassium iodide and sodium thiosulfate has been proposed by various

investigators (69, 424, 462). Gault and Mukerji (174) in 1924 oxidized the reduced copper with phosphomolybdic acid and titrated the reduced acid with potassium permanganate; in 1928 Scribner and Brode (436, 437) proposed a method based on that of Gault and Mukerji and Staud and Gray (457) using Fehling's solution; however, in 1931 the Scribner-Brode procedure was described as troublesome (74). Cerium (IV) sulfate has been used as oxidant for copper (167) and the excess of Fehling's solution has been titrated with invert sugar (254). Microchemical methods for determination of copper number have also been recommended (175, 237).

Copper number is dependent upon many factors. Clibbens and Geake (90) discovered that copper numbers may differ by as much as ten per cent for samples ranging in weight from one to 2.5 grams. The value was also shown dependent upon temperature of bath and time of heating, although the amount of copper reduced in the Schwalbe-Braidy method became approximately constant after two hours (90, 345). A more finely subdivided sample was shown to reduce more copper (11, 189, 263, 431, 514). The statement has been made that the copper number of cellulose-acetate rayon is always lower than that of the raw powdered collulose acetate because of change in physical state caused by spinning (11).

Despite the fact that the copper number has been severely criticized as no reliable criterion of degradation unless the previous history of a material is known or unless it is used with another test such as cuprammonium viscosity, alkali solubility, or breaking strength, it is still extensively employed (22, 205, 308, 347, 399, 445, 512). Copper number has been used as a measure of permanency of whiteness, inasmuch as textiles of high copper

number tend to yellow during prolonged storage (42, 205). In evaluating the extent of hydrolysis of "hydrocellulose", Hess, Weltzien, and Messmer (236) found copper number of little value; this index was found by others to vary with the method of preparation of the "hydrocellulose" (60, 409). Birtwell, Clibbens, and Geake (40) observed, however, that a definite relation existed between strength and copper number of the "hydrocelluloses" which they examined.

In general, two types of oxidized cellulose are recognized - one of low copper number and high Methylene Blue absorption, prepared on the alkaline side of neutrality, and one of high copper number and low Methylene Blue absorption prepared in acidic medium (42)-and it is for this reason that copper number should be interpreted cautiously in evaluating a cellulosic substance.

Determination of reducing power has also been made by oxidation of aldehydic groups with hypoiodite (33, 34, 233, 235, 333). The quantitative separation of tetramethyl glucoside has been used to follow molar degradation (234). A test which is described as of more value than copper number for the evaluation of quality is the cuprammonium viscosity; its significance has been critically studied (40, 92, 146, 410).

Tests which depend upon the presence of carboxyl groups have also been used. Vignon (439) noticed that the soluble portion of cellulose oxidized with potassium chlorate yielded the major part of furfural obtained from the oxidized cellulose; Pringsheim (394) postulated that primary alcoholic groups of cellulose were oxidized and the uronic acids thus formed yielded furfural; Godman, Haworth, and Peat (182) found that permanganate-oxidized cotton linters contained uronic acid residues.

Schwalbe and Becker (435), however, concluded that yield of furfural was not a characteristic property of oxidized cellulose. The dissociation constant of the carboxyl groups in oxidized cellulose has been measured as 10^{-4} to 10^{-3} (356). Recently Norman (365) and Whistler, Martin, and Harris (516) have shown that cotton cellulose contains uronic acid groups, but Harris concluded that the uronic acid content of cotton was probably derived from pectin.

The earliest workers recognized that oxidized cellulose exhibited an affinity for basic dyes; reactions with Methylene Blue and Crystal Violet have been suggested as measures of oxidation and acidity (41, 251, 402). Measurement of oxidation by affinity for metallic ions has also been developed (166, 208, 212, 471), although Bancroft (20) has stated that metallic ions may be removed by continued washing.

Another test which depends upon the presence of carboxyl groups was proposed by Kauffmann (270, 271, 272, 276) and involves determination of the potassium permanganate reduced by the alkali-soluble portion of oxidized cellulose. This method has been subject to much criticism (31, 32, 173, 196, 204, 311). Dyeing of oxidized cellulose with vat dyes has been suggested (142) but this test, like the metal-affinity tests, is applicable only to one type of product (166).

Difference in the fluorescence of oxidized cellulose and "hydrocellulose" has been suggested for identification (331, 451).

Heermann (227) concluded that only the Haller gold-purple test (212) clearly distinguished between "hydrocellulose" and oxidized cellulose.

Oxidation of cellulose acetate

In general, methods for bleaching cellulose and regenerated cellulose have been successfully extended to cellulose acetate. One finds a few dogmatic statements about bleaching with hypochlorite or with peroxide, some of which are directly contradictory. Bond (55, 56) stated that acetate could not be bleached with chlorine because of tendering and recommended hydrogen peroxide, while Haller (213) stated that acetate was very resistant to the action of hypochlorite. Ohl (373) and Bussina (420) were agreed that peroxide bleaching liquors should not be used for acetate. Sodium peroxyborate has been especially recommended for bleaching cellulose-acetate rayon (192, 369, 401). Persil, a soap-powder containing sodium peroxyborate, has been found advantageous for washing cellulose-acetate rayon; less bleeding of Persil-washed fabrics was observed than of fabrics washed with Marseilles soap (62, 371, 372). On the whole, both peroxide and active chlorine have been recommended for bleaching and stripping cellulose-acetate rayon (25, 47, 84, 97, 123, 137, 168, 192, 215, 249, 321, 351, 353, 363, 375, 385, 388, 393, 407, 415, 446, 447, 505, 515, 523). Ordway (376) stated that well scoured fabric was more necessary for bleaching with hypochlorite than with peroxide. Potassium permanganate has been recommended for bleaching Tubize and other types of rayon to be dyed light colors (84). Concentrations less than 0.1 per cent have been used for artificial "silks" (401). Viscose-acetate unions have been treated with cold potassium permanganate followed by sodium hydrogen sulfite in order to clear viscose stained with acetate dyes (315). Götze (183) stated that

potassium permanganate should not be used with rayons and Ordway (375) stated that potassium permanganate was not suitable for bleaching acetate fabrics. Cellulose-acetate rayon is susceptible to saponification by hot alkaline solution, and this is the basis of the objection to peroxides, usually employed in alkaline solution and at elevated temperature. Haller (214) found cellulose-acetate rayon very resistant to the common oxidizing bleaching agents, despite the fact that the cellulosic unit has been more hydrolyzed in preparation of the acetate than in the preparation of viscose (411). Cellulose acetate is, of course, a heterogeneous mixture; Harris, Mark, et al (452, 453) fractionated commercial mixtures of cellulose acetate and concluded that it consisted of chains of varying length nearly constant in acetyl when the effect of end-groups was not apparent.

As in the case of other cellulosic fibers, the copper number of cellulose acetate is said to change with simple mechanical treatment (11). Disagreement exists as to the value of copper number for assaying degradation (22, 24, 355). Ridge et al (410, 411) have pointed out difficulties in determining extent of degradation of cellulose acetate by means of copper number and viscosity; if oxidation of cellulose acetate occurs in alkaline solution, hydrolysis of the ester may be accompanied by decreased strength and copper number but increased viscosity.

A mixture of one to twelve parts of oxidized cellulose acetate and four parts of unoxidized cellulose acetate has been patented as a lacquer (165).

Thermal Degradation of Some Cellulosic Textiles by Steam

Importance of heat in the textile industry

The whole problem of heat is of utmost importance to the textile industry, both in Europe (159, 198, 379) and in this country, where a Textile Drying Conference was held in 1936 to discuss the problems involved and to plan an extensive program of research (57, 127, 469).

Uses of steam in textile processing

Steam is used in many processes of textile manufacture and maintenance; a few examples are: aging (162, 195, 261), bleaching (89, 108, 247, 248, 493), condensation of resins (474), decatizing (294), delustering (473), dyeing (126, 220), finishing of pile fabrics (259), lustering (136), pressing (101), printing (121, 130, 131, 203, 267, 473), setting of twist (65, 82, 408), stabilizing of cellulose and cellulosic derivatives (72, 404, 405), and sterilization (14). Temperature and time of treatment vary widely for the different operations, from twenty-five seconds at 212 to 252° C. (392) to thirty minutes at 140° C. (223, 473).

Summary of literature to 1923

In 1923 Farghor and Williams (145) summarized the literature as to the effect of water and steam on cotton. The major points they deduced were that "pure" cellulose was more resistant than "oxycellulose" to heat, that degradation of cellulose by steam began at approximately 150° C., and that substances made soluble by the treatment reduced Fehling's solution.

Degradation of cellulosic textiles by heat

The terms "dry steam" and "wet steam" are poorly defined in the textile industry. Adams (2) defined moist or wet steam as that containing more or less water in suspension in large or small droplets or as a mist and called dry saturated steam a rarity; Flynn (162) stated that some have claimed there was no such thing as "wet steam". So it is not surprising that disagreement exists as to the relative effects of "dry" and "wet" heat (338, 496).

Justin-Mueller (268) compared the behavior of cellulose, "hydrocellulose", and "oxycellulose". When submitted to dry heat at 130 to 150° C., "hydrocellulose" appeared to be caramelized, "oxycellulose" developed only a pale yellow color, and cellulose was unchanged. The yellowing of unbleached cotton when subjected to the action of steam has been attributed to decomposition of natural resins. Fischer, Schrader, and Treibs (156, 157, 158) studied the decomposition of cellulose at 200° C. in the presence of water and of "soda" solution; they found some decomposition at this temperature and identified the products of decomposition as acids (acetic, oxalic, and a trace of formic), some water-soluble substances, gases, and a solid residue one-fourth of the weight of the original cellulose. Clifford and Fargher (96) collected acetaldehyde, acetone, and higher aldehydes or ketones from the distillate of the reaction of water, sodium hydroxide, and American cotton for eight hours at 40 pounds pressure. Matthews (338) reported that at 160° C. cotton showed structural disintegration (carbonization began at 182° C.) and that even in the presence of moisture, prolonged exposure to a temperature of

160° C. brought about dehydration. Bain et al (18, 19) described the appearance of cotton as light yellow to dark brown, depending on temperature and time of heating and the reducing properties of the water-soluble products of cotton heated dry or in the presence of water. Kujirai and Akahira (310) found the thermal degradation of several cellulosic substances to be functions of the absolute temperature and time of heating, and loss of weight a measure of degradation. Akahira (4) postulated that the residual ratio of hydrogen to oxygen remained constant, that found in water. Tiltman and Porritt (472), too, found time of heating important; in studying the effect of heat on cotton tire fabric they noticed that permanent weakening was proportional to time of heating. The effect of heating became apparent at 115 to 120° C. and degradation increased with increasing temperature until at 240° C. complete loss of strength occurred after four hours.

Waterman and Perquin (506) heated cellulose under pressure at temperatures between 225 and 450° C. with and without hydrogen and found its decomposition rapid. Bobrov (54) reported that thermal decomposition of cellulose with superheated steam occurred at a temperature considerably lower than 275° C. Berl and Schmidt (36) observed no noticeable change when cellulose was heated with water under pressure at 150° C. but rapid decomposition above this temperature.

Bergneon (35) reported the life of a cotton end cloth as six to nine months when used for steaming rayon at 10 to 50 pounds pressure for three-minute intervals.

Haas (197, 198) heated unbleached, ether-extracted cotton for five-hour periods; at 120° C. a "strong" yellow color and caramel-like odor were developed and at 200° C. carbonization occurred. He disapproved of drying temperatures above 100° C. for one to two hours. Haller (209) found one hour's heating with steam at five atmospheres sufficient to color cotton an intense brown without formation of "oxycellulose". The increased wetting power of steamed raw cotton has been observed (209). Kozhin (309) commented that fibers which contained "pyrocellulose" (cellulose rendered soluble in sodium hydroxide by heat) showed a much higher capillarity than other fibers; he reported that "oxycellulose" and "pyrocellulose" of similar chemical reactions were difficult of differentiation.

Rogers and Hays (414) discovered that new and desized cotton sheeting underwent more deterioration when stored at high temperatures than at room temperature, and that greater deterioration occurred in new cotton sheeting than in desized sheeting.

Matthews (338) found mercerized cellulose more resistant to heat than anticipated. Inasmuch as regenerated-cellulose possesses many of the properties of mercerized cellulose, it is of interest to examine such fibers. Götze and Reiff (184) studied the hygroscopicity of viscose at temperatures above 40° C. Dry strength increased when viscose was heated between 40 and 140° C. because of its lowered hygroscopicity, whereas wet strength showed little change, but physical degradation occurred above 140° C. Cellulose acetate showed greater decrease in strength than viscose and cuprammonium fibers when boiled for thirty minutes in water. Dry strength suffered no decrease when any of these fibers was dried for five hours at temperatures

up to 105° C., but at 140° C. all suffered a decrease in strength of 15 per cent which increased to 85 per cent at 250° C., although the acetate melted at 230° C. Discoloration of the fiber and decrease in wet strength were noticeable first at 130 to 140° C. (71). Warning against excessive steaming of rayons to avoid decreased strength and luster was issued by Kegel (278). Fletcher, Houston, and Sherwood (160, 161) reported that the strength of viscose-cellulose acetate gabardines was not significantly decreased by heating for fifty hours at 150° C. and that cellulose acetate suffered less deterioration than viscose and cuprammonium when heated at 132 to 138° C. for ten to sixty hours. In an article, Hydrolysis of Cellulose Acetate (252), the statement was made that over-drying and baking were to be avoided as otherwise harshness and tendering might occur.

It is to be gathered from this resumé that 140 to 150° C. is generally considered the initial range of degradation for cellulose and that degradation increases rapidly with temperature beyond this heat. The rayons are in general reported to show degradation at approximately the same temperature as cotton, although dry strength may show an increase after the textile has been heated because of its lower regain. Cellulose acetate apparently suffers more degradation than regenerated cellulose when heated in contact with water but is more resistant to degradation by dry heat up to its melting point.

EXPERIMENTAL METHODS

Preparation of Samples

Samples of cellulose-acetate rayon were prepared for determination of acetyl, copper number, and residual weight by cutting rectangles 5 in. x 7 in. and raveling yarns from the edges for approximately 0.3 in.; smaller rectangles were used for determination of copper number of high value. Warp-breaking strength specimens were cut 6 in. in the direction of the warp and 1.5 in. wide and accurately raveled to a width of 1 in. by removing approximately the same number of warp yarns from each side. Sets of five breaking-strength specimens, piled alternately with three or five rectangles, were allowed to come to equilibrium with atmospheric conditions in the balance room for at least fifteen hours and weighed during a period no longer than three hours. Each third or fifth rectangle, intended for determination of residual weight and ash, was then heated in a tared weighing bottle at 105 to 110° C. for two-hour periods until successive weighings checked within 0.0004 gram. The oven-dry weights of the unheated samples were computed from these data. Rounding off decimal values was done in accordance with the method proposed by the Council of the American Physical Society (416).

Unbleached or bleached cotton cellulose and regenerated-cellulose rayon were cut into rectangles approximately 2.5 g. in weight and the edges raveled to prevent later loss of yarns. Warp breaking-strength

specimens were cut like those of cellulose-acetate rayon. Rectangles were brought to the condition of the balance room for at least fifteen hours before they were weighed. Each fifth rectangle was oven-dried to constant weight (tolerance of 0.0004 g.) before the oven-dry weights of the unheated samples were computed.

Analysis of New Textiles

Acetyl (133).

A rectangle of cellulose-acetate rayon was placed in a 250-ml. iodine flask and plasticized for fifteen hours with 25 ml. of 1:1 ethanol before the addition of 25 ml. of normal sodium hydroxide. Saponification was allowed to proceed for forty-eight hours before the excess of alkali was titrated with tenth-normal hydrochloric acid with phenolphthalein as indicator. The mean of five determinations is computed.

Ash

A rectangle, dried to constant weight at 105 to 110° C. in an electric oven, was ignited to constant weight in a tared porcelain crucible in a muffle furnace at 600 to 700° C. The mean of four determinations is computed.

Breaking strength and elongation of fabric at breaking load (10, p. 39)

Forty warp specimens were cut as described in part I; forty filling specimens were similarly cut. All were kept at standard condition (70 ± 2 F. and 65 ± 2 per cent relative humidity) for one week before

twenty of each set were clamped individually under an initial tension of 6 oz. between the two-inch jaws of a calibrated Scott Universal Tester whose movable jaw at rest was 3 in. below the stationary jaw. The lower jaw was then moved downward at a speed of 12.0 ± 0.5 in. per minute until the strip reached its breaking load. The remaining specimens were immersed in water for two hours before they were broken wet. Elongation was measured from the autographically recorded stress-strain curve.

Copper number (61)

The Schwalbe-Braidy method was used with some modification to determine the number of grams of copper (II) reduced to copper (I) by 100 grams of the cellulosic textile. A rectangle was cut into pieces 1 x 10 mm. and transferred to a 250-ml. iodine flask in which it was heated with 100 ml. of the oxidizing solution for three hours in a rapidly boiling water bath. After the filtered sample had been washed with dilute sodium carbonate and hot water it and the asbestos were returned to the iodine flask where they were treated first with ferric alum and then with 2 N sulfuric acid before titration with potassium permanganate. The mean of five observations is computed.

Distribution of yarns in fabric by number (10, p. 37-38)

The mean numbers of warp yarns and of filling yarns per inch were determined from counts made with a needle moving against a calibrated metal scale mounted under a magnifying glass. Yarns were counted in ten different places in the fabric, no nearer the selvage than one-tenth the width of the fabric.

Distribution of yarns in fabric by weight

Four two-inch squares of fabric, none of the same warp or filling yarns and none cut nearer the selvage than one-tenth the width of the fabric, were kept at standard condition for one week before they were weighed to the nearest milligram. They were then raveled and the warp yarns and filling yarns weighed separately to the nearest milligram.

Length of fiber

Five-inch lengths of warp or filling yarn were untwisted and individual fibers withdrawn without breakage were measured with a steel scale. The mean of ten observations is computed.

Thickness of fabric

Thickness was measured at ten different places in the fabric, no nearer the selvage than one-tenth the width of the fabric, with a Brown and Sharpe Mfg. Co. Micrometer which pressed upon a circle of fabric 0.25 in. in diameter with a pressure of 6 ounces.

Twist of yarn (10)

The twist was determined with an Improved United States Company Tester. Cotton yarns were determined by the twist-untwist method with manually applied tension pendulum control (p. 129); the rayon yarns were placed under tension (131 grams divided by the yarn number in typp) and the rotatable clamp was turned until a needle could be passed from clamp

to clamp without meeting any twist. Ten determinations were made with warp yarns and ten with filling yarns.

Weight of fabric

Four specimens, 4 in. long and the entire width of the fabric, were kept at standard condition for one week before they were weighed to the nearest milligram.

Yarn number

Four ten-yard lengths of warp yarn and four ten-yard lengths of filling yarn were removed from the fabric, measured, and wound onto a card. These yarns were kept at standard condition for one week before each ten-yard length was weighed to the nearest milligram.

Standardization of Reagents

Arsenious acid

In 40 ml. of normal sodium hydroxide were dissolved 4.9480 g. of 99.95 per cent arsenious oxide (Mallinckrodt Chemical Works). The solution was made slightly acidic to litmus with normal sulfuric acid before it was transferred to a volumetric flask and diluted to one liter.

Calcium hypochlorite (307, p. 610-11).

To a filtered aqueous solution of 7.5 g. of Perchloron (Pennsylvania Salt Manufacturing Company) normal hydrochloric acid was added until the neutral color of litmus was observed when a drop of the solution was placed

on a spot plate with a small crystal of sodium thiosulfate. The solution was diluted to one liter and standardized by titration against arsenious acid containing 0.5 g. of sodium hydrogen carbonate and 1.0 g. of potassium bromide; within a milliliter of the expected end-point a drop of 0.2 per cent Bordeaux (British Colour Index No. 88) indicator was introduced before the hypochlorite was added dropwise until the color flashed from pink to yellow.

Hydrochloric acid

Hydrochloric acid was standardized against standard sodium hydroxide with phenolphthalein as indicator.

Potassium permanganate (477, p. 547)

To a weighed portion of 99.95 per cent sodium oxalate (Mallinckrodt Chemical Works) dissolved in 200 ml. water at 80 to 90° C. were added 10 ml. of 18 N sulfuric acid. Potassium permanganate was added to this mixture with vigorous and constant stirring at the rate of 10 to 15 ml. per minute except for the last milliliter which was added dropwise until a pink color persisted. The temperature of the solution was not allowed to fall below 60° C.

Sodium hydrogen sulfite (477, p. 601, 638-9)

A standard solution of permanganate was measured from a buret into a 300-ml. Erlenmeyer flask which contained 3 g. of potassium iodide, 50 ml. of water, and 5 ml. of concentrated hydrochloric acid. This mixture was

allowed to stand in darkness for three minutes and then was diluted to 200 ml. before it was titrated slowly with sodium hydrogen sulfite with starch as indicator.

Sodium hydroxide

Dilute sodium hydroxide was standardized against weighed portions of 99.95 per cent potassium hydrogen phthalate (General Chemical Company). Normal solutions were titrated against standard acid. Phenolphthalein was used as indicator.

Sodium peroxyborate (307, p. 574-5)

To 0.5 g. of sodium peroxyborate, $NaBO_3 \cdot 4H_2O$, (General Chemical Company) in a 500-ml. Erlenmeyer flask was added a solution of 285 ml. of water and 15 ml. of concentrated sulfuric acid. The mixture was titrated immediately with standard potassium permanganate to a persistent pink color.

Sulfuric acid

Sulfuric acid was titrated against standard sodium hydroxide with phenolphthalein as indicator.

Sodium N-chloro-p-toluenesulfonamide

For the preparation of 0.1 N solution, 15 g. of Chloramine-T (Eastman Kodak Company) were dissolved in water, filtered, and diluted to one liter. Although titration of chloramine either iodometrically or with arsenious

acid in the presence of potassium iodide with starch as indicator has been recommended, it was desired if possible to use the same indicator for the inorganic and organic chlorine-bearing compounds, and Bordeaux seemed more desirable than starch. If, however, the titration was performed in the manner used with the hypochlorite, results inconsistent among themselves and in no agreement with the titer obtained by the potassium-iodide starch method were obtained. Vogel (491) stated that chloramine reacted in dilute acid solution; it was found that if 5 ml. of concentrated hydrochloric acid were put in the arsenious acid before the chloramine was added, the titration proceeded rapidly, the end-point was sharp, and the values obtained were in good agreement with those observed when starch was used as indicator. So this method was used.

Treatment of Textiles

With potassium permanganate

A fifty-volume bath of distilled water or 0.0200 or 0.0330 molar aqueous or acidic permanganate was prepared in an Erlenmeyer flask (0.0400 or 0.0660 M potassium permanganate was diluted with an equal volume of recently boiled distilled water or 0.1000 M sulfuric acid) and allowed to come to equilibrium in a constant-temperature bath at 15.0±0.1°C., 25.0±0.1° C., or 40.0±0.1° C. before a rectangle of cellulose-acetate rayon or one set of five breaking-strength specimens was added and the

flask stoppered for maintenance at temperature for four hours. The residual cellulose-acetate rayon was then removed and rinsed five times in water at room temperature before immersion in fifty volumes of 0.0750 M sodium hydrogen sulfite at room temperature. After three hours in the sodium hydrogen sulfite the cellulose-acetate rayon was rinsed five times in water at room temperature or until the final rinsing no longer decolorized permanganate. The rectangles were dried in air and the breaking-strength specimens were tested wet at once.

With sodium peroxyborate

A fifty-volume bath, 0.3 per cent as to soap, was prepared in an Erlenmeyer flask by dissolving the weighed amount of olive-oil soap (21) in distilled water and bringing this solution to $40.0 \pm 0.1^{\circ}$ C. in a constant-temperature bath or to the temperature of boiling water under a reflux condenser before the weighed amount of sodium peroxyborate was added from a 10 x 75 mm. glass tube which was also dropped into the flask when emptied so as to provide for inclusion of all crystals. Immediately upon dissolution of the salt (not more than five minutes at the lower nor more than one minute at the higher temperature) one rectangle or a set of five breaking-strength specimens was immersed and the flask stoppered for maintenance at temperature for eight or two hours. The residual cellulose-acetate rayon was then removed and rinsed five times in distilled water at room temperature. The rectangles were dried in air and the breaking-strength specimens tested wet at once. Specimens described as treated at zero concentration of sodium peroxyborate were given identical treatment, except that no oxidant was included in the bath.

With calcium hypochlorite or sodium N-chloro-p-toluenesulfonamide

A solution of 0.1 N calcium hypochlorite or 0.01, 0.1, 0.2, or 0.3 N sodium N-chloro-p-toluenesulfonamide was prepared shortly before use. A fifty-volume bath was measured into an Erlenmeyer flask and placed with four controls in a bath at 25.0 ± 0.1 or $40.0 \pm 0.1^{\circ}$ C. or in boiling water under a reflux condenser for one hour before a rectangle of cellulose-acetate rayon or one set of five breaking-strength specimens was added and the flask stoppered for maintenance at temperature. The normality of two controls was determined; the solutions from baths at the higher temperatures were cooled under tap to permit immediate titration. After two or four hours the cellulose-acetate rayon was removed and rinsed in water at room temperature ten times or until the final rinse no longer gave a precipitate with silver nitrate. The rectangles were dried in air and the breaking-strength specimens were tested wet at once. The normality of the remaining controls was determined at the close of the period of immersion.

With steam

Not more than five glass rods, each having tied to it one or more breaking-strength specimens (depending upon the length of the rod) or one rectangle, were placed across the top of a three-liter beaker in the autoclave. The beaker was then covered with an inverted porcelain evaporating dish to prevent any condensate which had been in contact with metal from flowing over the textiles. The pressure within the autoclave was raised to the desired value over a ten-minute period, held constant

for 1.5 hours, and reduced to zero gauge pressure over a ten-minute period before the cover of the autoclave was unbolted and the samples transferred to separate beakers containing one hundred volumes of water. The samples were rinsed three times, allowed to stand 1.5 hours in water to permit more thorough penetration, and rinsed three more times or sufficiently to remove completely the soluble products of degradation, the presence of which was tested with Fehling's solution. The rectangles were dried in air and the breaking-strength specimens were broken wet at once. Textiles described as steamed at room temperature were rinsed in this way without previous treatment in the autoclave.

Analysis of Residual Textiles

Acetyl, breaking strength of wet warp, and copper number were determined as for the new fabrics.

For determination of residual weight and ash, the air-dried rectangle was heated in a tared weighing bottle at 105 to 110° C. for two-hour periods until successive weighings checked within 0.0004 gram. It was then ignited in a tared porcelain crucible to constant weight in a muffle furnace at 600 to 700° Centigrade.

DERIVED TABLES

TABLE I. ANALYSIS OF NEW FABRICS

Fabric	Weave	Weight of fabric	Thickness of fabric	Ash of fabric	Length of fiber	
					Warp	Filling
		Ounce per square yard	Inch x 10^3	Percentage of fabric	Inch	Inch
1. Cellulose-acetate rayon taffeta	Plain	2.97(0.00)*	5.8(0.1)	0.08(0.02)	Continuous	Continuous
2. Cotton muslin sheeting, bleached	Plain	4.66(0.06)	7.9(0.3)	0.06(0.01)	1.26(0.04)	1.25(0.09)
3. Cotton muslin sheeting, unbleached	Plain	5.24(0.00)	9.2(0.3)	0.95(0.01)	1.28(0.11)	1.21(0.08)
4. Regenerated-cellulose rayon twill	Cork-screw twill	3.28(0.01)	4.7(0.1)	0.24(0.01)	Continuous	Continuous

*Mean deviations are within parentheses.

TABLE I. (Continued)

Fabric	Breaking strength of fabric			
	Warp		Filling	
	Conditioned	Wet	Conditioned	Wet
	Pound per inch	Percentage of conditioned	Pound per inch	Percentage of conditioned
1. Cellulose-acetate rayon taffeta	42(0)	50	20(0)	55
2. Cotton muslin sheeting, bleached	62(3)	111	65(2)	105
3. Cotton muslin sheeting, unbleached	61(3)	111	72(4)	118
4. Regenerated-cellulose rayon twill	68(1)	41	44(1)	43

TABLE I. (Continued)

Fabric	Elongation of fabric at breaking load				Type of yarn	
	Warp		Filling		Warp	Filling
	Conditioned: Percentage	Wet: Percentage	Conditioned: Percentage	Wet: Percentage		
1. Cellulose-acetate rayon taffeta	27(1)	33(2)	21(1)	34(2)	Multifilament	Multifilament
2. Cotton muslin sheeting, bleached	11(0)	19(1)	24(1)	29(2)	Single	Single
3. Cotton muslin sheeting, unbleached	17(1)	27(1)	15(1)	27(2)	Single	Single
4. Regenerated-cellulose rayon twill	19(0)	21(1)	15(2)	18(1)	Multifilament	Multifilament

TABLE I. (Continued)

Fabric	Distribution of yarns in fabric				Yarn number	
	By number		By weight			
	Warp	Filling	Warp	Filling	Warp	Filling
	Number per inch	Number per inch	Percentage of fabric	Percentage of fabric	Typp	Typp
1. Cellulose-acetate rayon taffeta	205(0)	66(0)	66.3(0.4)	33.6(0.3)	61(0)	36.4(0.1)
2. Cotton muslin sheeting, bleached	76(0)	67(1)	51.3(0.3)	49.6(0.3)	18.6(0.2)	19.3(0.1)
3. Cotton muslin sheeting, unbleached	69(0)	74(1)	53.6(0.1)	47.4(0.4)	15.9(0.1)	17.6(0.4)
4. Regenerated-cellulose rayon twill	143(2)	75(1)	55.3(0.1)	42.9(0.1)	44.6(0.2)	30.3(0.0)

TABLE I. (Continued)

Fabric	Twist of yarn: Warp: Number per inch, direction	Twist of yarn: Filling: Number per inch, direction	Copper number of textile	Barometric pressure: Millimeter of mercury	Acetyl of textile: Percentage
1. Cellulose-acetate rayon taffeta	5(0),S	3(0),S	3.08(0.03)	735.8	38.49(0.05)
2. Cotton muslin sheeting, bleached	21(1),Z	16(1),Z	0.09(0.01)	736.5	-
3. Cotton muslin sheeting, unbleached	21(1),Z	18(1),Z	1.10(0.03)	736.5	-
4. Regenerated-cellulose rayon twill	4(0),S	2(0),S	1.14(0.02)	737.1	-

TABLE II. EFFECT OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE IN FOUR HOURS ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Bleaching bath		ACETYL					
Potassium permanganate	Sulfuric acid	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.	
Molarity	Molarity	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric
0.0000	0.0000	38.40(0.09)*	38.5	38.47(0.01)	38.6	38.44(0.02)	38.6
0.0200	0.0000	38.96(0.12)	38.9	39.17(0.04)	39.0	39.39(0.10)	39.0
0.0330	0.0000	39.04(0.11)	38.8	39.33(0.02)	39.2	39.21(0.06)	39.3
0.0000	0.0500	38.46(0.05)	38.5	38.41(0.03)	38.5	38.40(0.02)	38.5
0.0200	0.0500	40.05(0.18)	40.3	40.28(0.06)	40.7	35.70(0.69)	38.7
0.0330	0.0500	39.79(0.22)	40.2	39.17(0.42)	40.8	**	

*Mean deviations are within parentheses.
**Fabric too disintegrated for determination.

TABLE III. EFFECT OF FIFTY-VOLUME BATHS OF POTASS

Bleaching bath		Cotton cellulose*							
Potassium permanganate	Sulfuric acid	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.		15.0 ±
Molarity	Molarity	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric
0.0000	0.0000	0.09(0.01)**	0.09	0.09(0.01)	0.09	0.05(0.00)	0.05	0.11(0.02
0.0200	0.0000	0.11(0.01)	0.11	0.15(0.01)	0.15	0.24(0.01)	0.24	0.21(0.01
0.0333***	0.0000	0.15(0.01)	0.15	0.18(0.01)	0.18	0.44(0.02)	0.45	0.43(0.01
0.0000	0.0500	0.01(0.00)	0.01	0.02(0.02)	0.02	0.01(0.00)	0.01	0.04(0.0(
0.0200	0.0500	0.18(0.01)	0.18	0.17(0.01)	0.17	0.42(0.01)	0.43	0.42(0.0
0.0333***	0.0500	0.18(0.02)	0.18	0.30(0.00)	0.31	0.48(0.00)	0.50	0.49(0.0

*Unpublished work of Minnie Lichte in this laboratory.
**Mean deviations are within parentheses.
***0.0330M permanganate used with cellulose-acetate rayon.
****Washing effected by decantation.

E BATHS OF POTASSIUM PERMANGANATE IN FOUR HOURS ON THE ASH OF THE FABRICS

ASH									
	Regenerated-cellulose rayon						Cellulose-aceta		
1° C.	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.		15.0 ± 0.1° C.		25.0 ±
Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric
0.05	0.11(0.02)	0.11	0.09(0.01)	0.09	0.08(0.01)	0.08	0.06(0.01)	0.06	0.07(0.01
0.24	0.21(0.01)	0.21	0.23(0.01)	0.23	0.46(0.01)	0.46	0.42(0.00)	0.42	0.55(0.01
0.45	0.43(0.01)	0.43	0.42(0.01)	0.42	0.58(0.01)	0.60	0.48(0.02)	0.48	0.60(0.01
0.01	0.04(0.00)	0.04	0.05(0.01)	0.05	0.05(0.01)	0.05	0.06(0.00)	0.06	0.05(0.00
0.43	0.42(0.02)	0.44	0.56(0.00)	0.57	0.56(0.03)	0.58	0.29(0.02)	0.29	0.23(0.02
0.50	0.49(0.02)	0.50	0.68(0.02)	0.72	0.68(0.01)	0.75	0.17(0.01)	0.17	0.19(0.01

HOURS ON THE ASH OF THE FABRICS

rayon*			Cellulose-acetate rayon					
° C.	40.0 ± 0.1° C.		15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.	
r-nt-ge of sid-ual abric	Percentage of original fabric	Per-cent-age of resid-ual fabric	Percentage of original fabric	Per-cent-age of resid-ual fabric	Percentage of original fabric	Per-cent-age of resid-ual fabric	Percentage of original fabric	Per-cent-age of resid-ual fabric
0.09	0.08(0.01)	0.08	0.06(0.01)	0.06	0.07(0.01)	0.07	0.04(0.00)	0.04
0.23	0.46(0.01)	0.46	0.42(0.00)	0.42	0.55(0.01)	0.55	0.93(0.01)	0.92
0.42	0.58(0.01)	0.60	0.48(0.02)	0.48	0.60(0.01)	0.60	0.48(0.03)	0.48
0.05	0.05(0.01)	0.05	0.06(0.00)	0.06	0.05(0.00)	0.05	0.06(0.00)	0.06
0.57	0.56(0.03)	0.58	0.29(0.02)	0.29	0.23(0.03)	0.23	0.25(0.01)	0.27
0.72	0.68(0.01)	0.75	0.17(0.01)	0.17	0.19(0.01)	0.20	0.30(0.07)	***0.55

TABLE IV. EFFECT OF FIFTY-VOLUME BATHS OF POTASSIUM PERM

BREAKING STRENGTH OF THE WET WARP OF THE FABRI

Bleaching bath		BREAKING STRE								Re	
		Cotton cellulose*									
Potassium permanganate	Sulfuric acid	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.		15.0 ± 0.1°			
Molarity	Molarity	Pound per inch	Percentage	Pound per inch	Percentage	Pound per inch	Percentage	Pound per inch	Perc ag		
0.0000	0.0000	28(1)**	100	28(1)	100	26(1)	100	30(1)	10		
0.0200	0.0000	23(1)	82	17(1)	61	15(0)	58	20(0)	6		
0.0333***	0.0000	18(1)	64	15(1)	54	8(0)	31	15(0)	5		
0.0000	0.0500	26(1)	100	25(1)	100	24(1)	100	28(1)	10		
0.0200	0.0500	17(1)	65	8(1)	32	8(1)	33	16(1)	5		
0.0333***	0.0500	13(1)	50	2(1)	8	4(1)	17	12(1)	4		

*Unpublished work of Minnie Lichte in this laboratory.

**Mean deviations are within parentheses.

***0.0330M permanganate used with cellulose-acetate rayon.

****Disintegrated.

)LUME BATHS OF POTASSIUM PERMANGANATE IN FOUR HOURS ON THE

OF THE WET WARP OF THE FABRICS

BREAKING STRENGTH OF WET WARP OF FABRIC																	
	Regenerated-cellulose rayon*												Cellulose-a				
.0 ± 0.1° C.		15.0 ± 0.1° C.			25.0 ± 0.1°C.			40.0 ± 0.1° C.			15.0 ± 0.1° C.						
	Percent-age	Pound per inch		Percent-age	Pound per inch		Percent-age	Pound per inch		Percent-age	Pound per inch		Percent-age	Pou pe in			
.)	100	30(1)		100	29(0)		100	29(1)		100	20(0)		100	21(			
))	58	20(0)		67	16(0)		55	13(0)		45	18(1)		90	18(			
)	31	15(0)		50	2(0)		7	1			15(1)		75	15(			
.)	100	28(1)		100	27(1)		100	27(1)		100	20(0)		100	20(			
.)	33	16(1)		57	7(2)		26	7(1)		26	10(0)		50	6(			
.)	17	12(1)		43	1			1			7(0)		35	**			

OURS ON THE

OF FABRIC

e rayon*			Cellulose-acetate rayon					
1°C.	40.0 ± 0.1° C.		15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.	
rcent-age	Pound per inch	Percent-age	Pound per inch	Percent-age	Pound per inch	Percent-age	Pound per inch	Percent-age
100	29(1)	100	20(0)	100	21(1)	100	21(1)	100
55	13(0)	45	18(1)	90	18(1)	86	15(0)	71
7	1		15(1)	75	15(0)	71	12(0)	57
100	27(1)	100	20(0)	100	20(1)	100	20(0)	100
26	7(1)	26	10(0)	50	6(1)	30	****	
	1		7(0)	35	****		****	

TABLE V. EFFECT OF FIFTY-VOLUME BATHS OF

OF THE FABRICS

Bleaching bath		Cotton cellulose*							
Potassium permanganate	Sulfuric acid	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.		15.0 ±
Molarity	Molarity	Based on original fabric	Based on residual fabric	Based on original fabric	Based on residual fabric	Based on original fabric	Based on residual fabric	Based on original fabric
0.0000	0.0000	0.14(0.01)**	0.14	0.14(0.01)	0.14	0.15(0.00)	0.15	0.81(0.0
0.0200	0.0000	0.88(0.02)	0.89	1.94(0.05)	1.96	2.47(0.02)	2.51	2.84(0.0
0.0333***	0.0000	1.36(0.03)	1.38	3.54(0.02)	3.59	3.65(0.01)	3.71	4.88(0.0
0.0000	0.0500	0.17(0.01)	0.17	0.18(0.01)	0.18	0.18(0.01)	0.18	0.99(0.0
0.0200	0.0500	1.82(0.02)	1.85	2.97(0.04)	3.03	3.49(0.01)	3.59	4.46(0.0
0.0333***	0.0500	2.95(0.04)	3.00	4.78(0.03)	4.91	5.37(0.00)	5.56	5.78(0.0

*Unpublished work of Minnie Lichte in this laboratory.

**Mean deviations are given within parentheses.

***0.0330M permanganate used with cellulose-acetate rayon.

****Textile too degraded for determination.

OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE IN FOUR HOURS ON THE COPPER NUMBER

FABRICS

COPPER NUMBER

	Regenerated-cellulose rayon*								Cellulo	
0 ± 0.1° C.		15.0 ± 0.1 C.		25.0 ± 0.1 C.		40.0 ± 0.1 C.		15.0 ± 0.1° C.		
d on inal ric	Based on resid-ual fabric	Based on original fabric	Based on resid-ual fabric	Based on original fabric	Based on resid-ual fabric	Based on original fabric	Based on resid-ual fabric	Based on original fabric	Based on resid-ual fabric	Ba or
(0.00)	0.15	0.81(0.03)	0.81	0.87(0.02)	0.87	0.91(0.01)	0.91	3.22(0.11)	3.23	
(0.02)	2.51	2.84(0.01)	2.85	4.62(0.02)	4.63	4.90(0.01)	4.92	3.79(0.06)	3.78	
(0.01)	3.71	4.88(0.02)	4.90	6.50(0.02)	6.54	7.21(0.04)	7.46	3.86(0.04)	3.84	
(0.01)	0.18	0.99(0.02)	0.99	1.02(0.02)	1.02	1.14(0.03)	1.14	2.86(0.19)	2.87	
(0.01)	3.59	4.46(0.03)	4.54	5.94(0.03)	6.02	6.10(0.03)	6.31	10.81(0.31)	10.87	12
(0.00)	5.56	5.78(0.01)	5.90	7.31(0.05)	7.75	8.00(0.06)	8.83	12.80(0.11)	12.94	15

IN FOUR HOURS ON THE COPPER NUMBER

se rayon*			Cellulose-acetate rayon					
1 C.	40.0 ± 0.1 C.		15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.	
Based on residual fabric	Based on original fabric	Based on residual fabric	Based on original fabric	Based on residual fabric	Based on original fabric	Based on residual fabric	Based on original fabric	Based on residual fabric
0.87	0.91(0.01)	0.91	3.22(0.11)	3.23	3.02(0.06)	3.03	2.95(0.07)	2.96
4.63	4.90(0.01)	4.92	3.79(0.06)	3.78	3.66(0.06)	3.67	3.59(0.03)	3.56
6.54	7.21(0.04)	7.46	3.86(0.04)	3.84	3.77(0.02)	3.75	3.87(0.01)	3.88
1.02	1.14(0.03)	1.14	2.86(0.19)	2.87	3.08(0.06)	3.09	3.07(0.04)	3.08
6.02	6.10(0.03)	6.31	10.81(0.31)	10.87	12.28(0.36)	12.45	11.04(0.28)	11.97
7.75	8.00(0.06)	8.83	12.80(0.11)	12.94	15.01(0.17)	15.65	***	

TABLE VI. EFFECT OF FIFTY-VOLUME BATHS OF POTAS

Bleaching bath		Cotton cellulose*						R
Potassium permanganate	Sulfuric acid	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.		15.0 ± 0.1°
Molarity	Molarity	Percentage of original fabric	Percentage of control fabric	Percentage of original fabric	Percentage of control fabric	Percentage of original fabric	Percentage of control fabric	Percentage of original fabric
0.0000	0.0000	99.8(0.0)**	100.0	99.8(0.0)	100.0	99.7(0.1)	100.0	100.2(0.1)
0.0200	0.0000	99.2(0.1)	99.4	99.0(0.1)	99.2	98.6(0.1)	98.9	99.8(0.0)
0.0333***	0.0000	98.7(0.1)	98.9	98.7(0.2)	98.9	98.3(0.0)	98.6	99.5(0.1)
0.0000	0.0500	99.6(0.1)	100.0	99.5(0.1)	100.0	99.7(0.1)	100.0	100.1(0.1)
0.0200	0.0500	98.4(0.2)	98.8	98.1(0.0)	98.6	97.2(0.1)	97.5	98.3(0.2)
0.0333***	0.0500	98.2(0.1)	98.6	97.3(0.1)	97.8	96.6(0.1)	96.9	98.0(0.2)

*Unpublished work of Minnie Lichte in this laboratory.
**Mean deviations are within parentheses.
***0.0330M permanganate used with cellulose-acetate rayon.
****Washing effected by decantation.

OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE IN FOUR HOURS ON THE WEIGHT OF THE FABRICS

WEIGHT										
	Regenerated-cellulose rayon*								Cellulose-	
0.0 ± 0.1° C.	15.0 ± 0.1° C.		25.0 ± 0.1° C.		40.0 ± 0.1° C.		15.0 ± 1.0° C.			
entage of iginal abric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric	Pe
7(0.1)	100.0	100.2(0.1)	100.0	100.3(0.1)	100.0	100.3(0.1)	100.0	99.7(0.0)	100.0	
6(0.1)	98.9	99.8(0.0)	99.6	99.7(0.2)	99.4	99.5(0.1)	99.2	100.2(0.0)	100.5	1
3(0.0)	98.6	99.5(0.1)	99.3	99.4(0.1)	99.1	96.6(0.1)	96.3	100.5(0.0)	100.8	1
7(0.1)	100.0	100.1(0.1)	100.0	100.0(0.0)	100.0	100.3(0.1)	100.0	99.8(0.0)	100.0	
2(0.1)	97.5	98.3(0.2)	98.2	98.6(0.2)	98.6	96.7(0.1)	96.4	99.4(0.0)	99.6	
6(0.1)	96.9	98.0(0.2)	97.9	94.3(0.1)	94.3	90.6(0.6)	90.3	98.9(0.0)	99.1	

FOUR HOURS ON THE WEIGHT OF THE FABRICS

rayon*			Cellulose-acetate rayon					
C.	40.0 ± 0.1° C.		15.0 ± 1.0° C.		25.0 ± 1.0° C.		40.0 ± 0.1° C.	
r-nt-e of on-rol brio	Percentage of original fabric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric	Percentage of original fabric	Per-cent-age of con-trol fabric
00.0	100.3(0.1)	100.0	99.7(0.0)	100.0	99.6(0.0)	100.0	99.6(0.0)	100.0
99.4	99.5(0.1)	99.2	100.2(0.0)	100.5	100.4(0.0)	100.8	100.9(0.0)	101.3
99.1	96.6(0.1)	96.3	100.5(0.0)	100.8	100.4(0.0)	100.8	99.8(0.0)	100.2
00.0	100.3(0.1)	100.0	99.8(0.0)	100.0	99.7(0.0)	100.0	99.7(0.0)	100.0
98.6	96.7(0.1)	96.4	99.4(0.0)	99.6	98.6(0.0)	98.9	92.2(0.8)	92.5
94.3	90.6(0.6)	90.3	98.9(0.0)	99.1	95.9(0.3)	96.2	54.5(5.4)****	54.7

TABLE VII. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Bleaching bath	ACETYL				
Sodium peroxyborate	After eight hours at 40.0 ± 0.1° C.*		After two hours at 100° C.		
Normality	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of control fabric
0.0000	38.34(0.01)**	38.5	38.05(0.08)	38.34	100.0
0.0480	38.22(0.04)	38.5	36.28(0.13)	37.33	97.4
0.0961	37.92(0.02)	38.3	31.07(0.31)	33.50	87.4
0.1441	37.69(0.02)	38.3	27.16(0.12)	30.64	79.9
0.1922	37.27(0.17)	38.0	22.77(0.25)	26.96	70.3

*Unpublished work of Jean Vivian Bower in this laboratory.
**Mean deviations are within parentheses.

TABLE VIII. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOA

OF THE WET WARP OF THE FABRICS

Bleaching bath	BREAKING STRENGTH OF WET WARP OF FABRICS							
	After eight hours at 40.0 ± 0.1° C.						After t	
Sodium peroxyborate	Cotton cellulose*		Regenerated-cellulose rayon*		Cellulose-acetate rayon*		Cotton Cellulose*	
Normality	Pound per inch	Percentage of control fabric	Pound per inch	Percentage of control fabric	Pound per inch	Percentage of control fabric	Pound per inch	Percen age o conti fabri
0.0000	23(1)**	100	24(0)	100	17(1)	100	21(2)	10
0.0480	19(1)	83	21(1)	88	17(1)	100	19(2)	9
0.0961	20(1)	87	17(1)	71	16(1)	94	20(3)	9
0.1441	19(1)	83	14(1)	58	16(1)	94	19(1)	9
0.1922	20(1)	87	11(1)	46	15(0)	88	19(1)	9

*Unpublished work of Jean Vivian Bower in this laboratory.

**Mean deviations are within parentheses.

SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, ON THE BREAKING STRENGTH

BREAKING STRENGTH OF WET WARP OF FABRICS

) ± 0.1° C.			After two hours at 100° C.					
d- yon*	Cellulose-acetate rayon*		Cotton Cellulose*		Regenerated-cellulose rayon*		Cellulose-acetate rayon	
rcent- ge of ntrol abric	Pound per inch	Percent-age of control fabric	Pound per inch	Percent-age of control fabric	Pound per inch	Percent-age of control fabric	Pound per inch	Percent-age of control fabric
100	17(1)	100	21(2)	100	23(1)	100	18(1)	100
88	17(1)	100	19(2)	90	19(3)	83	17(1)	94
71	16(1)	94	20(3)	95	14(2)	61	15(1)	83
58	16(1)	94	19(1)	90	12(1)	52	13(1)	72
46	15(0)	88	19(1)	90	10(1)	43	11(1)	61

this laboratory.

TABLE IX. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS T

COPPER NUMBER OF THE FABRICS

Bleaching bath	COPPER NUMBER							
	After eight hours at 40.0 ± 0.1° C.						After	
Sodium peroxyborate	Cotton cellulose*		Regenerated-cellulose rayon*		Cellulose-acetate rayon		Cotton cellulose*	
Normality	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	P c a r f
0.0000	0.18(0.01)**	0.18	1.10(0.05)	1.11	2.91(0.07)	2.93	0.14(0.02)	0
0.0480	0.19(0.01)	0.19	1.32(0.01)	1.34	3.06(0.01)	3.08	0.33(0.02)	0
0.0961	0.27(0.01)	0.27	1.96(0.06)	1.99	3.01(0.07)	3.04	0.45(0.08)	0
0.1441	0.30(0.03)	0.30	2.24(0.02)	2.27	2.99(0.19)	3.04	0.60(0.05)	0
0.1922	0.42(0.04)	0.42	2.94(0.15)	2.98	3.01(0.07)	3.07	0.62(0.02)	0

*Unpublished work of Jean Vivian Bower in this laboratory.
**Mean deviations are within parentheses.

3 OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, ON THE

3

COPPER NUMBER

± 0.1° C.			After two hours at 100° C.					
d-ayon*	Cellulose-acetate rayon		Cotton cellulose*		Regenerated-cellulose rayon*		Cellulose-acetate rayon	
Per-centage of resid-ual fabric	Percentage of original fabric	Per-centage of resid-ual fabric	Percentage of original fabric	Per-centage of resid-ual fabric	Percentage of original fabric	Per-centage of resid-ual fabric	Percentage of original fabric	Per-centage of resid-ual fabric
1.11	2.91(0.07)	2.93	0.14(0.02)	0.14	1.04(0.02)	1.05	3.24(0.06)	3.26
1.34	3.06(0.01)	3.08	0.33(0.02)	0.33	1.37(0.02)	1.38	2.93(0.09)	3.01
1.99	3.01(0.07)	3.04	0.45(0.08)	0.46	2.09(0.02)	2.11	2.68(0.10)	2.89
2.27	2.99(0.19)	3.04	0.60(0.05)	0.61	2.44(0.00)	2.48	2.48(0.02)	2.60
2.98	3.01(0.07)	3.07	0.62(0.02)	0.63	2.83(0.02)	2.89	2.17(0.09)	2.57

1 this laboratory.

TABLE X. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CEN

ON THE WEIGHT OF THE FABRICS

Bleaching bath	WEIGHT OF RESIDUAL FABRICS							
	After eight hours at 40.0 ± 0.1° C.						After tw	
Sodium peroxyborate	Cotton cellulose*		Regenerated-cellulose rayon*		Cellulose-acetate rayon*		Cotton cellulose*	
Normality	Percentage of original fabric	Percentage of control fabric	Percentage of original fabric	Percentage of control fabric	Percentage of original fabric	Percentage of control fabric	Percentage of original fabric	Percen age of contr fabri
0.0000	100.1(0.1)**	100.0	99.0(0.1)	100.0	99.4(0.0)	100.0	100.2(0.1)	100
0.0480	99.3(0.1)	99.2	98.5(0.0)	99.5	99.3(0.1)	99.9	99.1(0.2)	98
0.0961	99.0(0.0)	98.9	98.5(0.1)	99.5	99.0(0.1)	99.6	98.5(0.2)	98
0.1441	99.0(0.0)	98.9	98.5(0.1)	99.5	98.4(0.1)	99.0	98.2(0.1)	98
0.1922	98.9(0.0)	98.8	98.6(0.1)	99.6	98.0(0.1)	98.6	98.1(0.0)	97

*Unpublished work of Jean Vivian Bower in this laboratory.
**Mean deviations are within parentheses.

UME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP,

E FABRICS

WEIGHT OF RESIDUAL FABRICS									
0.0 ± 0.1° C.			After two hours at 100° C.						
ted-rayon*	Cellulose-* acetate rayon		Cotton cellulose*		Regenerated-cellulose rayon*		Cellulose-acetate rayon	
Percent-age of control fabric	Percent-age of original fabric	Percent-age of control fabric	Percent-age of original fabric	Percent-age of control fabric	Percent-age of original fabric	Percent-age of control fabric	Percent-age of original fabric	Percent-age of control fabric
100.0	99.4(0.0)	100.0	100.2(0.1)	100.0	98.5(0.0)	100.0	99.2(0.0)	100.0
99.5	99.3(0.1)	99.9	99.1(0.2)	98.9	98.4(0.0)	99.9	97.2(0.2)	98.0
99.5	99.0(0.1)	99.6	98.5(0.2)	98.3	98.2(0.1)	99.7	92.8(0.3)	93.5
99.5	98.4(0.1)	99.0	98.2(0.1)	98.0	98.0(0.2)	99.5	88.6(0.2)	89.3
99.6	98.0(0.1)	98.6	98.1(0.0)	97.9	97.8(0.1)	99.3	84.5(0.3)	85.2

in this laboratory.

B.

TABLE XI. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Calcium hypochlorite		Time	Temperature	Acetyl	
Initial normality	Final normality of blank	Hour	°C.	Percentage of original fabric	Percentage of residual fabric
0.0000	0.0000	2	25.0 ± 0.1	38.36(0.02)*	38.46
0.0970	0.0955			38.49(0.05)	38.58
0.0000	0.0000	4	25.0 ± 0.1	38.39(0.02)	38.49
0.1040	0.0975			38.45(0.20)	38.53
0.0000	0.0000	4	40.0 ± 0.1	38.44(0.02)	38.58
0.1026	0.0802			38.69(0.05)	39.15

*Mean deviations are within parentheses.

TABLE XII. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE ON THE BREAKING STRENGTH OF THE WET WARP OF THE FABRICS

Fabric	Calcium hypochlorite		Time	Temperature	Breaking strength of wet warp of fabric	
	Initial normality	Final normality of blank	Hour	°C.	Pound per inch	Percentage of control fabric
Cotton cellulose*	0.0000	0.0000	4	25.0 ± 0.1	22(0)**	100
	0.1008	0.0976			18(1)	82
	0.0000	0.0000	4	40.0 ± 0.1	22(0)	100
	0.0993	0.0725			8(2)	36
Regenerated-cellulose rayon*	0.0000	0.0000	2	25.0 ± 0.1	25(1)	100
	0.1000	0.0932			16(1)	64
	0.0000	0.0000	4	25.0 ± 0.1	25(2)	100
	0.1008	0.0976			1	4
	0.0000	0.0000	4	40.0 ± 0.1	23(1)	100
	0.0993	0.0725			***	0
Cellulose-acetate rayon	0.0000	0.0000	2	25.0 ± 0.1	19(1)	100
	0.0970	0.0955			19(1)	100
	0.0000	0.0000	4	25.0 ± 0.1	19(1)	100
	0.1040	0.0975			19(1)	100
	0.0000	0.0000	4	40.0 ± 0.1	19(1)	100
	0.1026	0.0802			14(1)	74

*Unpublished work of Mary Alexander in this laboratory.
**Mean deviations are within parentheses.
***Disintegrated.

TABLE XIII. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE ON THE COPPER NUMBER OF THE FABRICS

Fabric	Calcium hypochlorite		Time	Temperature	Barometric pressure	Copper number	
	Initial normality	Final normality of blank	Hour	°C.	Millimeter of mercury	Percentage of original fabric	Percentage of residual fabric
Cotton cellulose*	0.0000	0.0000	4	25.0 ± 0.1	736.5	0.11(0.01)**	0.11
	0.0988	0.0924			739.3	0.50(0.01)	0.51
	0.0000	0.0000	4	40.0 ± 0.1	736.0	0.08(0.01)	0.08
	0.0991	0.0851			736.5	1.66(0.02)	1.69
Regenerated-cellulose rayon*	0.0000	0.0000	2	25.0 ± 0.1	736.5	0.58(0.01)	0.58
	0.1003	0.0939			736.5	5.14(0.08)	5.16
Cellulose-acetate rayon	0.0000	0.0000	2	25.0 ± 0.1	747.0	2.98(0.05)	2.99
	0.0970	0.0955			738.6	3.22(0.11)	3.23
	0.0000	0.0000	4	25.0 ± 0.1	747.0	2.98(0.04)	2.99
	0.1040	0.0975			741.5	3.91(0.04)	3.92
	0.0000	0.0000	4	40.0 ± 0.1	738.6	3.06(0.04)	3.07
	0.1026	0.0802			741.5	5.58(0.22)	5.65

*Unpublished work of Mary Alexander in this laboratory.
**Mean deviations are within parentheses.

TABLE XIV. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE ON THE WEIGHT OF THE FABRICS

Fabric	Calcium hypochlorite		Time	Temperature	Weight	
	Initial normality	Final normality of blank	Hour	°C.	Percentage of original fabric	Percentage of control fabric
Cotton cellulose*	0.0000	0.0000	4	25.0 ± 0.1	99.8(0.0)**	100.0
	0.1000	0.0879			98.3(0.1)	98.5
	0.0000	0.0000	4	40.0 ± 0.1	99.7(0.0)	100.0
	0.0996	0.0838			98.1(0.0)	98.4
Regenerated-cellulose rayon*	0.0000	0.0000	2	25.0 ± 0.1	100.0(0.0)	100.0
	0.0991	0.0851			99.7(0.0)	99.7
	0.0000	0.0000	4	25.0 ± 0.1	100.0(0.0)	100.0
	0.1003	0.0755			93.4(1.5)	93.4
Cellulose-acetate rayon	0.0000	0.0000	2	25.0 ± 0.1	99.7(0.0)	100.0
	0.0970	0.0955			99.8(0.0)	100.1
	0.0000	0.0000	4	25.0 ± 0.1	99.8(0.0)	100.0
	0.1040	0.0975			99.8(0.0)	100.0
	0.0000	0.0000	4	40.0 ± 0.1	99.6(0.0)	100.0
	0.1026	0.0802			98.8(0.0)	99.2

*Unpublished work of Mary Alexander in this laboratory.
**Mean deviations are given within parentheses.

TABLE XV. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM N-CHLORO-p-TOLUENE-SULFONAMIDE IN FOUR HOURS ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Sodium N-chloro-p-toluene-sulfonamide		Temperature	Acetyl	
Initial normality	Final normality of blank	°C.	Percentage of original fabric	Percentage of residual fabric
0.0000	0.0000	40.0 ± 0.1	38.44(0.02)*	38.58
0.1012	0.1012		38.43(0.05)	38.54
0.1902	0.1904		38.44(0.03)	38.44
0.3148	0.3152		38.48(0.03)	38.52

*Mean deviations are within parentheses.

TABLE XVI. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM N-CHLORO-p-TOLUENESULFONAMIDE IN FOUR HOURS ON THE BREAKING STRENGTH OF THE WET WARP OF THE FABRICS

Fabric	Sodium N-chloro-p-toluenesulfonamide: Initial normality	Sodium N-chloro-p-toluenesulfonamide: Final normality of blank	Temperature °C.	Breaking strength of wet warp of fabric: Pound per inch	Breaking strength of wet warp of fabric: Percentage of control fabric
Cotton cellulose*	0.0000	0.0000	25.0 ± 0.1	22(0)**	100
	0.0997	0.0997		22(0)	100
	0.0000	0.0000	40.0 ± 0.1	22(0)	100
	0.0997	0.0992		21(1)	95
	0.1986	0.1986		22(1)	100
	0.3357	0.3357		22(1)	100
	0.0000	0.0000	100	22(0)	100
	0.0112	0.0112		20(1)	91
	0.0997	0.0981		20(1)	91
	0.1983	0.1954		18(1)	82
	0.2983	0.2923		17(1)	77
Regenerated-cellulose rayon*	0.0000	0.0000	25.0 ± 0.1	25(2)	100
	0.0997	0.0997		25(2)	100
	0.2238	0.2238		23(1)	92
	0.3357	0.3357		23(1)	92
	0.0000	0.0000	40.0 ± 0.1	23(1)	100
	0.0997	0.0992		23(1)	100
	0.2238	0.2238		18(1)	78
	0.3357	0.3380		18(1)	78
	0.0000	0.0000	100	24(1)	100
	0.0112	0.0112		***	0
	0.0997	0.0986		***	0
	0.2238	lost		***	0
	0.3357	0.3401		***	0

*Unpublished work of Mary Alexander in this laboratory.
**Mean deviations are within parentheses.
***Disintegrated.

TABLE XVI. (Continued)

Fabric	Sodium N-chloro-p-toluenesulfonamide: Initial normality	Final normality of blank	Temperature: °C.	Breaking strength of wet warp of fabric: Pound per inch	Percentage of control fabric
Cellulose-acetate rayon	0.0000	0.0000	25.0 ± 0.1	19(1)	100
	0.1011	0.1014		18(0)	95
	0.1905	0.1904		19(1)	100
	0.3146	0.3149		19(1)	100
	0.0000	0.0000	40.0 ± 0.1	19(1)	100
	0.1012	0.1012		18(1)	95
	0.1902	0.1904		20(1)	105
	0.3148	0.3152		19(1)	100
	0.0000	0.0000	100	18(1)	100
	0.0096	0.0085		16(1)	89
	0.0994	0.0912		8(0)	44
	0.1819	lost		***	0
	0.3201	0.2872		***	0

TABLE XVII. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM N-CHLORO-p-TOLUENE-SULFONAMIDE IN FOUR HOURS ON THE COPPER NUMBER OF THE FABRICS

Fabric	Sodium N-chloro-p-toluenesulfonamide		Temperature	Barometric pressure	Copper number	
	Initial normality	Final normality of blank	°C.	Millimeter of mercury	Percentage of original fabric	Percentage of residual fabric
Cotton cellulose*	0.0000	0.0000	100	750.0	0.06(0.00)**	0.06
	0.0099	0.0098		736.0	0.20(0.01)	0.20
	0.0997	0.0992		738.6	0.29(0.01)	0.30
	0.2013	0.1944		739.2	0.38(0.04)	0.39
	0.3030	0.2972		745.4	0.67(0.03)	0.68
Regenerated-cellulose rayon*	0.0000	0.0000	40.0 ± 0.1	738.0	0.61(0.02)	0.61
	0.0997	0.0992		737.7	0.65(0.03)	0.65
	0.1999	0.1968		736.8	0.70(0.02)	0.70
	0.3034	0.3002		738.0	0.79(0.01)	0.79
Cellulose-acetate rayon	0.0000	0.0000	40.0 ± 0.1	738.6	3.06(0.04)	3.07
	0.1012	0.1012		746.3	2.79(0.17)	2.80
	0.1902	0.1904		746.0	2.67(0.13)	2.67
	0.3148	0.3152		730.7	2.66(0.06)	2.66

*Unpublished work of Mary Alexander in this laboratory.
**Mean deviations are within parentheses.

TABLE XVIII. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM N-CHLORO-p-TOLUENESULFONAMIDE IN FOUR HOURS ON THE WEIGHT OF THE FABRICS

Fabric	Sodium N-chloro-p-toluenesulfonamide: Initial normality	Sodium N-chloro-p-toluenesulfonamide: Final normality of blank	Temperature °C.	Weight: Percentage of original fabric	Weight: Percentage of control fabric
Cotton cellulose*	0.0000	0.0000	100	99.7(0.0)**	100.0
	0.0099	0.0098		98.7(0.1)	99.0
	0.1002	0.1002		98.2(0.1)	98.5
	0.1997	0.1963		98.0(0.0)	98.3
	0.2997	0.2994		98.0(0.1)	98.3
Regenerated-cellulose rayon*	0.0000	0.0000	40.0 ± 0.1	100.0(0.0)	100.0
	0.0997	0.0992		99.9(0.0)	99.9
	0.1994	0.1982		99.8(0.1)	99.8
	0.2999	0.2990		99.7(0.1)	99.7
Cellulose-acetate rayon	0.0000	0.0000	40.0 ± 0.1	99.6(0.0)	100.0
	0.1012	0.1012		99.7(0.0)	100.1
	0.1902	0.1904		100.0(0.0)	100.4
	0.3148	0.3152		99.9(0.0)	100.3

*Unpublished work of Mary Alexander in this laboratory.
**Mean deviations are within parentheses.

TABLE XIX. EFFECT OF STEAM IN 1.5 HOURS ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Steam		Acetyl		
Gauge pressure	Temperature			
Pound per square inch	°C.	Percentage of original fabric	Percentage of residual fabric	Percentage of value at room temperature
-	Room	38.34(0.04)*	38.49	100.0
10 ± 1	115.2	38.33(0.02)	38.43	99.8
30 ± 1	134.5	38.02(0.08)	38.20	99.2
60 ± 1	153.0	37.63(0.01)	37.98	98.7

*Mean deviations are within parentheses.

TABLE XX. EFFECT OF STEAM IN 1.5 HOURS ON THE BREAKING STRENGTH OF THE WET WARP OF THE FABRICS

Steam		BREAKING STRENGTH OF WET WARP OF FABRIC							
Gauge pressure	Temperature	Cotton cellulose, unbleached		Cotton cellulose, bleached		Regenerated-cellulose rayon		Cellulose-acetate rayon	
Pound per square inch	°C.	Pound per inch	Percentage of value at room temperature	Pound per inch	Percentage of value at room temperature	Pound per inch	Percentage of value at room temperature	Pound per inch	Percentage of value at room temperature
-	room	67(4)*	100	66(5)	100	26(1)	100	19(1)	100
10 ± 1	115.2	65(2)	97	66(4)	100	**		14(3)	74
								21(2)	111
								10(0)	53
								15(2)	79
30 ± 1	134.5	47(2)	70	58(1)	88	27(1)	104	8(0)	42
45 ± 1	144.6	**		**		24(1)	92	**	
60 ± 1	153.0	17(1)	25	35(1)	53	20(1)	77	6(0)	32

*Mean deviations are within parentheses.
**Values not determined.

TABLE XXI. EFFECT OF STEAM IN 1.5 HOURS ON THE COPPER NUMBER OF THE FABRICS

Steam		COPPER NUMBER							
Gauge pressure	Temperature	Cotton cellulose, unbleached		Cotton cellulose, bleached		Regenerated-cellulose rayon		Cellulose-acetate rayon	
Pound per square inch	°C.	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric	Percentage of original fabric	Percentage of residual fabric
-	room	0.24(0.01)*	0.25	0.12(0.00)	0.12	1.06(0.06)	1.06	2.96(0.03)	2.97
10 ± 1	115.2	0.28(0.00)	0.29	0.14(0.01)	0.14	**		3.12(0.06)	3.13
30 ± 1	134.5	1.17(0.04)	1.24	0.26(0.01)	0.26	1.62(0.08)	1.63	3.85(0.03)	3.87
45 ± 1	144.6	**		**		2.76(0.08)	2.76	**	
60 ± 1	153.0	3.28(0.18)	3.55	1.05(0.08)	1.05	3.97(0.15)	4.00	3.77(0.01)	3.81

*Mean deviations are within parentheses.
**Values not determined.

TABLE XXII. EFFECT OF STEAM IN 1.5 HOURS ON THE WEIGHT OF THE FABRICS

Steam		WEIGHT							
Gauge pressure	Temperature	Cotton cellulose, unbleached		Cotton cellulose, bleached		Regenerated-cellulose rayon		Cellulose-acetate rayon	
Pound per square inch	°C.	Percentage of original fabric	Percentage of value at room temperature	Percentage of original fabric	Percentage of value at room temperature	Percentage of original fabric	Percentage of value at room temperature	Percentage of original fabric	Percentage of value at room temperature
-	room	96.73(0.03)*	100.0	99.80(0.02)	100.0	99.74(0.01)	100.0	99.61(0.01)	100.0
10 ± 1	115.2	97.21(0.01)	100.5	100.05(0.01)	100.3	**		99.74(0.00)	100.1
30 ± 1	134.5	94.42(0.04)	97.6	99.95(0.04)	100.2	99.69(0.03)	99.9	99.53(0.06)	99.9
45 ± 1	144.6	**		**		99.82(0.04)	100.1	**	
60 ± 1	153.0	92.32(0.11)	95.4	99.57(0.03)	99.8	99.28(0.04)	99.5	99.08(0.01)	99.5

*Mean deviations are within parentheses.
**Values not determined.

GRAPHS

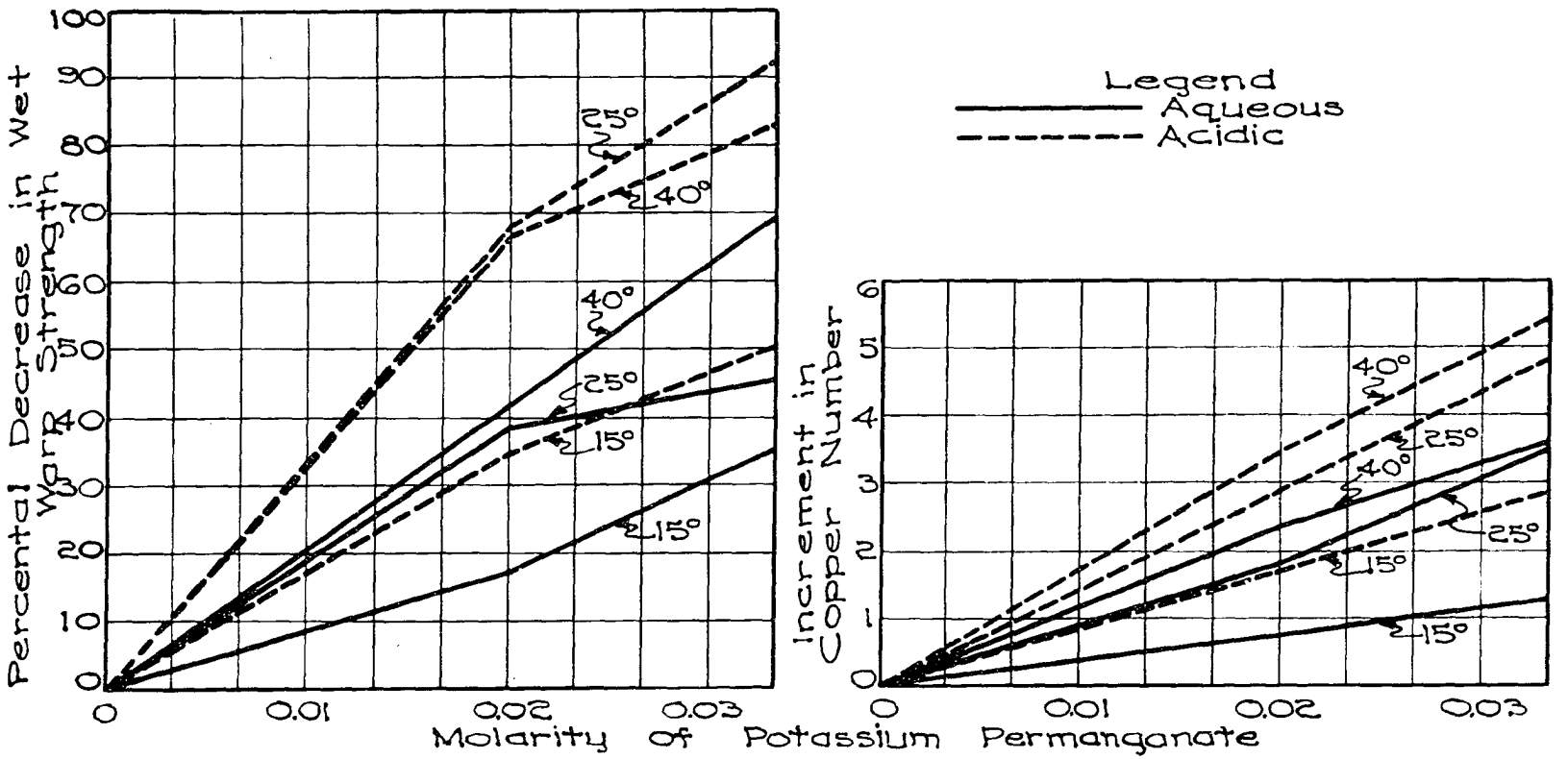

Fig. 1. Effect of Fifty-volume Baths of Aqueous or Acidic Potassium Permanganate on the Wet Strength and Copper Number of Cotton Cellulose.

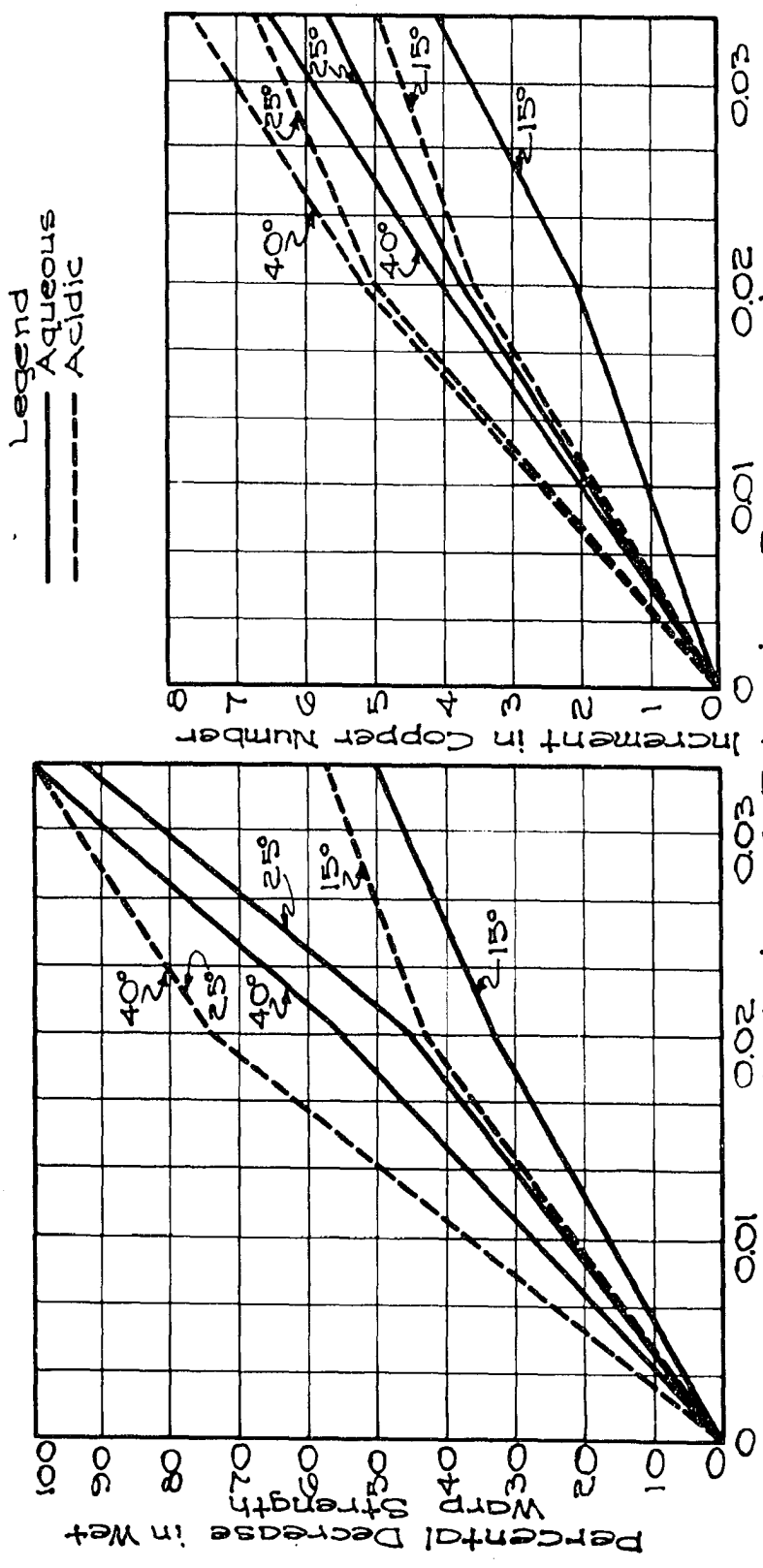

Fig. 2. Effect of Fifty-volume Baths of Aqueous or Acidic Potassium Permanganate on the Wet Warp Strength and Copper Number of Regenerated-cellulose Rayon.

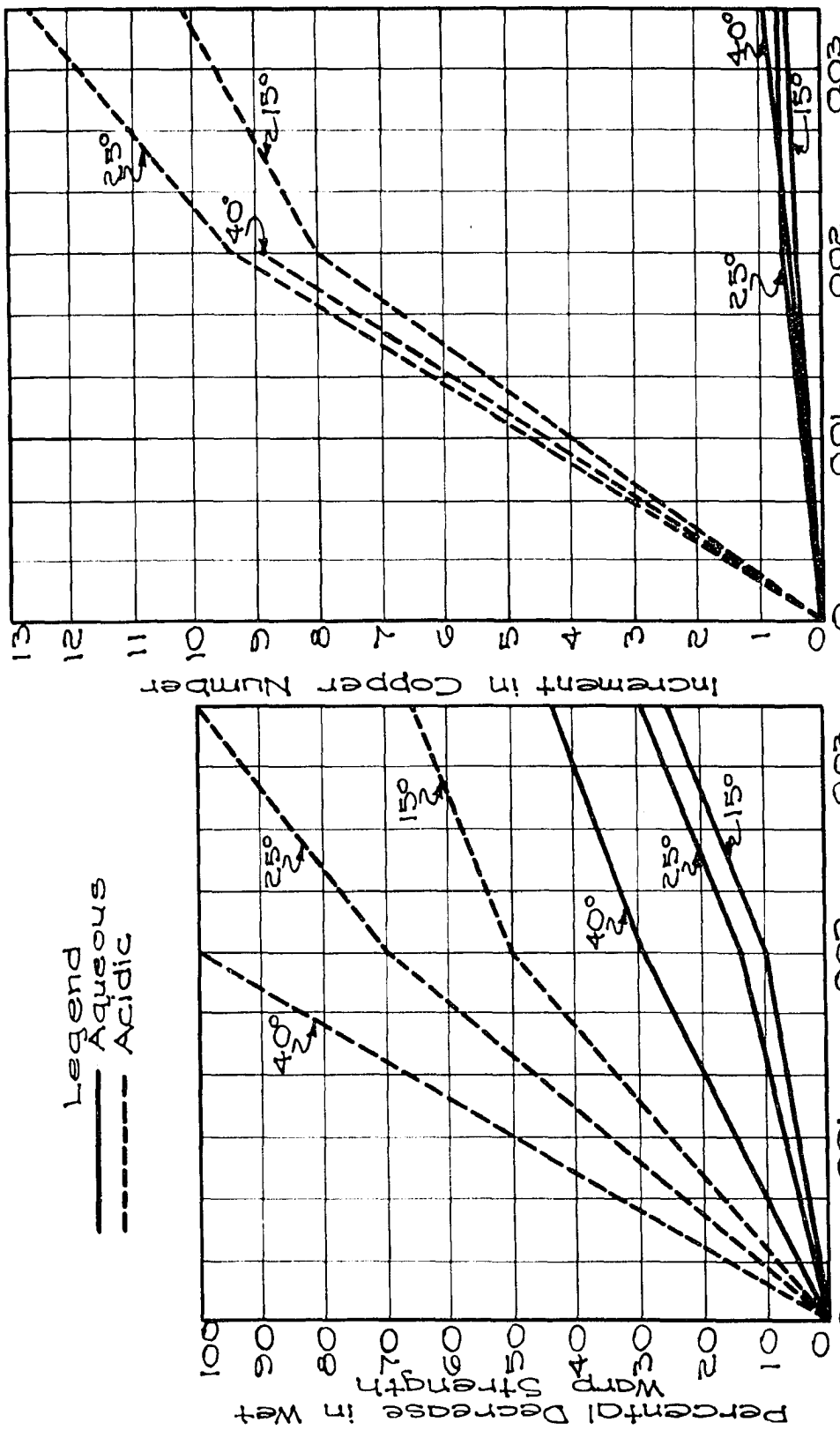

Fig. 3. Effect of Fifty-volume Baths of Aqueous or Acidic Potassium Permanganate on the Wet Strength and Copper Number of Cellulose-acetate Rayon.

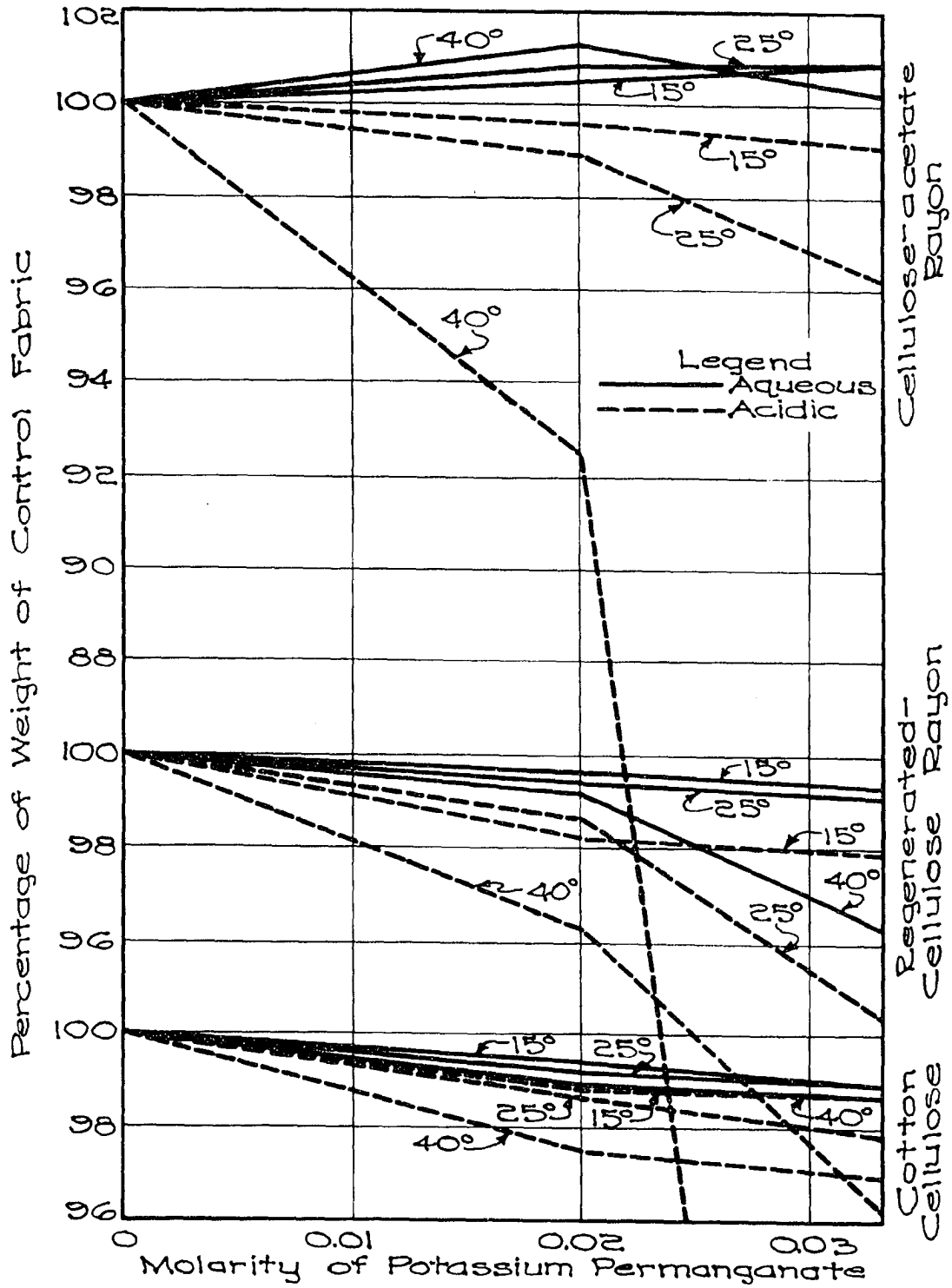

Fig.4. Effect of Fifty-volume Baths of Aqueous or Acidic Potassium Permanganate on the Weights of Cotton Cellulose, Regenerated-cellulose Rayon, and Cellulose-acetate Rayon.

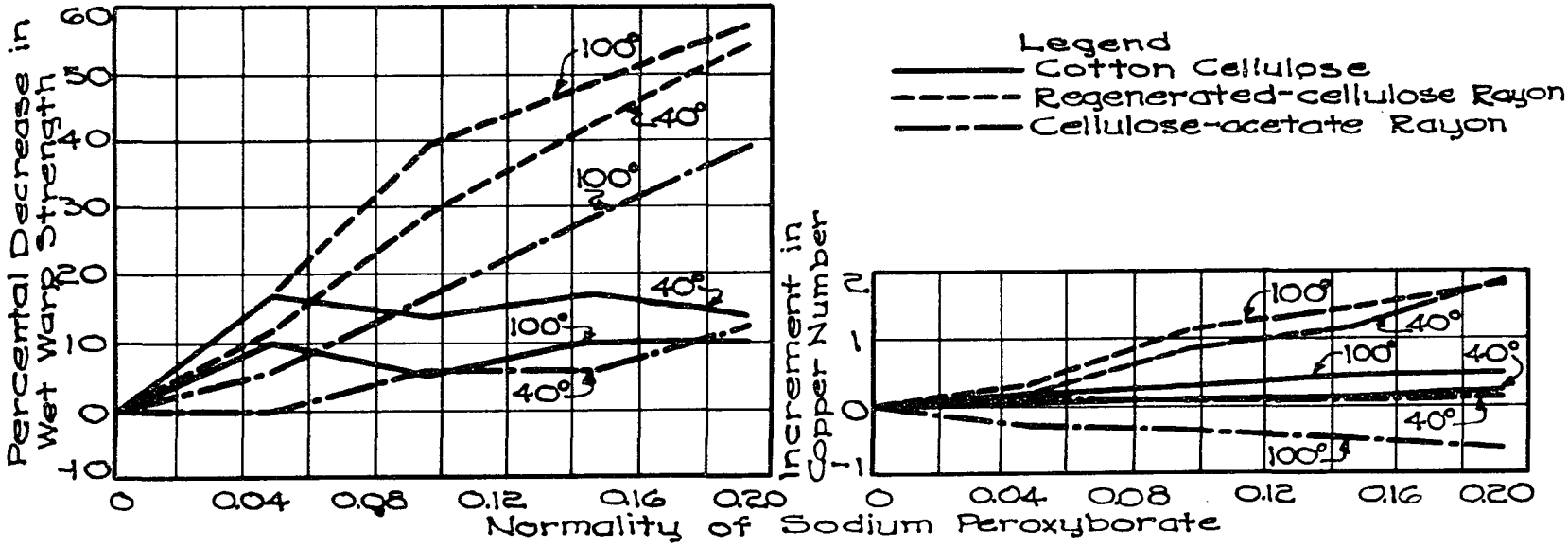

Fig. 5. Effect of Fifty-volume Baths of Sodium Peroxyborate on the Wet Warp Strength and Copper Number of Cotton Cellulose, Regenerated-cellulose Rayon, and Cellulose-acetate Rayon.

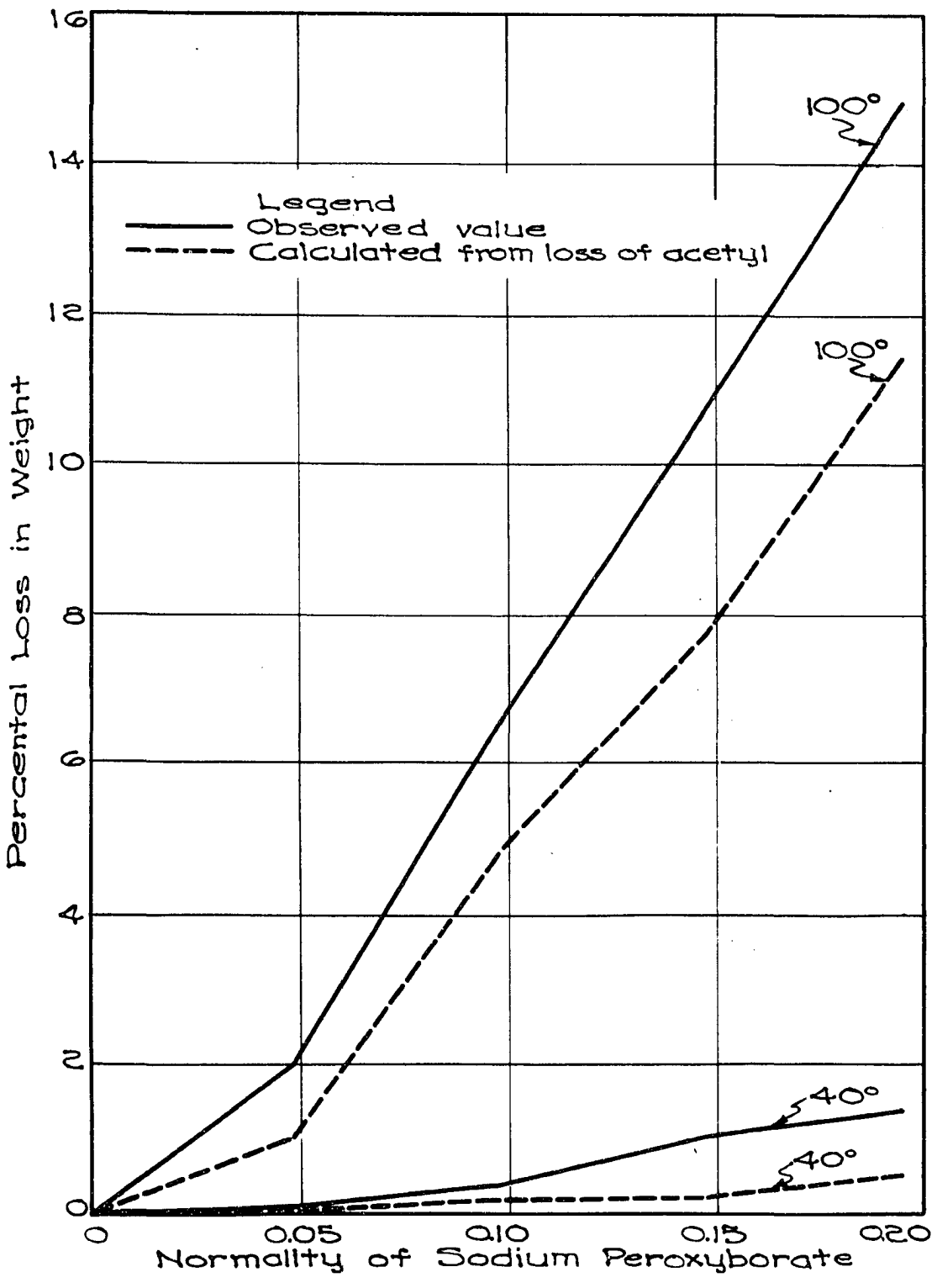

Fig. 6 Effect of Fifty-volume Baths of Sodium Peroxyborate on the Weight of Cellulose-acetate Rayon.

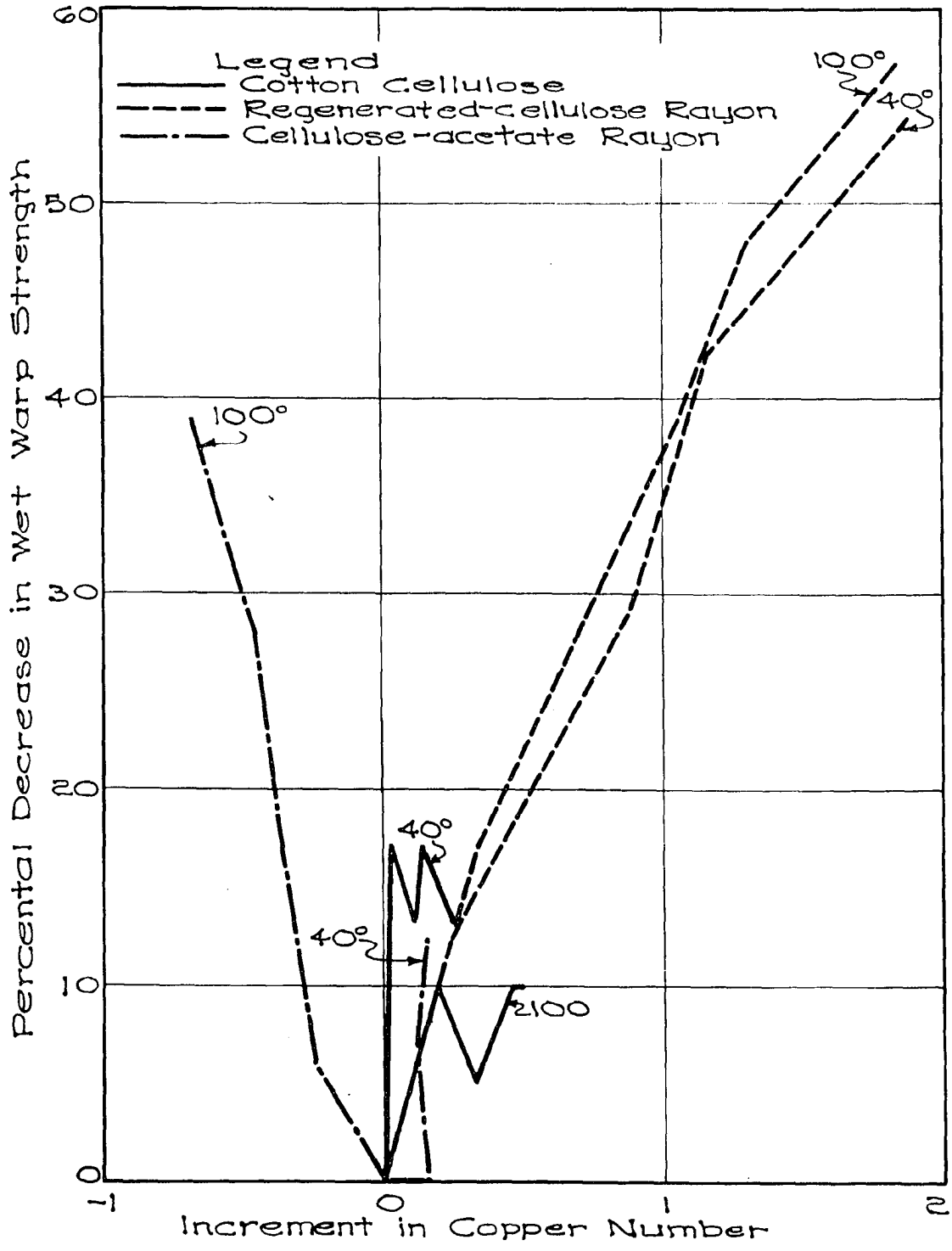

Fig.7. Increment in Copper Number of Cotton Cellulose, Regenerated-cellulose Rayon, and Cellulose-acetate Rayon as a Function of the Percental Decrease in Wet Warp Strength Produced by Fifty-volume Baths of Sodium Peroxyborate.

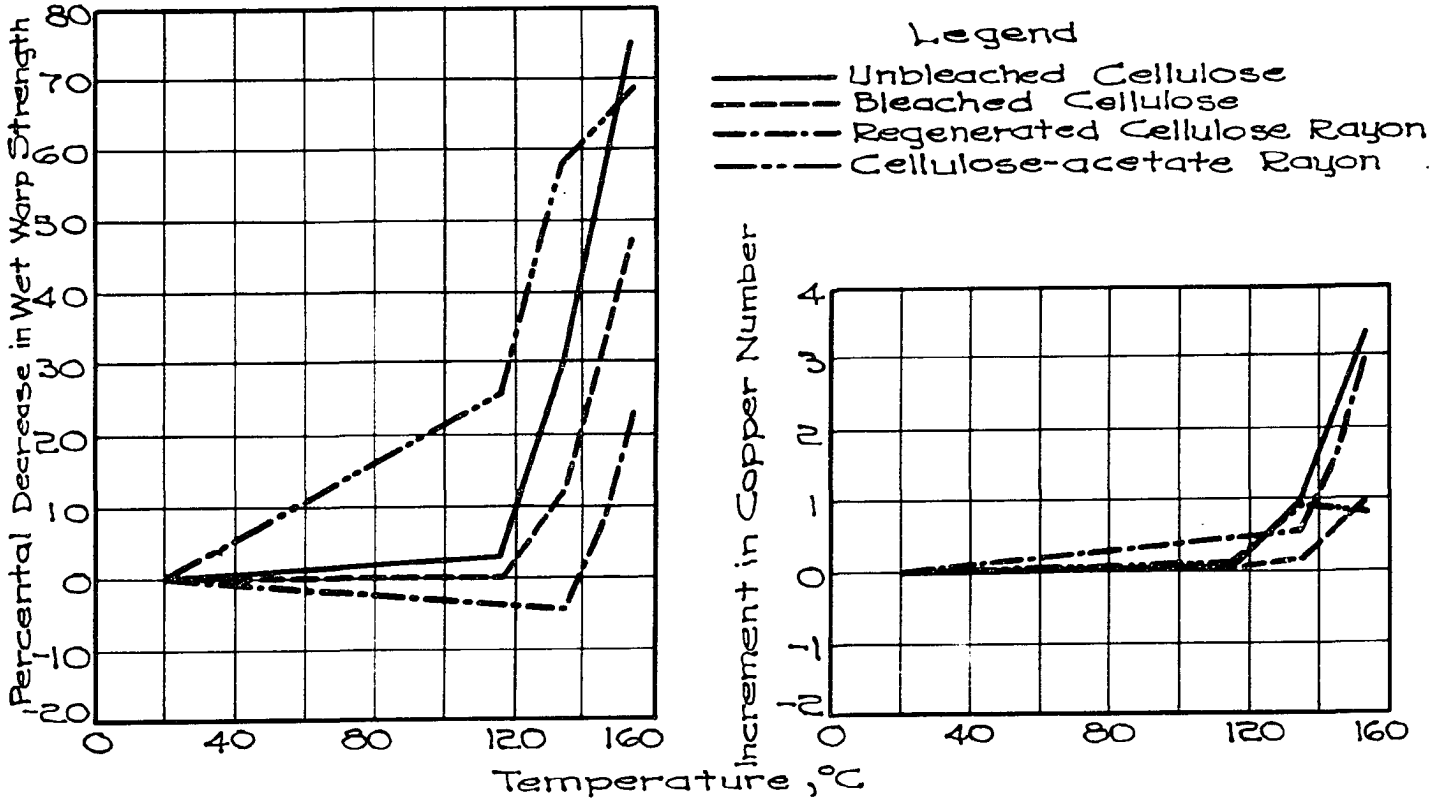

Fig. 8. Effect of Steam in 1.5 Hours on the Wet Warp Strength and Copper Number of Four Cellulosic Textiles.

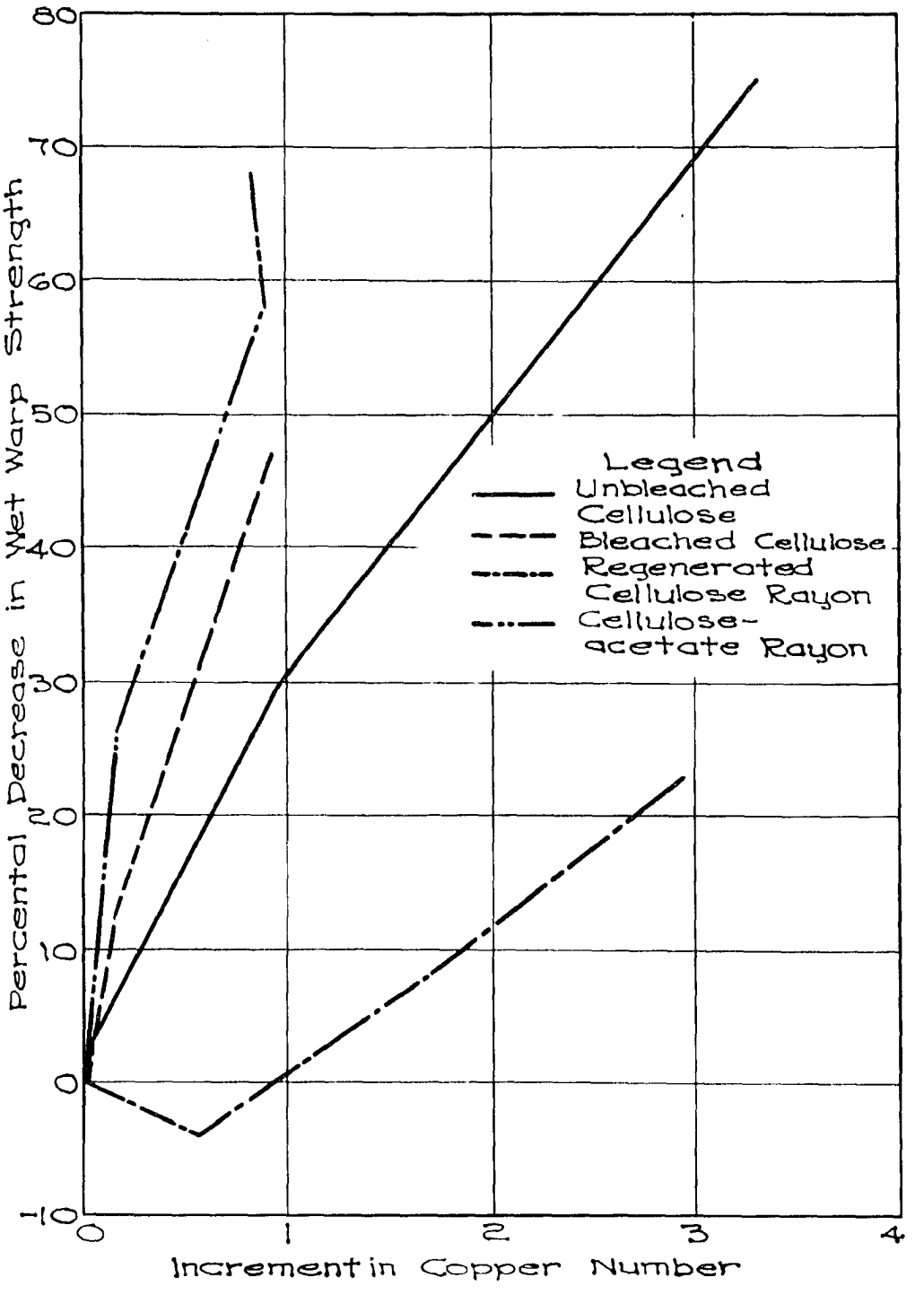

Fig.9. Increment in Copper Number Brought About by Steaming of Four Cellulosic Textiles as a Function of the Percental Decrease in Wet Warp Strength.

DISCUSSION

Oxidative Degradation of Cellulose-acetate Rayon

Limitations of study of oxidation of cellulose-acetate rayon

Commercial cellulose acetate is a mixture of chains of different degrees of polymerization whose acetyl value is approximately constant except for very short chains where the presence of the fourth hydroxyl group becomes apparent (453). We may expect oxidation to proceed at different rates for the different degrees of polymerization and always at a surface of the fiber.

Oxidation with potassium permanganate

A comparison of Figure 1 and Figure 2 shows that, while oxidation of regenerated-cellulose rayon by potassium permanganate is more vigorous than oxidation of cotton, the action of a solution of low acidity is similar to the action of a neutral or slightly alkaline solution, and for each textile the effect of temperature is usually greater than the effect of pH, as measured both by decrease in wet strength and increase in copper number. It should be noted, however, that the cotton cellulose used was an unbleached, desized organdie of light color and low ash; the action of the bleaching agent was diverted in part to the colored impurities, whereas in the case of the regenerated-cellulose rayon and cellulose-acetate

rayon, the full effect of the oxidizing agent was spent upon the fiber. However, for cellulose-acetate rayon, reported more resistant to oxidation than other cellulosic fibers, we find by an examination of Figure 3 that pH is of far greater influence than temperature. The sharp difference in reactivity is shown dramatically in Figure 4, which portrays the effect of potassium permanganate on the weight of fabric. Here again, for cellulose and regenerated-cellulose rayon the effect of pH and of temperature are of comparative magnitudes, while for cellulose-acetate rayon the effect of pH is predominant.

Doree and Healey (125) studied the oxidation of cellulose acetate and of cotton linters with 0.04 N potassium permanganate which was 0.1 M with respect to sodium carbonate or 0.05 M with respect to sulfuric acid; they found that the copper number of cellulose acetate after five hours had increased from 0.15 to 0.18 with the alkaline solution and to 0.53 with the acidic solution, whereas that of the linters had increased from 0.10 to 3.55 with the basic solution and to 3.33 with the acidic solution. Here, too, the action of acidic and alkaline permanganate was similar for cotton but the acidic bath was more deleterious to cellulose acetate than the alkaline bath, although the cellulose acetate did not undergo as great an increase in copper number as that observed in this study.

Nickerson (359) has developed a method for estimating the degradation of cellulosic substances by hydrolysis and catalytic oxidation; he has concluded by its use that the amorphous regions of cellulosic substances are less resistant to attack by acidic oxidant than are the crystalline regions (360, 361, 362). Goldfinger, Mark, and Siggia (185) have recently

confirmed this view. Nickerson stated that mercerization appeared to increase the proportion of amorphous substance and thus to render the crystallite more susceptible to hydrolytic attack. Further, cellulose acetate has been considered a more or less expanded structure which breaks down rapidly, because its ester groups render the chains incapable of association into impermeable cohesive units. Ridge, Parsons, and Corner (411) have pointed out that the degree of polymerization is lower for cellulose acetate than for viscose or cellulose. Dorée and Healey (125) showed that the presence of the ester groups afforded some protection against oxidation, but that eventually the copper number of completely acetylated cellulose increased to a value comparable to that for similarly treated cellulose. They suggested that, inasmuch as the primary alcoholic group was masked rather than converted to carboxyl (Kalb and Falkenhausen (260)), hydrolyzed glucosidic secondary alcoholic groups were oxidized to ketone; if this assumption is tenable, we may expect that regenerated cellulose will be attacked more vigorously than cellulose and, over a period of time, cellulose acetate more completely than either. Dorée and Healey have also pointed out that the presence of ketonic groups may enhance the reducing properties of cellulosic substances. An examination of Tables III through VI indicates that the effect of 0.05 M sulfuric acid in the absence of permanganate is negligible, and it is only the combination of acid and oxidant which brings about the great degradation suffered by cellulose-acetate rayon.

Values of acetyl, shown in Table II, are anomalous. Cellulose-acetate rayon treated with aqueous permanganate shows slightly higher values

than the untreated textile, while that oxidized by acidic permanganate at the lower temperatures shows a noticeable increase. The high value is probably due to the formation of carboxyl groups which neutralize sodium hydroxide during the determination of acetyl and are thus computed as acetyl. At 40° C. the degradation is so great that experimental error conceals any increase.

The greater degradation of cellulose-acetate rayon by acidic permanganate was visually apparent; a heavy coating of an oxide of manganese formed and was very slowly removed by reduction with sodium hydrogen sulfite. Cellulose-acetate rayon treated with aqueous permanganate was decolorized by sodium hydrogen sulfite much more rapidly, and the hand of the rinsed, air-dried textile was softer than that bleached in an acidic bath.

Oxidation with sodium peroxyborate

Figure 5 indicates that cellulose is little affected by oxidation with sodium peroxyborate, either at 40 or 100° C.; the difference in values at the two temperatures is within experimental error. Raaschou and Larsen (397) noticed that a solution 0.013 N in sodium peroxyborate in the presence of sodium hydroxide caused but slightly more degradation to cotton cellulose than the alkaline solution without oxidant, but that increased degradation occurred when higher concentrations were used, especially above 0.065 N. In this study cotton cellulose showed a loss of only ten per cent of its wet strength after two hours' oxidation at the boiling point of water in a bath 0.1922 N to sodium peroxyborate. The different results may be explained by the use of sodium hydroxide by Raaschou and Larsen.

Regenerated-cellulose rayon is affected but little more at 100° C. than at 40°, but at both temperatures it is much more degraded than cellulose, probably because of its greater exposed surface. The similarity of values at the two temperatures may be due to the fact that peroxyborate is unstable at elevated temperatures (87); thus, while the salt was added in amount to give the specified normality in each case, the more rapid decomposition at higher temperature undoubtedly resulted in a bath of lower available oxygen.

For cellulose-acetate rayon we have to consider, as before, the opposing effects of expanded structure and resistance of ester groups to oxidation and the added factor of hydrolysis. At 40° C. hydrolysis is slight, but little more than one per cent of acetyl is removed in a 0.1922 N bath. We may attribute a very slight decrease in wet strength and in copper number (411) to this hydrolysis. Figure 5 shows that at 40° C. cellulose-acetate rayon is more resistant to attack than is cellulose. Figure 6 shows the observed loss of weight of cellulose-acetate rayon and the loss of weight caused by hydrolysis in baths of zero to 0.1922 N sodium peroxyborate; the difference is apparently due to oxidation. Again, comparing the value so found (0.9 per cent) with the value for cellulose from Table X (1.2 per cent), we find cellulose-acetate rayon more resistant to oxidation. It is well to consider, however, that regenerated-cellulose rayon, which shows a greater loss in wet strength and greater change in copper number than either cellulose or cellulose-acetate rayon, shows a smaller loss in weight. This suggests the possibility that sodium per-

oxyborate will oxidize either primary or secondary alcoholic groups but preferably the latter, for loss of weight is usually ascribed to solution of salts of carboxylic acids formed during oxidation. Thus, cellulose, with a more impermeable structure, offers only primary alcoholic groups to the oxidant; these are oxidized to carboxyl and dissolve in the alkaline solution, but degradation of residual cellulose is slight. During alkaline oxidation enolization may occur at the carbonyl of the terminal anhydroglucose unit and cleavage of carbon-carbon linkage may occur within the anhydroglucose unit. This, of course, may occur equally in cellulose and regenerated-cellulose rayon, and in cellulose acetate if the alcohol of carbon three has not been esterified. The large available surface of regenerated cellulose allows oxidation of secondary as well as primary alcoholic radicals; the formation of carbonyl groups results in a high copper number, while destruction of hydroxyl groups destroys secondary linkages and results in decreased strength. At 100° C. hydrolysis of cellulose-acetate rayon occurs; saponification tends to lower wet strength, but the observed lowering cannot be ascribed solely to deacetylation. The wet strength of regenerated cellulose is approximately forty per cent of its dry strength, whereas the wet strength of cellulose acetate is approximately 60 per cent of its dry strength; complete hydrolysis of cellulose acetate, without other action, might be expected to cause a 33 per cent lowering of wet strength. If decrease of wet strength is proportional to deacetylation, for 0.2 N sodium peroxyborate at 100° C., where approximately thirty per cent of acetyl has been removed, the loss in wet strength caused by deacetylation will be only eleven per cent. A

loss of 39 per cent is actually observed, or a loss of approximately thirty per cent brought about by oxidation. Figure 6 indicates a loss in weight of 3.4 per cent caused by oxidation.

On the basis of this equation for the hydrolysis of sodium peroxyborate,

$$4Na^{+} + 4BO_3^{-} + 5H_2O \longrightarrow 4H_2O_2 + 4Na^{+} + B_4O_7^{-} + 2OH^{-}$$

a solution 0.1922 N with respect to sodium peroxyborate will be 0.0480 N with respect to sodium hydroxide. Such a concentration of alkali will hydrolyze 10.3 per cent acetyl from this cellulose-acetate rayon; loss of acetyl, 11.4 per cent, at this concentration suggests that hydrolysis of borax and soap also furnished alkali. Thus, the solution which oxidized the cellulose-acetate rayon became less alkaline as hydrolysis occurred until it was finally almost neutral. Inasmuch as the effect of a peroxide bleaching bath is greater at higher pH, we may conclude that the cotton cellulose and regenerated-cellulose rayon were oxidized under more vigorous experimental conditions than cellulose-acetate rayon. We may conclude from its behavior under conditions prescribed that cellulose-acetate rayon would be more degraded in a bath of pH such as that used with the cellulosic textiles and that the degradation would probably exceed that undergone by cellulose and regenerated-cellulose rayon.

Decrease in copper number of cellulose-acetate rayon is a linear function of hydrolysis, in accordance with the observation of Ridge, Parsons, and Corner (411).

Thus, it would appear that with sodium peroxyborate, too, cellulose-acetate rayon is resistant to mild oxidation but much less resistant than cellulose or regenerated-cellulose rayon under more drastic conditions of oxidation.

Oxidation with calcium hypochlorite

An investigation of Tables XI through XIV shows the effect of 0.1 N calcium hypochlorite in two and four hours at 25 and 40° C. on the acetyl of cellulose-acetate rayon and copper number, weight, and wet strength of cellulose, regenerated-cellulose rayon, and cellulose-acetate rayon. Here the cellulose acetate is again characterized by extreme resistance, while the reported high susceptibility of regenerated-cellulose rayon to oxidation by hypochlorite is confirmed. Ridge, Pusey, and Bowden (410) oxidized cellulose acetate with 0.04 N sodium hypochlorite at 25° C. and pH values ranging from 4.6 to 12; although degradation of cellulose was found to be rapid with neutral hypochlorite, cellulose acetate was very resistant and showed no significant change in acetyl, copper number, or strength. After four hours, however, the cellulose acetate showed a significant rise in copper number; it is unfortunate that limitation of time did not permit this investigation to be carried further in order to find out whether, upon prolonged contact with hypochlorite, the cellulose-acetate rayon would be more degraded than cellulose and regenerated-cellulose.

Oxidation with sodium N-chloro-p-toluenesulfonamide

Table XV shows that the total acetyl of cellulose-acetate rayon remained unchanged within four hours at 40° C. in concentrations up to 0.3 N sodium N-chloro-p-toluenesulfonamide. Examination of Table XVI indicates that, although cellulose-acetate rayon is more resistant to oxidation than

regenerated cellulose at 25 and 40° C. and equal in resistance to cellulose at these temperatures, at 100° C. it is rapidly degraded with increasing concentration of reagent, although not so rapidly as regenerated-cellulose rayon; cellulose is more stable than cellulose-acetate rayon at this temperature. Copper number and weight were followed only at those temperatures at which degradation, measured by wet strength, was neither excessive nor nil. Tables XVII and XVIII show that little or no change occurred in either copper number or weight. It is of interest to note, however, that the cellulose-acetate rayon increased in weight. This is believed due to absorption by this rayon of the oxidant or its product of reaction, p-toluenosulfonamide, since yellowing occurred and increased with increasing concentration of oxidant as is shown on Specimen Sheet I.

Catalysis in this study

In view of the emphasis placed upon metallic ions as catalysts (p. 7, 9) and the fact that the distilled water used in this investigation contained traces of copper, it is necessary to consider the effect of this copper. Ridge, Parsons, and Corner (411) stated that copper and iron ash are considered to be so small, if eight to ten milligrams for 100 g. of dry rayon, that catalysis in bleaching is negligible. Unpublished results from this laboratory show that cellulose-acetate rayon washed once with distilled water and sodium naphthenate decreased in ash from an initial 0.08 to 0.04 per cent but increased in ten washings to 0.05 per cent; with sodium rosinate the values were 0.05 and 0.08 per cent after one and ten washings, respectively. If we assume this ash to be metallic, the increase per washing is of the order of only 0.003 per cent, well within the limit, 0.01 per cent, set by

Ridge, Parsons, and Corner. Percental increases in ash per washing with naphthenate and rosinate, respectively, are 0.001 and 0.003 for cotton and 0.002 and 0.004 for regenerated-cellulose rayon. It is possible, of course, that not all of the copper present in the water was precipitated as insoluble soap, but the magnitude of the values indicates that we may disregard catalysis.

Correlation between copper number and wet strength

Both with regard to "oxycellulose" and "hydrocellulose", disagreement exists as to relationship between copper number and strength. Clibbens et al (40, 92, 93, 411) found a definite correlation between rate of change of copper number and strength of all the "hydrocelluloses" they studied but none for "oxycellulose". Hall (206) stated that greater degradation was accompanied by higher copper number. Hess, Weltzien, and Messmer (236) found that copper numbers of "hydrocelluloses" varied with the method of their preparation. Figure 7 illustrates the change of copper number with wet strength of cellulose, regenerated-cellulose rayon, and cellulose-acetate rayon treated with sodium peroxyborate. It is seen that, while these lines are, within experimental error, of the general equation, $y = mx + b$, m is different for each textile.

Thermal Degradation of Some Cellulosic Textiles by Steam

Loss of wet strength in steaming

The temperature at which cellulose begins to suffer degradation has been reported as 140 to 150° C. (71, 268, 309, 330) but, as seen in Table XX, the bleached cotton cellulose used in this investigation showed 12 per cent loss in wet strength at 134.5° C. and 47 per cent loss at 153.0°C. Unbleached cotton cellulose, of the same trade name as the bleached, had its wet strength reduced 30 per cent at the lower and 75 per cent at the higher temperature. Increased wetting power of steamed unbleached cellulose (209) was also observed. Regenerated-cellulose rayon was appreciably more resistant than cellulose to heat: its wet warp strength was reduced only 23 per cent at 153.0° C. Cellulose-acetate rayon retained only 42 per cent of its wet warp strength at 134.5° C. The values at 115.2° C. are anomalous; this temperature is near that at which acetic acid volatilizes and the explanation occurs that fluctuation in pressure is involved here. Table XIX indicates that deacetylation is low at this and at higher temperatures and cannot be blamed for the loss in strength unless acetic acid formed during hydrolysis stayed in intimate contact with the fiber and induced the observed loss of strength (94).

Effect of steaming on copper number

Figure 8 shows that increase in copper number did not follow decrease in wet strength in all cases. The degradation of unbleached cotton cellulose represented by decrease in wet strength was reflected by its increase in

copper number, but while wet strength of regenerated-cellulose declined less than that of the other fibers, its copper number showed almost as great an increase as the copper number of unbleached cotton. The copper number of cellulose-acetate rayon did not increase as strength decreased.

Change in weight of textiles during steaming

It is interesting to note, in Table XXII, that weight increased when the fabrics were steamed at 115.0° C. This apparent increase in weight may be accounted for by the presence of residual size, less easily removed by washing after the fabric had been heated. Loss of weight was considerable only in the case of unbleached cellulose; loss in weight of cellulose-acetate rayon approximated loss of acetyl.

These results tend to place the decomposition point of cellulose at approximately 130° C. Viscose is, as reported, more resistant to heat than cellulose itself, and cellulose-acetate rayon is much more susceptible to moist heat than the other cellulosic fibers.

Correlation between copper number and wet strength

It is shown in Figure 9 that change in copper number induced by steaming is a linear function of loss of wet strength, with a different slope for each textile. Comparison of Figure 7 and Figure 9 shows that m for a given textile varies with the reagent which brings about the change.

Color of steamed textiles

Specimen sheets II through V show the increasing color of the four fabrics when exposed to increasing temperatures.

Protection of cellulosic textiles during steaming by starch size

"Pure" cellulose has been reported unaffected in color when subjected to temperatures between 130 and 150° C. (36, 268). Because color developed at 134.5° C. in the bleached cotton as well as in the unbleached cotton, it was suspected that decomposition of starch size might be responsible and might also account for decomposition of the fiber if acidic products were formed. However, when breaking-strength specimens of unbleached cotton and bleached cotton were desized with Taka-Diastase, steamed, and broken wet, it was found that the strength of the sized fabric was in each case greater than that of the desized. Knecht and Egan (296) had reported that starch and cutch protected bleached cotton during oxidation with hypochlorous acid. Rogers and Hays (414), however, discovered that greater deterioration occurred in new cotton sheeting than in desized sheeting upon storage at high temperatures.

The data about the protective action of starch size in steaming were collected after the main body of the work was completed and are not ready for presentation here.

CONCLUSIONS

These conclusions have been reached on the basis of the work embodied in this dissertation.

Oxidative Degradation of Cellulose-acetate Rayon

1. Cellulose-acetate rayon is more resistant than either cotton cellulose or regenerated-cellulose rayon to mild oxidation, but it undergoes greater degradation under more drastic oxidation.
2. Regenerated-cellulose rayon is attacked more vigorously than is unbleached cotton cellulose by aqueous and acidic solutions of 0.033 M potassium permanganate in four hours at 40° C. as indicated by increase in copper number (6.55 in aqueous and 7.69 in acidic bath for regenerated-cellulose rayon; 3.56 in aqueous and 4.73 in acidic bath for cotton cellulose), by decreased weight (3.7 per cent in aqueous and 9.7 per cent in acidic bath for regenerated-cellulose rayon; 1.4 per cent in aqueous and 3.1 per cent in acidic bath for cotton cellulose), and by lowered wet strength (complete loss for regenerated-cellulose rayon; 69 and 83 per cent loss for cotton cellulose), but temperature at which oxidation occurs is in both cases a more important factor than pH of bath.
3. Oxidation of cellulose-acetate rayon by 0.033 M aqueous potassium permanganate in four hours at 40° C. results in loss of wet strength of 43 per cent, but in a solution 0.05 M as to sulfuric acid, degradation, assayed by rise in copper number (from 3 to a value greater than 12),

by loss in weight (45 per cent), and by decrease in wet strength to no measurable value, is considerable. Temperature is of much less importance than pH in oxidation of cellulose-acetate rayon with permanganate.

4. The apparent increase of acetyl in cellulose-acetate rayon by potassium permanganate may be due to neutralization of sodium hydroxide during saponification by carboxyl groups formed during oxidation.

5. The effect of sodium peroxyborate, in solution 0.3 per cent as to soap, on unbleached cotton cellulose at 40 and 100° C. is negligible for concentrations up to 0.1922 N. Regenerated-cellulose rayon is attacked equally and considerably at both these temperatures, inasmuch as 55 per cent loss of wet strength occurred in a bath 0.1922 N. The similarity of results at both temperatures may be explained by the more rapid decomposition of sodium peroxyborate at the higher temperature.

6. Cellulose-acetate rayon suffers negligible degradation in baths of sodium peroxyborate up to 0.1922 N at 40° C. for eight hours. At 100° C. for two hours loss in wet strength is approximately 40 per cent; ten per cent of this may be attributed to loss of acetyl, the remainder to oxidation. Inasmuch as oxidation with peroxide is enhanced in alkaline solution, and the alkalinity of the solution in contact with cellulose-acetate rayon is less than that in contact with regenerated-cellulose rayon or cotton cellulose because of exhaustion of alkali resulting from saponification, it is concluded that in a bath of constant pH greater than 7, at 100° C. oxidation would result in greater degradation

to cellulose-acetate rayon than to either regenerated-cellulose rayon or cotton cellulose.

7. Copper number of cellulose-acetate rayon oxidized with sodium peroxyborate decreases. This is in accord with the observation (411) that deacetylation results in decreased copper number.

8. During treatment with 0.1 N neutral calcium hypochlorite, cellulose-acetate rayon is attacked to no noticeable degree until it is oxidized for four hours at 40° C.; it then loses only 26 per cent of its wet strength, whereas under the same conditions cotton cellulose loses 64 per cent of its wet strength and regenerated-cellulose rayon is left with no measurable wet strength. In four hours at 25° C. cotton cellulose loses 18 per cent and regenerated-cellulose rayon 96 per cent of wet strength. Copper number and loss of weight in each case reflect loss in strength.

9. In oxidation with sodium N-chloro-p-toluenesulfonamide, regenerated-cellulose rayon is attacked more vigorously than either cotton cellulose or cellulose-acetate rayon, neither of which shows any loss in wet strength when oxidized four hours at 40° C. at concentrations up to 0.3 N. At 100° C. regenerated-cellulose rayon retains no wet strength even in concentrations as low as 0.01 N. The wet strength of cellulose-acetate rayon is decreased 11 per cent in 0.01 N solution, 56 per cent in 0.1 N solution and completely in 0.2 and 0.3 N solution during four hours at 100° C. Cotton cellulose retains 77 per cent of its wet strength after four hours at 100° C. and 0.3 N. Copper number reflects decrease in wet strength in all these cases studied.

10. Cellulose-acetate rayon increases in weight and is yellowed when oxidized for four hours at 40° C. with sodium N-chloro-p-toluenesulfonamide, probably because of absorption of this oxidant or its product, p-toluenesulfonamide.

Thermal Degradation of Some Cellulosic Textiles by Steam

1. Unbleached cotton cellulose loses 75 per cent of its wet strength when steamed for 1.5 hours at 153° C. in contrast to bleached cotton cellulose for which the loss is but 47 per cent. Regenerated-cellulose rayon, which retains 77 per cent of its wet strength, is more resistant to the action of steam than cellulose or cellulose-acetate rayon which retains only 32 per cent of its wet strength at 153° C.
2. It is suggested that the loss of strength of cellulose-acetate rayon is brought about by the acetic acid released upon hydrolysis.
3. Depth of color of each textile increases as the temperature at which it is steamed increases; unbleached cellulose steamed for 1.5 hours at 153° C. is of a deep brown color.
4. When increment in copper number is plotted against decrease in wet strength, a line of the general equation $y = mx + b$ results; m is shown to be different for each textile and for each reagent.
5. Starch size provides protection against the action of steam.

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APPENDIX

SPECIMEN SHEET 1

CELLULOSE-ACETATE RAYON BLEACHED WITH
SODIUM N-CHLORO-p-TOLUENESULFONAMIDE
FOR FOUR HOURS AT 40.0 ± 0.1 °C.

Original

0.0 N
solution

0.1 N
solution

0.2 N
solution

0.3 N
solution

SPECIMEN SHEET 2

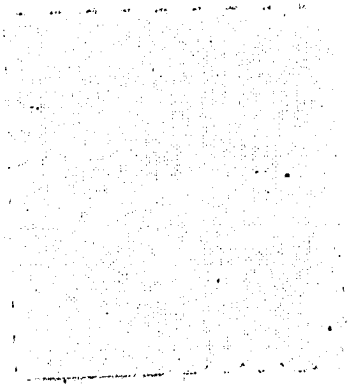
COTTON CELLULOSE, UNBLEACHED
STEAMED FOR 1.5 HOURS

Original

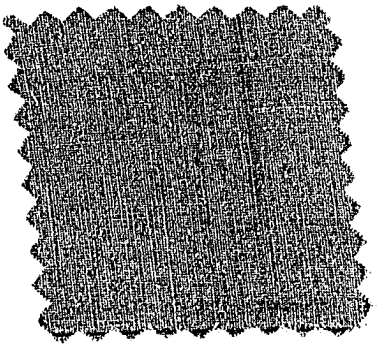
Room
temperature

115.2 °C.

134.5 °C.



153.0 °C.



SPECIMEN SHEET 3

COTTON CELLULOSE, BLEACHED
STEAMED FOR 1.5 HOURS

Original

Room
temperature

115.2 °C.

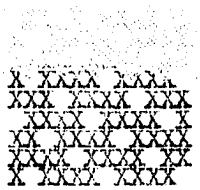
134.5 °C.

153.0 °C.

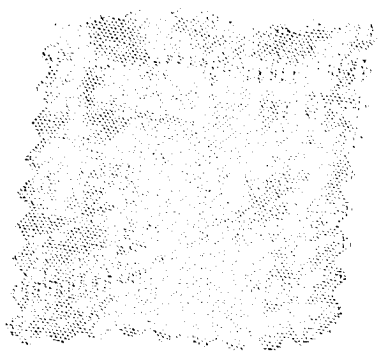
SPECIMEN SHEET 4

REGENERATED-CELLULOSE RAYON
STEAMED FOR 1.5 HOURS

Original

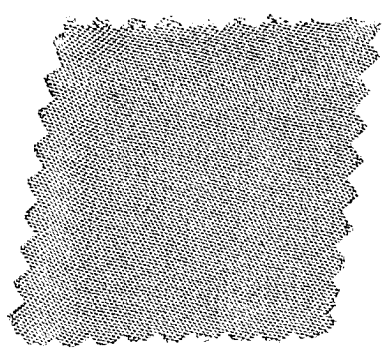


Room
temperatures

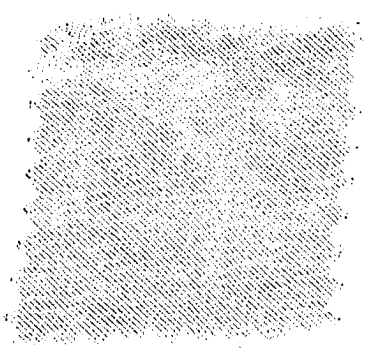


134.5 °C.

144.6 °C.



153.0 °C.



SPECIMEN SHEET 5

CELLULOSE-ACETATE RAYON
STEAMED FOR 1.5 HOURS

Original

Room
temperature

115.2 °C.

134.5 °C.

153.0 °C.

Tables of Experimental Data

TABLE 1. WEIGHT OF SAMPLES

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
		a. Cellulose-acetate rayon, Series A		
1	2.2839			2.2426
BS-1A	2.2048			2.1649
2	2.2789	2.2371	98.17	
3	2.2723			2.2312
4	2.2680			2.2269
BS-1B	2.2088			2.1688
5	2.2535	2.2139	98.24	
6	2.2794			2.2381
7	2.2993			2.2577
BS-1C	2.2030			2.1631
8	2.2588	2.2192	98.25	
9	2.2577			2.2168
10	2.2551			2.2143
BS-1D	2.2220			2.1818
11	2.2250	2.1866	98.27	
12	2.2537			2.2129
13	2.2321			2.1917
14	2.3000	2.2542	98.01*	
15	2.2520			2.2112
16	2.2310			2.1906
BS-2A	2.2187			2.1785
17	2.2900	2.2485	98.19	
18	2.2890			2.2476
19	2.2929			2.2514
BS-2B	2.2137			2.1736
20	2.2848	2.2444	98.23	
21	2.2868			2.2454
22	2.2969			2.2553
BS-2C	2.2186			2.1784
23	2.2760	2.2378	98.24	

*Rejected observation.

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
24	2.2882			2.2468
25	2.2702			2.2291
BS-2D	2.2128			2.1727
26	2.2880	2.2383	97.83*	
27	2.2950			2.2535
28	2.2964			2.2548
29	2.2794	2.2389	98.22	
30	2.2982			2.2566
31	2.2960			2.2544
BS-3A	2.2161			2.1760
32	2.2823	2.2412	98.20	
33	2.2711			2.2300
34	2.2837			2.2424
BS-3B	2.2178			2.1777
35	2.2664	2.2240	98.13	
36	2.2751			2.2339
37	2.2852			2.2438
BS-3C	2.2103			2.1703
38	2.2891	2.2474	98.18	
39	2.2749			2.2337
40	2.2694			2.2283
BS-3D	2.2220			2.1818
41	2.2603	2.2188	98.16	
42	2.2733			2.2322
43	2.2719			2.2308
44	2.2802	2.2386	98.18	
45	2.2638			2.2228
46	2.2790			2.2378
BS-4A	2.1975			2.1577
47	2.2694	2.2268	98.12	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
48	2.2694			2.2283
49	2.2698			2.2287
BS-4B	2.2024			2.1625
50	2.2825	2.2396	98.12	
51	2.2747			2.2335
52	2.2682			2.2271
BS-4C	2.1834			2.1439
53	2.2826	2.2402	98.14	
54	2.2889			2.2475
55	2.2781			2.2369
BS-4D	2.2042			2.1643
56	2.2653	2.2232	98.14	
57	2.2714			2.2303
58	2.2594			2.2185
59	2.2710	2.2285	98.13	
60	2.2547			2.2139
61	2.2723			2.2312
BS-5A	2.2108			2.1708
62	2.2711	2.2293	98.16	
63	2.2595			2.2186
64	2.2450			2.2044
BS-5B	2.2167			2.1766
65	2.2723	2.2310	98.18	
66	2.2883			2.2469
67	2.2660			2.2250
BS-5B	2.2120			2.1720
68	2.2805	2.2394	98.20	
69	2.2948			2.2533
70	2.2723			2.2312
BS-5D	2.2103			2.1703

TABLE 1. (Continued)

Sample Number	Air-dry weight	Oven-dry weight		
		Determined		Calculated
	Gram	Gram	Percentage	Gram
71	2.2757	2.2349	98.21	
72	2.2893			2.2479
73	2.2708			2.2297
74	2.2776	2.2359	98.17	
75	2.2781			2.2369
76	2.2789			2.2377
BS-6A	2.2410			2.2004
77	2.2786	2.2371	98.18	
78	2.2796			2.2383
79	2.2809			2.2396
BS-6B	2.2319			2.1915
80	2.2890	2.2487	98.24	
81	2.2976			2.2560
82	2.2864			2.2450
BS-6C	2.2404			2.1998
83	2.2888	2.2408	97.90*	
84	2.2899			2.2485
85	2.2892			2.2478
BS-6D	2.2358			2.1953
86	2.3106	2.2688	98.19	
87	2.2926			2.2511
88	2.2823			2.2410
89	2.2775	2.2365	98.20	
90	2.2855			2.2441
Mean			98.19	
Deviation			0.02	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
91	2.3008			2.2608
BS-7A	2.2183			2.1797
92	2.2914	2.2514	98.25	
93	2.2847			2.2449
94	2.2941			2.2542
BS-7B	2.2176			2.1790
95	2.2718	2.2315	98.23	
96	2.2702			2.2307
97	2.2968			2.2568
BS-7C	2.2152			2.1767
98	2.2936	2.2531	98.23	
99	2.2729			2.2334
100	2.2742			2.2346
BS-7D	2.2113			2.1728
101	2.2921	2.2524	98.27	
102	2.2845			2.2447
103	2.3044			2.2643
104	2.2873	2.2480	98.28	
105	2.2982			2.2582
106	2.2803			2.2406
BS-8A	2.1930			2.1548
107	2.2865	2.2475	98.29	
108	2.2904			2.2505
109	2.2787			2.2391
BS-8B	2.1912			2.1531
110	2.3000	2.2605	98.28	
111	2.3092			2.2690
112	2.2949			2.2550
113	2.2874	2.2487	98.31	
BS-8C	2.1914			2.1533

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
114	2.2967			2.2567
115	2.2930			2.2531
BS-8D	2.1956			2.1574
116	2.2827	2.2424	98.23	
117	2.2700			2.2305
118	2.2928			2.2529
119	2.2608	2.2208	98.23	
120	2.2528			2.2136
121	2.2607			2.2214
BS-9A	2.2125			2.1740
122	2.2497	2.2107	98.27	
123	2.2572			2.2179
124	2.2530			2.2138
BS-9B	2.2141			2.1756
125	2.2558	2.2168	98.27	
126	2.2912			2.2513
127	2.2690			2.2295
BS-9C	2.2060			2.1676
128	2.2716	2.2319	98.25	
129	2.2686			2.2291
130	2.2735			2.2339
BS-9D	2.2051			2.1667
131	2.2789	2.2394	98.27	
132	2.2909			2.2510
133	2.2607			2.2214
134	2.2825	2.2421	98.23	
135	2.2770			2.2374
136	2.3067			2.2666
BS-10A	2.2187			2.1801
137	2.2794	2.2398	98.26	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
138	2.2738			2.2342
139	2.2786			2.2390
BS-10B	2.2197			2.1811
140	2.2757	2.2353	98.22	
141	2.2670			2.2276
142	2.2776			2.2380
BS-10C	2.2160			2.1774
143	2.2855	2.2450	98.23	
144	2.2666			2.2272
145	2.2703			2.2308
BS-10D	2.2142			2.1757
146	2.2890	2.2486	98.24	
147	2.2947			2.2548
148	2.2773			2.2377
149	2.2877	2.2483	98.28	
150	2.2700			2.2305
Mean			98.26	
Deviation			0.02	
		b. Cellulose-acetate rayon, Series B		
1	2.2670			2.2339
BS-1A	1.7339			1.7086
2	2.2506	2.2175	98.53	
3	2.2528			2.2199
4	2.2736			2.2404
BS-1B	1.7339			1.7086
5	2.2935	2.2589	98.49	
6	2.2658			2.2327
7	2.2484			2.2156
BS-1C	1.7353			1.7100

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
8	2.2729	2.2401	98.56	
9	2.2653			2.2322
10	2.2960			2.2625
BS-1D	1.7282			1.7030
11	2.2915	2.2585	98.56	
12	2.2859			2.2525
13	2.2710			2.2378
BS-1E	1.7448			1.7193
14	2.2856	2.2527	98.56	
15	2.2731			2.2399
16	2.2733			2.2401
BS-2A	1.8283			1.8016
17	2.2582	2.2259	98.57	
18	2.2609			2.2279
19	2.2615			2.2285
BS-2B	1.8215			1.7949
20	2.2799	2.2472	98.57	
21	2.2802			2.2469
22	2.2866			2.2532
BS-2C	1.8298			1.8031
23	2.2482	2.2160	98.57	
24	2.2574			2.2244
25	2.2836			2.2503
BS-2D	1.8291			1.8024
26	2.2346	2.2019	98.54	
27	2.2627			2.2297
28	2.2455			2.2127
BS-2E	1.8319			1.8052
29	2.2513	2.2186	98.55	
30	2.2315			2.1989

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
31	2.2363			2.2036
BS-3A	1.8565			1.8294
32	2.2731	2.2408	98.58	
33	2.2609			2.2279
34	2.2728			2.2396
BS-3B	1.8522			1.8252
35	2.2642	2.2306	98.52	
36	2.2624			2.2294
37	2.2677			2.2346
BS-3C	1.8578			1.8307
38	2.2610	2.2292	98.59	
39	2.2990			2.2654
40	2.2510			2.2181
BS-3D	1.8366			1.8098
41	2.2670	2.2346	98.57	
42	2.2667			2.2336
43	2.2736			2.2404
BS-3E	1.8608			1.8336
44	2.2710	2.2378	98.54	
45	2.2809			2.2476
46	2.2767			2.2435
BS-4A	1.7131			1.6881
47	2.2923	2.2582	98.51	
48	2.2812			2.2479
49	2.2794			2.2461
BS-4B	1.7196			1.6945
50	2.2868	2.2531	98.53	
51	2.2768			2.2436
52	2.2900			2.2566
BS-4C	1.7177			1.6926

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
53	2.2598	2.2265	98.53	
54	2.2600			2.2270
55	2.2880			2.2546
BS-4D	1.7164			1.6913
56	2.2808	2.2469	98.51	
57	2.2736			2.2404
58	2.2830			2.2497
BS-4E	1.7222			1.6971
59	2.2757	2.2416	98.50	
60	2.2919			2.2584
Mean			98.54	
Deviation			0.02	
61	2.3252			2.2813
BS-5A	2.1955			2.1540
62	2.3050	2.2613	98.10	
63	2.3123			2.2686
64	2.2995			2.2560
BS-5B	2.1926			2.1512
65	2.2878	2.2441	98.09	
66	2.3057			2.2621
67	2.3242			2.2803
BS-5C	2.1960			2.1545
68	2.3273	2.2826	98.08	
69	2.3080			2.2644
70	2.2956			2.2522
BS-5D	2.1930			2.1516
71	2.3128	2.2704	98.17	
72	2.3200			2.2762
73	2.3242			2.2803
74.	2.2897	2.2469	98.13	
75	2.3218			2.2779
76	2.3180			2.2742

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
BS-6A	2.2462			2.2037
77	2.2887	2.2468	98.17	
78	2.2836			2.2404
79	2.2900			2.2467
BS-6B	2.2485			2.2060
80	2.2983	2.2565	98.18	
81	2.2908			2.2475
82	2.2842			2.2410
BS-6C	2.2402			2.1979
83	2.2919	2.2501	98.18	
84	2.2748			2.2318
85	2.2827			2.2396
BS-6D	2.2456			2.2032
86	2.2946	2.2520	98.14	
87	2.2980			2.2546
88	2.2819			2.2388
89	2.2922	2.2493	98.13	
90	2.3025			2.2590
91	2.2878			2.2446
BS-7A	2.1982			2.1567
92	2.2959	2.2523	98.10	
93	2.2858			2.2426
94	2.2887			2.2454
BS-7B	2.1953			2.1538
95	2.2977	2.2544	98.12	
96	2.2872			2.2440
97	2.3048			2.2612
BS-7C	2.2020			2.1604
98	2.2948	2.2511	98.10	
99	2.2754			2.2324

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
100	2.2970			2.2536
BS-7D	2.1933			2.1568
101	2.3038	2.2600	98.10	
102	2.2875			2.2443
103	2.2950			2.2516
104	2.2724	2.2298	98.13	
105	2.2966			2.2532
106	2.2782			2.2351
BS-8A	2.2803			2.2372
107	2.2888	2.2450	98.09	
108	2.2838			2.2406
109	2.2994			2.2559
BS-8B	2.2719			2.2290
110	2.3173	2.2723	98.06	
111	2.3137			2.2700
112	2.3108			2.2671
BS-8C	2.2762			2.2332
113	2.3194	2.2756	98.11	
114	2.3108			2.2671
115	2.3105			2.2668
BS-8D	2.2818			2.2387
116	2.3155	2.2705	98.06	
117	2.2888			2.2455
118	2.2957			2.2523
119	2.2884	2.2433	98.03	
120	2.3171			2.2733
121	2.2915			2.2482
BS-9A	2.2673			2.2244
122	2.2798	2.2373	98.14	
123	2.2861			2.2429

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
124	2.2782			2.2351
BS-9B	2.2722			2.2295
125	2.2764	2.2338	98.13	
126	2.3013			2.2578
127	2.3018			2.2583
BS-9C	2.2697			2.2268
128	2.2774	2.2343	98.11	
129	2.2843			2.2411
130	2.2820			2.2389
BS-9D	2.2757			2.2327
131	2.3017	2.2577	98.09	
132	2.2837			2.2405
133	2.2700			2.2271
134	2.2807	2.2364	98.06	
135	2.2695			2.2266
136	2.2846			2.2414
BS-10A	2.2843			2.2411
137	2.2882	2.2453	98.13	
138	2.2762			2.2332
139	2.2669			2.2241
BS-10B	2.2837			2.2405
140	2.2392	2.1964	98.09	
141	2.2594			2.2167
142	2.2823			2.2392
BS-10C	2.2893			2.2460
143	2.2597	2.2169	98.11	
144	2.2695			2.2266
145	2.2573			2.2146
BS-10D	2.2891			2.2458
146	2.3110	2.2657	98.04	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
147	2.2865			2.2433
148	2.2790			2.2359
149	2.2857	2.2411	98.05	
150	2.2957			2.2523
Mean			98.11	
Deviation			0.03	
		c. Cellulose-acetate rayon, Series E		
1	2.3470	2.2803	97.16	
BS-1A	2.2527			2.1905
BS-1B	2.2767			2.2139
BS-1C	2.2595			2.1971
BS-1D	2.2520			2.1898
2	2.3541	2.2905	97.30	
BS-2A	2.2278			2.1663
BS-2B	2.2345			2.1728
BS-2C	2.2409			2.1791
BS-2D	2.7072			2.6325
3	2.3501	2.2862	97.28	
BS-3A	2.2448			2.1828
BS-3B	2.2270			2.1655
BS-3C	2.2695			2.2069
BS-3D	2.6880			2.6138
4	2.3366	2.2725	97.26	
BS-4A	2.7100			2.6352
BS-4B	2.2573			2.1950
BS-4C	2.2620			2.1996
BS-4D	2.2841			2.2211

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
5	2.3382	2.2738	97.25	
BS-5A	2.7165			2.6415
BS-5B	2.2391			2.1773
BS-5C	2.2631			2.2006
BS-5D	2.2771			2.2143
6	2.3100	2.2458	97.22	
BS-6A	2.2439			2.1820
BS-6B	2.2459			2.1839
BS-6C	2.2417			2.1798
BS-6D	2.2549			2.1927
7	2.3040	2.2418	97.30	
BS-7A	2.2496			2.1875
BS-7B	2.2408			2.1790
BS-7C	2.2272			2.1657
BS-7D	2.2345			2.1728
8	2.3137	2.2505	97.27	
BS-8A	2.6918			2.6175
BS-8B	2.2506			2.1885
BS-8C	2.2482			2.1861
BS-8D	2.2540			2.1918
9	2.3043	2.2385	97.14	
BS-9A	2.2576			2.1953
BS-9B	2.2553			2.1931
BS-9C	2.2511			2.1890
BS-9D	2.2572			2.1949
10	2.3238	2.2590	97.21	
BS-10A	2.7267			2.6514
BS-10B	2.2789			2.2160
BS-10C	2.2860			2.2229
BS-10D	2.2785			2.2156

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
11	2.3095	2.2457	97.24	
BS-11A	2.7150			2.6401
BS-11B	2.2660			2.2035
BS-11C	2.2722			2.2095
BS-11D	2.2687			2.2061
12	2.2976	2.2314	97.12	
BS-12A	2.2223			2.1610
BS-12B	2.6670			2.5934
BS-12C	2.2203			2.1590
BS-12D	2.2130			2.1519
13	2.2934	2.2284	97.17	
BS-13A	2.2440			2.1821
BS-13B	2.2450			2.1830
BS-13C	2.2462			2.1842
BS-13D	2.2420			2.1801
14	2.3029	2.2387	97.21	
BS-14A	2.6917			2.6174
BS-14B	2.2551			2.1929
BS-14C	2.2459			2.1839
BS-14D	2.2549			2.1927
15	2.3310	2.2652	97.18	
BS-15A	2.6940			2.6196
BS-15B	2.2547			2.1925
BS-15C	2.2588			2.1965
BS-15D	2.2527			2.1905
16	2.3046	2.2399	97.19	
BS-16A	2.7546			2.6786
BS-16B	2.2927			2.2294
BS-16C	2.2967			2.2333
BS-16D	2.2964			2.2330

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
17	2.3217	2.2527	97.03	
BS-17A	2.2888			2.2256
BS-17B	2.2837			2.2207
BS-17C	2.2854			2.2223
BS-17D	2.2898			2.2266
18	2.3155	2.2501	97.18	
BS-18A	2.7542			2.6782
BS-18B	2.2909			2.2277
BS-18C	2.2897			2.2265
BS-18D	2.2859			2.2228
19	2.3379	2.2685	97.03	
BS-19A	2.7017			2.6271
BS-19B	2.2496			2.1875
BS-19C	2.2356			2.1739
BS-19D	2.2460			2.1840
20	2.3365	2.2695	97.13	
BS-20A	2.7535			2.6775
BS-20B	2.2950			2.2317
BS-20C	2.2940			2.2307
BS-20D	2.2969			2.2335
21	2.3285	2.2624	97.16	
BS-21A	2.2810			2.2180
BS-21B	2.2833			2.2203
BS-21C	2.2839			2.2209
BS-21D	2.2697			2.2071
22	2.3406	2.2749	97.19	
BS-22A	2.8107			2.7331
BS-22B	2.3536			2.2886
BS-22C	2.3572			2.2921
BS-22D	2.3482			2.2834

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
23	2.3295	2.2625	97.12	
BS-23A	2.7355			2.6600
BS-23B	2.2770			2.2142
BS-23C	2.2797			2.2168
BS-23D	2.2799			2.2170
24	2.3062	2.2411	97.18	
BS-24A	2.7710			2.6945
BS-24B	2.3073			2.2436
BS-24C	2.2927			2.2294
BS-24D	2.2918			2.2285
25	2.3151	2.2495	97.17	
26	0.8704			0.8464
27	0.9571			0.9307
28	0.7540			0.7332
29	0.8304			0.8075
30	0.8304			0.8075
31	0.8969			0.8721
32	1.0134	0.9879	97.48	
33	1.0744			1.0447
34	0.9859			0.9587
35	0.9949			0.9674
36	1.0394			1.0107
37	1.0284			1.0000
38	0.9182			0.8929
39	0.8662	0.8443	97.47	
40	0.9053			0.8803
41	0.9846			0.9574
42	0.9149			0.8896
43	0.8900			0.8654
44	0.9906			0.9633

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
45	0.9261			0.9005
46	0.8763			0.8521
47	0.9618	0.9373	97.45	
48	0.9762			0.9493
49	0.8628			0.8390
50	1.0377			1.0091
51	0.9531			0.9268
52	1.0075			0.9797
53	1.0093			0.9814
54	0.8732			0.8491
55	0.8773			0.8531
56	0.9175	0.8940	97.44	
57	0.9673			0.9406
58	0.8567			0.8331
59	0.9200			0.8946
60	0.9280			0.9024
61	0.9206			0.8952
62	0.8696			0.8456
63	0.8528			0.8293
64	1.0959	1.0664	97.31	
65	1.1538			1.1220
66	1.1768			1.1443
67	1.1640			1.1319
68	1.1444			1.1128
69	1.2431			1.2088
70	1.1857			1.1530
71	1.1405	1.1102	97.34	
72	1.1570			1.1251
73	1.1490			1.1173
74	1.0940			1.0638

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
75	1.1465			1.1149
76	1.1161			1.0853
77	1.0977			1.0674
78	1.1036	1.0750	97.41	
79	1.2543			1.2197
80	1.1904			1.1575
81	1.2630			1.2281
82	1.1369			1.1055
83	1.2383			1.2041
84	1.2370			1.2029
85	1.1750	1.1450	97.45	
Mean			97.24	
Deviation			0.10	
		d. Cellulose-acetate rayon, Series F		
1	2.3564			2.2951
2	2.3573			2.2960
3	2.3398	2.2818	97.52	
4	2.3385			2.2777
5	2.3442			2.2833
6	2.3447			2.2837
7	2.3318			2.2712
8	2.3305			2.2699
9	2.3346			2.2739
10	2.3437	2.2851	97.50	
11	2.3637			2.3022
12	2.3593			2.2980
13	2.3700			2.3084
14	2.3546			2.2934
15	2.3514			2.2903

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
16	2.3524			2.2912
17	2.3620	2.3010	97.42	
18	2.3587			2.2974
19	2.3622			2.3008
20	2.3595			2.2982
21	2.3672			2.3057
22	2.3817			2.3198
23	2.3430			2.2821
24	2.3289	2.2696	97.45	
25	2.3242			2.2638
26	2.3472			2.2862
27	2.3367			2.2759
28	2.3549			2.2937
29	2.3431			2.2822
30	2.3423			2.2814
31	2.3770	2.3119	97.26	
32	2.3491			2.2880
33	2.3704			2.3088
34	2.3686			2.3070
35	2.3688			2.3072
36	2.3422			2.2813
37	2.3586			2.2973
38	2.3318	2.2725	97.46	
39	2.3224			2.2620
40	2.3300			2.2694
41	2.3328			2.2721
42	2.3516			2.2905
43	2.3436			2.2827
44	2.3417			2.2808
45	2.3503	2.2864	97.28	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
46	2.3445			2.2835
47	2.3533			2.2921
48	2.3462			2.2852
49	2.3610			2.2996
50	2.3514			2.2903
51	2.3381			2.2773
52	2.3397	2.2803	97.46	
53	2.3328			2.2721
54	2.3319			2.2713
55	2.3400			2.2792
56	2.3339			2.2732
57	2.3413			2.2804
58	2.3396			2.2788
59	2.3460	2.2867	97.47	
60	2.3594			2.2981
61	2.3416			2.2807
62	2.3435			2.2826
63	2.3339			2.2732
64	2.3481			2.2870
65	2.3410			2.2801
66	2.3388	2.2740	97.23	
67	2.3455			2.2845
68	2.3443			2.2833
69	2.3425			2.2816
70	2.3479			2.2869
71	2.3544			2.2932
72	2.3478			2.2868
73	2.3616	2.2977	97.29	
74	2.3540			2.2928
75	2.3405			2.2796

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
76	2.3691			2.3075
77	2.3547			2.2935
78	2.3611			2.2997
79	2.3689			2.3073
80	2.3686	2.3082	97.45	
81	2.3470			2.2860
82	2.3317			2.2711
83	2.3361			2.2754
84	2.3374			2.2766
85	2.3475			2.2865
86	2.3594			2.2981
87	2.2985	2.2403	97.47	
88	2.3018			2.2420
89	2.3020			2.2421
90	2.3130			2.2529
Mean			97.40	
Deviation			0.09	
91	2.3140			2.2485
92	2.2992			2.2341
93	2.2960			2.2310
94	2.2858			2.2211
95	2.2865	2.2229	97.22	
96	2.3036			2.2384
97	2.3151			2.2496
98	2.3015			2.2364
99	2.3085			2.2432
100	2.3022			2.2370

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
101	2.3240			2.2582
102	2.3140	2.2485	97.17	
103	2.3000			2.2349
104	2.3212			2.2555
105	2.3222			2.2565
106	2.3087			2.2434
107	2.3083			2.2430
108	2.3017			2.2366
109	2.3052	2.2423	97.27	
110	2.3085			2.2432
111	2.3066			2.2413
112	2.2929			2.2280
113	2.2728			2.2085
114	2.2770			2.2126
115	2.2816			2.2170
116	2.2960	2.2330	97.26	
117	2.2676			2.2034
118	2.2551			2.1913
119	2.2799			2.2154
120	2.2460			2.1824
121	2.2747			2.2103
122	2.2763			2.2119
123	2.2702	2.2067	97.20	
124	2.2690			2.2048
125	2.2864			2.2217
126	2.2791			2.2146
127	2.2540			2.1902
128	2.2617			2.1977
129	2.2547			2.1909
130	2.2656	2.2022	97.20	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
131	2.2644			2.2003
132	2.2754			2.2110
133	2.2930			2.2281
134	2.2730			2.2087
135	2.2670			2.2028
136	2.2657			2.2016
137	2.3018	2.2385	97.25	
138	2.2930			2.2281
139	2.3064			2.2411
140	2.2990			2.2339
141	2.3042			2.2390
142	2.2965			2.2315
143	2.3111			2.2457
144	2.2863	2.2214	97.16	
145	2.3013			2.2362
146	2.3125			2.2471
147	2.3059			2.2406
148	2.2958			2.2308
149	2.3090			2.2437
150	2.3041			2.2389
151	2.3143	2.2468	97.08	
152	2.3074			2.2421
153	2.3043			2.2391
154	2.3005			2.2354
155	2.2964			2.2314
156	2.3016			2.2365
157	2.3074			2.2421
158	2.2993	2.2340	97.16	
159	2.2960			2.2310
160	2.2994			2.2343

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
161	2.3006			2.2355
162	2.3040			2.2388
163	2.2908			2.2260
164	2.2856			2.2209
165	2.2840	2.2183	97.12	
166	2.3000			2.2349
167	2.2967			2.2317
168	2.2975			2.2225
169	2.3101			2.2447
170	2.3103			2.2449
171	2.3172			2.2516
172	2.3031	2.2365	97.11	
173	2.2876			2.2229
174	2.3077			2.2424
175	2.3003			2.2352
176	2.3047			2.2395
177	2.3088			2.2435
178	2.2958			2.2308
179	2.2923	2.2282	97.20	
180	2.2980			2.2330
181	2.2958			2.2308
182	2.2993			2.2342
183	2.2692	2.2043	97.14	
184	2.2760			2.2116
185	2.2740			2.2096
186	2.2855	2.2221	97.23	
187	2.3110			2.2456
188	2.2832			2.2186
189	2.2897			2.2249
190	2.2657			2.2016

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
191	2.2833			2.2187
192	2.2846			2.2199
193	2.2538	2.1892	97.13	
194	2.2650			2.2009
195	2.2629			2.1989
196	2.2861			2.2214
197	2.2804			2.2159
198	2.2768			2.2124
199	2.2783			2.2138
200	2.2856	2.2216	97.20	
201	2.2775			2.2130
202	2.2852			2.2205
203	2.2722			2.2079
204	2.2817			2.2171
205	2.2783			2.2138
206	2.2743			2.2099
207	2.2841	2.2184	97.12	
208	2.2882			2.2234
209	2.2711			2.2068
210	2.2797			2.2152
211	2.2813			2.2167
212	2.2983			2.2333
213	2.2852			2.2205
214	2.2933	2.2284	97.17	
215	2.2888			2.2240
216	2.2884			2.2236
217	2.2863			2.2216
218	2.2923			2.2274
219	2.2864			2.2217
220	2.2918			2.2269

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
221	2.2886	2.2254	97.24	
222	2.2807			2.2162
223	2.2807			2.2162
224	2.2766			2.2122
225	2.2786			2.2141
226	2.2996			2.2345
227	2.2801			2.2156
228	2.2764	2.2112	97.14	
229	2.2792			2.2147
230	2.2796			2.2151
231	2.2835			2.2189
232	2.3105			2.2451
233	2.2934			2.2285
234	2.3141			2.2486
235	2.2948	2.2289	97.13	
236	2.3254			2.2596
237	2.3166			2.2510
238	1.1786	1.1450	97.15	
239	1.1987			1.1648
240	1.1575			1.1247
241	1.2370			1.2020
242	1.2365			1.2015
243	1.2358			1.2008
244	1.3092	1.2714	97.11	
245	1.3530			1.3147
246	1.4843			1.4423
Mean			97.17	
Deviation			0.04	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
		e. Cellulose-acetate rayon, Series M		
BS-1A	2.2573			2.2149
BS-1B	2.2555			2.2131
BS-1C	2.7117			2.6607
BS-1D	2.7136			2.6626
1	2.1663	2.1221	97.96	
BS-2A	2.2517			2.2094
BS-2B	2.2401			2.1980
BS-2C	2.6950			2.6443
BS-2D	2.2403			2.1982
2	2.1622	2.1205	98.07	
BS-3A	2.2549			2.2125
BS-3B	2.2471			2.2049
BS-3C	2.6960			2.6453
BS-3D	2.7063			2.6554
3	2.1555	2.1137	98.06	
BS-4A	2.2443			2.2021
BS-4B	2.2487			2.2064
BS-4C	2.2448			2.2026
BS-4D	2.2432			2.2010
4	2.1327	2.0916	98.07	
BS-5A	2.2367			2.1947
BS-5B	2.2365			2.1945
BS-5C	2.6858			2.6353
BS-5D	2.6886			2.6381
5	2.1571	2.1153	98.06	
6	1.1252			1.1040
7	1.1488			1.1272
8	1.1293			1.1081
9	1.1370			1.1156
10	1.1292			1.1080

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
11	2.2486	2.2053	98.07	
12	1.1221			1.1010
13	1.1430			1.1215
14	1.1400			1.1186
15	1.1403			1.1189
16	1.1446			1.1231
17	2.2244	2.1832	98.15	
18	1.1230			1.1019
19	1.1256			1.1044
20	1.1234			1.1023
21	1.1280			1.1068
22	1.1359			1.1145
23	2.2422	2.2004	98.14	
24	1.1282			1.1070
25	1.1240			1.1029
26	1.1253			1.1041
27	1.1260			1.1048
28	1.1340			1.1127
29	2.2329	2.1896	98.06	
30	1.1460			1.1245
31	1.1334			1.1121
32	1.1314			1.1101
33	1.1216			1.1005
34	1.1378			1.1164
35	2.2867	2.2427	98.08	
36	1.1372			1.1158
37	1.1275			1.1063
38	1.1314			1.1101
39	1.1262			1.1050
40	1.1341			1.1128

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
41	2.2724	2.2282	98.05	
42	1.1418			1.1203
43	1.1236			1.1025
44	1.1245			1.1034
45	1.1376			1.1162
46	1.1357			1.1143
47	2.2526	2.2110	98.15	
48	1.1301			1.1089
49	1.1263			1.1051
50	1.1223			1.1012
51	1.1198			1.0987
52	1.1100			1.0891
53	2.2441	2.2029	98.16	
54	1.1197			1.0986
55	1.1290			1.1078
56	1.1322			1.1109
57	1.1188			1.0978
58	1.1280			1.1068
59	2.2552	2.2136	98.16	
60	1.1206			1.0995
61	1.1234			1.1023
62	1.1295			1.1083
63	1.1144			1.0934
64	1.1297			1.1085
65	2.2495	2.2093	98.21	
66	1.1116			1.0907
67	1.1300			1.1088
68	1.1208			1.0997
69	1.1189			1.0979
70	1.1184			1.0974

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
71	2.2321	2.1915	98.18	
72	1.1360			1.1146
73	1.1224			1.1013
74	1.1338			1.1125
75	1.1256			1.1044
76	1.1346			1.1133
77	2.2367	2.1957	98.17	
78	1.1374			1.1160
79	1.1404			1.1190
80	1.1405			1.1191
81	1.1325			1.1112
82	1.1246			1.1035
83	2.2197	2.1796	98.19	
84	1.1396			1.1182
85	1.1221			1.1010
86	1.1244			1.1033
87	1.1282			1.1070
88	1.1264			1.1052
89	2.2518	2.2099	98.14	
90	1.1300			1.1088
91	1.1327			1.1114
92	1.9625			1.9256
93	1.8170			1.7828
94	1.8100			1.7760
95	2.2558	2.2164	98.25	
96	1.8041			1.7702
97	1.8164			1.7823
Mean			98.12	
Deviation			0.06	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
		f. Cellulose-acetate rayon, Series N		
1	2.3211			2.2283
2	2.3120			2.2195
3	2.3232	2.2299	95.98	
4	2.3252			2.2322
5	2.3296			2.2364
6	2.3316			2.2383
7	2.3506			2.2566
8	2.3514			2.2573
9	2.3410	2.2479	96.02	
10	2.3483			2.2544
11	2.3493			2.2553
12	2.3122			2.2197
13	2.3814			2.2861
14	2.3237			2.2308
15	2.3540	2.2599	96.00	
16	2.3291			2.2359
17	2.3411			2.2475
18	2.3517			2.2576
19	2.3197			2.2269
20	2.3262			2.2332
21	2.3904	2.2943	95.98	
22	2.3652			2.2706
23	2.3784			2.2833
24	2.3685			2.2738
25	2.3170			2.2243
26	2.3081			2.2158
27	2.3341	2.2408	96.00	
28	2.3346			2.2412
29	2.3311			2.2379
30	2.3264			2.2333

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
31	2.3378			2.2443
32	2.3487			2.2548
33	2.3273	2.2338	95.98	
34	2.3462			2.2524
35	2.3431			2.2494
36	2.3370			2.2435
37	2.3801			2.2849
38	2.3515			2.2574
39	2.3361	2.2433	96.03	
40	2.3434			2.2497
41	2.3507			2.2567
42	2.3436			2.2499
43	2.3438			2.2500
44	2.3350			2.2416
45	2.3279	2.2350	96.01	
46	2.3449			2.2511
47	2.3358			2.2424
48	2.3281			2.2350
49	2.3540			2.2598
50	2.3153			2.2227
51	2.3506	2.2570	96.02	
52	2.3648			2.2702
53	2.3330			2.2397
54	2.3226			2.2297
55	2.3282			2.2351
56	2.3426			2.2489
57	2.3166	2.2246	96.03	
58	2.3275			2.2344
59	2.3214			2.2285
60	2.3601			2.2657
Mean			96.00	
Deviation			0.02	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
		g. Cellulose-acetate rayon, Series X		
1	1.6223			1.5733
2	1.5206	1.4749	96.99	
3	1.2838			1.2450
4	1.3568			1.3158
5	1.3106			1.2710
6	1.3287			1.2886
7	1.5539	1.5070	96.98	
8	1.3867			1.3448
9	1.3770			1.3354
10	1.3823			1.3406
Mean			96.98	
Deviation			0.00	
		h. Cotton muslin sheeting, bleached. Series S		
1	2.5373			2.4518
2	2.5509			2.4649
3	2.5311	2.4460	96.64	
4	2.6978			2.6069
5	2.6751			2.5849
6	2.4339			2.3519
7	2.4138			2.3325
8	2.6900	2.6000	96.65	
9	2.6341			2.5453
10	2.4553			2.3726

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
11	2.4187			2.3372
12	2.4178			2.3363
13	2.4693	2.3862	96.63	
14	2.3583			2.2788
15	2.4180			2.3365
16	2.3955			2.3148
17	2.3814			2.3011
18	2.4116	2.3308	96.65	
19	2.4733			2.3899
20	2.4747			2.3913
21	2.4207			2.3391
22	2.3958			2.3151
23	2.4599	2.3767	96.62	
24	2.4638			2.3808
25	2.4510			2.3684
26	2.4580			2.3752
27	2.3914			2.3108
28	2.4744	2.3912	96.64	
29	2.4811			2.3975
30	2.4773			2.3938
31	2.4888			2.4049
32	2.4420			2.3597
33	2.5046	2.4164	96.48	
34	2.4143			2.3329
35	2.4420			2.3597
36	2.4387			2.3565
37	2.4923			2.4083
38	2.3866	2.3050	96.58	
39	2.5695			2.4829
40	2.3753			2.2953

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
41	2.3870			2.3066
42	2.3433			2.2643
43	2.3598	2.2805	96.64	
44	2.4362			2.3541
45	2.4240			2.3423
46	2.3838			2.3035
47	2.4199			2.3383
48	2.3598	2.2805	96.64	
49	2.3720			2.2921
50	2.4175			2.3360
51	2.3653			2.2861
52	2.3738			2.2938
53	2.3591	2.2811	96.69	
54	2.3964			2.3156
55	2.3499			2.2707
56	2.3610			2.2814
57	2.3420			2.2631
58	2.3714	2.2927	96.68	
59	2.3694			2.2896
60	2.3468			2.2677
Mean			96.63	
Deviation			0.03	
		i. Cotton muslin sheeting, bleached. Series T		
22		4.7011		
24		4.7168		
26		4.6851		
28		4.5373		

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
		j. Cotton muslin sheeting, unbleached. Series S		
1	2.6065			2.5142
2	2.6271			2.5341
3	2.5889	2.4979	96.48	
4	2.6356			2.5423
5	2.6412			2.5477
6	2.6372			2.5438
7	2.6922			2.5969
8	2.7361	2.6405	96.51	
9	2.7831			2.6846
10	2.8850			2.7829
11	2.8343			2.7340
12	2.8818			2.7798
13	2.7538	2.6565	96.47	
14	2.8523			2.7513
15	2.5123			2.4234
16	2.5013			2.4128
17	2.5076			2.4188
18	2.5370	2.4454	96.39	
19	2.4633			2.3761
20	2.4402			2.3538
21	2.7238			2.6274
22	2.6641			2.5698
23	2.7602	2.6614	96.42	
24	2.8404			2.7398
25	2.6008			2.5087
26	2.6044			2.5122
27	2.5326			2.4429
28	2.4925	2.4015	96.35	
29	2.6003			2.5082
30	2.6434			2.5498

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
31	2.5422			2.4522
32	2.5106			2.4217
33	2.6492	2.5553	96.46	
34	2.6462			2.5525
35	2.5312			2.4416
36	2.5657			2.4749
37	2.6474			2.5537
38	2.6947	2.6037	96.62	
39	2.5507			2.4604
40	2.5862			2.4946
41	2.6642			2.5699
42	2.6973			2.6018
43	2.6177	2.5234	96.40	
44	2.6465			2.5528
45	2.6145			2.5219
46	2.5927			2.5009
47	2.6408			2.5473
48	2.7086	2.6129	96.47	
49	2.6060			2.5137
50	2.5980			2.5060
51	2.5185			2.4293
52	2.5308			2.4412
53	2.6867	2.5927	96.50	
54	2.6521			2.5582
55	2.5530			2.4626
56	2.5185			2.4293
57	2.6482			2.5545
58	2.6586	2.5630	96.40	
59	2.7428			2.6457
60	2.7395			2.6425
Mean			96.46	
Deviation			0.05	

TABLE 1. (Continued)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
		k. Cotton muslin sheeting, unbleached. Series T		
2		5.2290		
4		5.2689		
6		5.0738		
8		5.3068		
		l. Regenerated-cellulose rayon. Series S		
1	2.3500			2.2151
2	2.3478			2.2150
3	2.3608	2.2278	94.37	
4	2.3498			2.2149
5	2.3218			2.1885
6	2.3523			2.2173
7	2.3144			2.1816
8	2.2556	2.1272	94.31	
9	2.2800			2.1491
10	2.2415			2.1128
11	2.2696			2.1393
12	2.2568			2.1273
13	2.2612	2.1317	94.27	
14	2.2459			2.1170
15	2.2637			2.1338
16.	2.2508			2.1216
17	2.2484			2.1193
18	2.2647	2.1345	94.25	
19	2.2321			2.1040
20	2.2463			2.1174
21	2.2382			2.1097
22	2.2440			2.1152
23	2.2676	2.1356	94.18	
24	2.2335			2.1053
25	2.2487			2.1196

TABLE 1. (Continued)

Sample Number	Air-dry weight	Oven-dry weight		
		Determined		Calculated
	Gram	Gram	Percentage	Gram
26	2.2363			2.1079
27	2.2590			2.1293
28	2.2663	2.1376	94.32	
29	2.2579			2.1283
30	2.2676			2.1374
31	2.2692			2.1389
32	2.2980			2.1661
33	2.3120	2.1794	94.26	
34	2.2952			2.1635
35	2.2984			2.1665
36	2.2810			2.1501
37	2.2656			2.1356
38	2.2662	2.1389	94.30	
39	2.2910			2.1595
40	2.2848			2.1537
41	2.2706			2.1403
42	2.2421			2.1134
43	2.3014	2.1680	94.20	
44	2.3165			2.1835
45	2.3105			2.1779
46	2.2758			2.1452
47	2.2795			2.1487
48	2.2945	2.1615	94.20	
49	2.2762			2.1455
50	2.3227			2.1894
51	2.3083			2.1758
52	2.3112			2.1785
53	2.3288	2.1941	94.22	
54	2.2725			2.1421
55	2.2954			2.1636

TABLE 1. (Concluded)

Sample	Air-dry weight	Oven-dry weight		
		Determined		Calculated
Number	Gram	Gram	Percentage	Gram
56	2.3488			2.2140
57	2.3335			2.2043
58	2.3056	2.1737	94.28	
59	2.3292			2.1955
60	2.3164			2.1834
Mean			94.26	
Deviation			0.04	
		m. Regenerated-cellulose rayon. Series T		
2		4.5432		
4		4.5935		
6		4.5043		
8		4.4527		

TABLE 2. ACETYL OF NEW CELLULOSE-ACETATE RAYON

Determination Number	Cellulose-acetate rayon: Rectangle Number	Cellulose-acetate rayon: Weight Gram	Hydrochloric acid: Milliliter of 0.1010H	Acetyl: Percentage
1	A63	2.2186	50.75*	38.39
2	A66	2.2469	47.85*	38.46
3	A69	2.2533	47.16*	38.49
4	A72	2.2479	41.48**	38.55
5	A75	2.2369	42.47**	38.54
Mean				38.49
Deviation				0.05

*Original volume of alkali: 25.00 ml. 0.9965 N sodium hydroxide.

**Original volume of alkali: 25.00 ml. 0.9728 N sodium hydroxide.

TABLE 3. ASH OF NEW FABRICS

Determination Number	Fabric	Ash		
		Gram	Gram	Percentage
1	Cotton cellulose,	5.7040	0.0547	0.96
2	unbleached	6.1150	0.0577	0.94
3		5.2619	0.0488	0.93
4		5.2505	0.0505	0.96
Mean				0.95
Deviation				0.01
1	Cotton cellulose,	5.3591	0.0036	0.07
2	bleached	6.0327	0.0032	0.05
3		5.4782	0.0034	0.06
4		5.3183	0.0029	0.05
Mean				0.06
Deviation				0.01
1	Regenerated-cellulose	2.2322	0.0052	0.23
2	rayon	2.2557	0.0059	0.26
3		2.1300	0.0049	0.23
4		2.2163	0.0054	0.24
5		2.1761	0.0052	0.24
Mean				0.24
Deviation				0.01
1	Cellulose-acetate	2.1221	0.0020	0.09
2	rayon	2.1205	0.0010	0.05
3		2.1137	0.0013	0.06
4		2.0916	0.0019	0.09
5		2.1153	0.0022	0.10
Mean				0.08
Deviation				0.02

TABLE 4. BREAKING STRENGTH OF WET WARP AND ELONGATION AT BREAKING LOAD OF THE FABRICS

Determination Number	Breaking strength of wet warp of fabric				Elongation at breaking load of fabric			
	Conditioned		Wet		Conditioned		Wet	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Percentage	Percentage	Percentage	Percentage
	a. Cotton cellulose, unbleached							
1	47*	78	67	92	17	15	30	26
2	60	74	67	80	15	13	26	26
3	52	72	65	78	17	13	26	30
4	53	76	63	80	17	13	28	28
5	60	79	70	80	17	13	28	30
6	58	79	64	80	15	13	28	30
7	54	77	70	81	15	13	28	30
8	62	69	65	90	15	13	26	30
9	61	74	49*	92	19	17	26	26
10	63	74	72	88	19	15	28	26
11	62	72	65	90	17	15	26	26
12	65	67	76	90	17	15	28	24
13	65	69	58	94	17	17	26	26
14	60	69	72	64*	-	17	28	22
15	63	64	66	90	17	15	28	26
16	62	67	71	82	17	15	26	26
17	66	67	69	85	19	17	28	24
18	59	69	69	95	15	17	28	26
19	65	67	68	74	19	15	26	26
20	62	68	68	79	19	15	26	-
Mean	61	72	68	85	17	15	27	27
Deviation	3	4	3	6	1	1	1	2
Percentage of conditioned			111	118			159	180

*Rejected observation.

TABLE 4. (Continued)

Determination Number	Breaking strength of wet warp of fabric: Conditioned: Warp (Pound per inch)	Breaking strength of wet warp of fabric: Conditioned: Filling (Pound per inch)	Breaking strength of wet warp of fabric: Wet: Warp (Pound per inch)	Breaking strength of wet warp of fabric: Wet: Filling (Pound per inch)	Elongation at breaking load of fabric: Conditioned: Warp (Percentage)	Elongation at breaking load of fabric: Conditioned: Filling (Percentage)	Elongation at breaking load of fabric: Wet: Warp (Percentage)	Elongation at breaking load of fabric: Wet: Filling (Percentage)
			b. Cotton cellulose, bleached					
1	63	64	72	64	11	24	17	33
2	57	64	69	71	11	-	20	30
3	65	65	69	71	11	24	17	28
4	58	66	67	68	11	24	15	30
5	58	70	71	67	9	26	19	28
6	62	65	70	65	13	22	19	28
7	65	67	69	69	11	20	20	28
8	64	55*	67	72	11	22	19	24
9	57	65	65	67	11	22	22	30
10	69	67	69	67	11	24	22	30
11	62	65	69	71	11	26	19	30
12	62	66	72	67	11	26	19	-
13	58	62	67	64	11	26	19	26
14	59	67	70	66	11	26	20	26
15	67	69	71	65	11	22	22	-
16	64	68	72	65	11	24	19	30
17	64	56*	70	70	11	24	19	30
18	58	67	77*	60	-	24	20	30
19	63	58	69	72	9	24	15	28
20	67	61	69	74	11	24	19	28
Mean	62	65	69	68	11	24	19	29
Deviation	3	2	1	3	0	1	1	2
Percentage of conditioned			111	105			173	121

*Rejected observation.

TABLE 4. (Continued)

Determination Number	Breaking strength of wet warp of fabric				Elongation at breaking load of fabric			
	Conditioned		Wet		Conditioned		Wet	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Percentage	Percentage	Percentage	Percentage
	c. Regenerated-cellulose rayon							
1	64	44	25	19	20	13	20	15
2	67	44	30	18	19	15	22	19
3	69	44	29	19	19	15	22	19
4	69	45	29	20	19	13	19	17
5	67	45	28	18	19	15	20	15
6	71	46	28	20	19	17	20	17
7	69	45	28	18	19	17	22	19
8	69	44	27	19	19	17	19	19
9	69	45	27	18	19	19	-	19
10	68	44	28	21	20	17	22	22
11	65	43	28	20	19	15	20	19
12	70	44	28	20	19	15	22	19
13	67	43	29	18	19	17	22	19
14	58*	42	28	19	19	13	22	17
15	69	42	29	20	13*	13	22	17
16	69	42	29	19	20	13	19	17
17	69	42	28	18	20	13	22	19
18	69	42	27	18	19	17	20	19
19	69	42	27	18	19	13	19	17
20	70	42	29	19	19	13	22	19
Mean	68	44	28	19	19	15	21	18
Deviation	1	1	1	1	0	2	1	1
Percentage of conditioned			41	43			111	120

*Rejected observation.

TABLE 4. (Concluded)

Determination Number	Breaking strength of wet warp of fabric: Conditioned: Warp (Pound per inch)	Breaking strength of wet warp of fabric: Conditioned: Filling (Pound per inch)	Breaking strength of wet warp of fabric: Wet: Warp (Pound per inch)	Breaking strength of wet warp of fabric: Wet: Filling (Pound per inch)	Elongation at breaking load of fabric: Conditioned: Warp (Percentage)	Elongation at breaking load of fabric: Conditioned: Filling (Percentage)	Elongation at breaking load of fabric: Wet: Warp (Percentage)	Elongation at breaking load of fabric: Wet: Filling (Percentage)
			d. Cellulose-acetate rayon					
1	42	20	20	11	26	22	30	33
2	42	20	20	11	19*	20	30	31
3	40	20	20	11	26	20	28	37
4	42	20	21	11	28	22	37	22*
5	40	20	21	10	26	20	30	31
6	41	20	23	11	26	20	37	33
7	42	20	21	11	26	20	35	37
8	42	20	21	11	26	20	31	33
9	41	20	22	11	28	22	33	35
10	42	20	23	11	28	22	37	33
11	42	20	23	11	28	22	37	33
12	43	20	20	10	28	22	22*	35
13	42	20	21	11	26	20	33	35
14	42	20	21	11	26	20	33	35
15	41	20	22	11	24	20	33	31
16	42	20	21	11	26	20	33	35
17	41	20	21	11	30	20	30	31
18	42	20	18	10	28	20	20*	35
19	41	20	20	11	-	20	33	33
20	42	20	22	11	28	20	33	35
Mean	42	20	21	11	27	21	33	34
Deviation	0	0	1	0	1	1	2	2
Percentage of conditioned			50	55			122	162

*Rejected observation.

TABLE 5. COPPER NUMBER OF NEW FABRICS

Determination Number	Fabric	Rectangle Number	Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Normality	Potassium permanganate Milliliter*	Copper number
1	Cotton cellulose,	S1	2.5142	736.5	0.0514	8.41	1.08
2	unbleached	S2	2.5341			9.03	1.15
3		S4	2.5423			8.74	1.11
4		S5	2.5477			8.53	1.08
5		S6	2.5438			8.43	1.07
Mean Deviation							1.10
							0.03
1	Cotton cellulose,	S1	2.4518	736.5	0.0514	0.70	0.08
2	bleached	S2	2.4649			0.60	0.07
3		S4	2.6069			0.98	0.11
4		S5	2.5849			0.92	0.10
5		S6	2.3519			0.80	0.10
Mean Deviation							0.09
							0.01
1	Regenerated-	S34	2.1635	737.1	0.0511	7.59	1.13
2	cellulose rayon	S35	2.1665			7.85	1.16
3		S36	2.1501			7.79	1.16
4		S37	2.1356			7.46	1.12
5		S39	2.1595			8.35	1.24**
Mean Deviation							1.14
							0.02
1***	Cellulose-acetate	X4	1.3158	736.5	0.0514	11.53	2.84
2	rayon	X5	1.2710			11.30	2.88
3		X6	1.2886			10.99	2.76**
						11.71	2.82

3		S36	2.1501			7.79		1.16
4		S37	2.1356			7.46		1.12
5		S39	2.1595			8.35		1.24**
Mean								1.14
Deviation								0.02
1***	Cellulose-acetate	X4	1.3158	736.5	0.0514	11.53		2.84
2	rayon	X5	1.2710			11.30		2.88
3		X6	1.2886			10.99		2.76**
4		X8	1.3448			11.71		2.82
Mean								2.85
Deviation								0.02
1****		X1	1.5733	736.5	0.0514	13.69		2.82
2		X3	1.2450			10.98		2.86
3		X9	1.3354			11.38		2.76**
4		X10	1.3406			11.81		2.86
Mean								2.85
Deviation								0.02
1		F220	2.2269	735.8	0.0511	21.09		3.06
2		F222	2.2162			21.18		3.09
3		F223	2.2162			21.46		3.13
4		F224	2.2122			20.97		3.07
5		F225	2.2141			20.82		3.04
Mean								3.08
Deviation								0.03

*Blank

Determination Number	Potassium permanganate Milliliter of 0.0514 N
1A*****	0.08
2A	0.10
3B	0.09
4B	0.09
Mean	0.09
Deviation	0.00

**Rejected observation.
***Braidy method.
****Modified Braidy method.
*****Letter designates parallel determinations.

TABLE 6. DISTRIBUTION OF YARNS BY NUMBER

IN NEW FABRICS

Determination	Cellulose-acetate rayon		Cotton cellulose bleached		Cotton cellulose unbleached		Regenerated-cellulose rayon	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
Number	Number per inch	Number per inch	Number per inch	Number per inch	Number per inch	Number per inch	Number per inch	Number per inch
1	204	66	77	67	69	74	143	76
2	205	65	76	67	69	73	142	75
3	205	66	76	66	69	73	145	75
4	205	66	76	68	69	75	141	75
5	205	66	76	68	68	75	140	76
6	204	66	75	67	69	75	141	76
7	205	65	75	67	69	73	146	74
8	206	66	76	68	69	74	141	75
9	205	66	76	68	69	75	145	74
10	206	66	75	68	69	74	143	77
Mean	205	66	76	67	69	74	143	75
Deviation	0	0	0	1	0	1	2	1

TABLE 7. DISTRIBUTION OF YARNS BY WEIGHT IN NEW FABRICS

Determination	Fabric	Yarn			
		Weight		Distribution by weight	
		Warp	Filling	Warp	Filling
Number	Gram	Gram	Gram	Percentage	Percentage
		a. Cotton cellulose, unbleached			
1	0.460	0.246	0.216	53.5	47.0
2	0.450	0.242	0.212	53.8	47.1
3	0.452	0.240	0.217	53.1*	48.0
4	0.445	0.238	0.212	53.6	47.6
Mean				53.6	47.4
Deviation				0.1	0.4
		b. Cotton cellulose, bleached			
1	0.422	0.215	0.211	50.9	50.0
2	0.417	0.221	0.201	53.0*	48.2*
3	0.422	0.216	0.209	51.2	49.5
4	0.422	0.218	0.208	51.7	49.3
Mean				51.3	49.6
Deviation				0.3	0.3
		c. Regenerated-cellulose rayon			
1	0.284	0.157	0.122	55.3	43.0
2	0.287	0.159	0.123	55.4	42.9
3	0.288	0.157	0.127	54.5*	44.1*
4	0.285	0.157	0.122	55.1	42.8
Mean				55.3	42.9
Deviation				0.1	0.1
		d. Cellulose-acetate rayon			
1	0.269	0.179	0.089	66.5	33.1
2	0.267	0.176	0.090	65.9	33.7
3	0.268	0.177	0.091	66.0	34.0
4	0.269	0.180	0.090	66.9	33.5
Mean				66.3	33.6
Deviation				0.4	0.3

*Rejected observation.

TABLE 8. LENGTH OF FIBER OF NEW FABRICS

Determination Number	Fabric	Length of fiber	
		Warp	Filling
		Inch	Inch
1	Cotton cellulose, unbleached	1.50	1.19
2		1.19	1.38
3		1.31	1.31
4		1.25	1.06
5		1.44	1.25
6		1.25	1.25
7		0.94	1.06
8		1.25	1.19
9		1.25	1.25
10		1.44	1.12
Mean		1.28	1.21
Deviation		0.11	0.08
1	Cotton cellulose, bleached	1.25	1.25
2		1.25	1.31
3		1.25	1.19
4		1.12	1.12
5		1.25	1.38
6		1.31	1.38
7		1.31	1.38
8		1.25	1.19
9		1.31	1.06
10		1.25	1.25
Mean		1.26	1.25
Deviation		0.04	0.09

TABLE 9. THICKNESS OF NEW FABRICS

Determination	Thickness			
	Cellulose-acetate rayon	Cotton cellulose, bleached	Cotton cellulose, unbleached	Regenerated-cellulose rayon
Number	Inch x 10^3	Inch x 10^3	Inch x 10^3	Inch x 10^3
1	5.8	7.3	8.9	4.5
2	5.6	7.5	8.6	4.7
3	5.8	7.9	9.3	4.8
4	5.9	8.2	9.2	5.1
5	5.8	7.6	9.0	4.5
6	5.7	7.7	9.5	4.8
7	5.8	8.0	9.2	4.8
8	5.9	8.5	9.8	4.7
9	5.8	7.8	9.7	4.6
10	5.9	8.5	8.9	4.8
Mean	5.8	7.9	9.2	4.7
Deviation	0.1	0.3	0.3	0.1

TABLE 10. TWIST OF YARN

Determination	Cotton cellulose unbleached		Cotton cellulose bleached		Regenerated-cellulose rayon		Cellulose-acetate rayon	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
Number	Number per 10 inch*	Number per 6 inch*	Number per 10 inch*	Number per 10 inch*	Number per 10 inch*	Number per 10 inch*	Number per 10 inch	Number per 10 inch
1	436Z	245Z	424Z	311Z	38S	25S	47S	30S
2	462	224	414	324	41	27	50	29
3	538	246	452	314	38	22	47	25
4	385	196	398	314	40	26	48	33
5	404	196	401	387	39	23	45	30
6	430	214	444	334	40	29	48	30
7	402	194	405	303	42	28	47	28
8	422	201	395	359	38	21	48	31
9	416	212	471	339	40	25	47	28
10	390	216	437	307	37	21	49	28
Mean twist per inch	21	18	21	16	4	2	5	3
Deviation	1	1	1	1	0	0	0	0

*Twist-untwist method; observed values are halved in deriving mean twist per inch.

TABLE 11. WEIGHT OF NEW FABRICS

Determination Number	Fabric	Length	Width	Weight	
		Inch	Inch	Gram	Ounce per square yard
1	Cotton cellulose,	4.04(0.03)*	45.94	20.967	5.17**
2	unbleached	4.00(0.00)	45.94	21.014	5.24
3		4.02(0.01)	45.69	21.131	5.24
4		4.02(0.01)	45.94	21.152	5.25
5			45.75		
Mean			45.85		5.24
Deviation			0.11		0.00
1	Cotton cellulose,	4.02(0.01)	45.12	18.884	4.75
2	bleached	4.01(0.03)	45.19	18.149	4.58
3		4.01(0.01)	45.25	18.408	4.64
4		3.99(0.01)	45.12	18.484	4.69
5			45.25		
Mean			45.19		4.66
Deviation			0.05		0.06
1	Regenerated-cellulose rayon	4.03(0.00)	38.25	11.050	3.28
2		4.06(0.00)	38.22	11.145	3.28
3		4.11(0.01)	38.25	11.318	3.29
4		4.01(0.01)	38.31	10.898	3.25
5			38.25		
Mean			38.26		3.28
Deviation			0.02		0.01
1	Cellulose-acetate rayon	4.05(0.01)	39.19	10.307	2.97
2		4.01(0.01)	39.19	10.192	2.97
3		3.99(0.01)	39.16	10.158	2.97
4		4.01(0.01)	39.12	10.213	2.97
5			39.12		
Mean			39.16		2.97
Deviation			0.03		0.00

*Mean deviations are within parentheses.
**Rejected observation.

TABLE 12. YARN NUMBER OF NEW FABRICS

Determination	Warp			Filling		
	Length	Weight		Length	Weight	
Number	Inch	Gram	Typp	Inch	Gram	Typp
		a. Cotton cellulose, unbleached				
1	395.3	0.312	16.0	389.9	0.275	17.9
2		0.317	15.7		0.287	17.1
3		0.311	16.0		0.273	18.0
4		0.327	15.2*		0.283	17.4
Mean			15.9			17.6
Deviation			0.1			0.4
		b. Cotton cellulose, bleached				
1	378.7	0.259	18.4	415.1	0.270	19.4
2		0.259	18.4		0.259	20.2*
3		0.254	18.8		0.274	19.1
4		0.256	18.6		0.271	19.3
Mean			18.6			19.3
Deviation			0.2			0.1
		c. Regenerated-cellulose rayon				
1	300.0	0.084	45.0	382.6	0.159	30.3
2		0.085	44.5		0.159	30.3
3		0.085	44.5		0.159	30.3
4		0.085	44.5		0.159	30.3
Mean			44.6			30.3
Deviation			0.2			0.0
		d. Cellulose-acetate rayon				
1	367.6	0.077	60	360.0	0.125	36.3
2		0.076	61		0.125	36.3
3		0.076	61		0.125	36.3
4		0.076	61		0.124	36.6
Mean			61			36.4
Deviation			0			0.1

*Rejected observation.

TABLE 13. STANDARDIZATION OF CALCIUM HYPOCHLORITE

Determination Number	Standardization Number	Calcium hypochlorite		
		Milliliter*	Initial normality	Final normality of blank
1	A	25.71**	0.0971	
2		25.76	0.0969	
3		26.11		0.0956
4		26.16		0.0954
Mean			0.0970	0.0955
Deviation			0.0001	0.0001
1	B	24.02	0.1040	
2		24.02	0.1040	
3		25.57		0.0977
4		25.65		0.0973
Mean			0.1040	0.0975
Deviation			0.0000	0.0002
1	C	24.17	0.1033	
2		24.47	0.1020	
3		30.91		0.0808
4		31.36		0.0796
Mean			0.1026	0.0802
Deviation			0.0006	0.0006

*24.96 ml. 0.1000 N arsenious acid.
**Indicator correction: 0.01 ml. hypochlorite.

TABLE 14. STANDARDIZATION OF HYDROCHLORIC ACID

Determination Number	Sodium hydroxide: Milliliter of 0.9965N	Sodium hydroxide: Milliliter of 0.2060N	Hydrochloric acid: Milliliter	Hydrochloric acid: Normality
1	10.02		98.90	0.1010
2	10.02		98.96	0.1009
3	10.02		98.72	0.1011
4	10.08		99.54	0.1009
5	10.12		99.80	0.1010
Mean				0.1010
Deviation				0.0001
1		30.07	61.24	0.1011
2		30.02	61.22	0.1010
3		32.18	65.62	0.1010
4		30.57	62.38	0.1010
Mean				0.1010
Deviation				0.0000

TABLE 15. STANDARDIZATION OF POTASSIUM PERMANGANATE

Determination Number	Sodium oxalate: Gram of 99.95 per cent	Potassium permanganate: Milliliter	Normality	Molarity
1	0.3422	25.50	0.2002	0.0400
2	0.3237	24.13	0.2001	0.0400
3	0.4195	31.23	0.2004	0.0401
4	0.3375	25.16	0.2001	0.0400
5	0.3842	28.63	0.2002	0.0400
6	0.4077	30.37	0.2003	0.0401
Mean			0.2002	0.0400
Deviation			0.0001	0.0000
1	0.7802	35.28	0.3299	0.0660
2	0.5800	26.25	0.3296	0.0659
3	0.6200	28.05	0.3297	0.0659
4	0.7172	32.39	0.3303	0.0661
5	0.4907	22.22	0.3294	0.0659
Mean				0.0660
Deviation				0.0001
1	0.1311	38.13	0.0513	
2	0.2438	70.48	0.0516	
3	0.1643	47.66	0.0514	
4	0.1304	37.89	0.0513	
5	0.1332	38.64	0.0514	
6	0.1364	39.57	0.0514	
7	0.1441	41.71	0.0515	
Mean			0.0514	
Deviation			0.0001	
1	0.1040	30.25	0.0513	
2	0.1646	47.97	0.0512	
3	0.1563	45.66	0.0511	
4	0.1361	39.90	0.0509	
Mean			0.0511	
Deviation			0.0001	
1	0.4694	34.86	0.2009	
2	0.5172	38.48	0.2005	
3	0.5506	40.96	0.2005	
4	0.3929	29.26	0.2003	
Mean			0.2006	
Deviation			0.0002	

TABLE 16. STANDARDIZATION OF SODIUM N-CHLORO-p-TOLUENE-SULFONAMIDE

Determination Number	Standardization Number	Arsenious acid	Sodium N-chloro-p-toluenesulfonamide		
		Milliliter of 0.1000N	Milliliter*	Initial normality	Final normality of blank
1	D	4.96	50.97	0.00975	
2			52.02	0.00955	
3			59.79		0.00831
4			56.47		0.00880
Mean				0.00965	0.00856
Deviation				0.00010	0.00024
1	E	24.96	24.70	0.1011	
2			24.70	0.1011	
3			24.61		0.1015
4			24.67		0.1012
Mean				0.1011	0.1014
Deviation				0.0000	0.0002
1	F	24.96	24.68	0.1012	
2			24.69	0.1011	
3			24.69		0.1011
4			24.62		0.1014
Mean				0.1012	0.1012
Deviation				0.0000	0.0002
1	G	24.96	24.97	0.1000	
2			25.29	0.0987	
3			27.40		0.0911
4			27.36		0.0913
Mean				0.0994	0.0912
Deviation				0.0006	0.0001

*Indicator correction: equivalent of 0.01 ml. 0.1 N hypochlorite.

TABLE 16. (Continued)

Determination Number	Standardization Number	Arsenious acid: Milliliter of 0.1000N	Sodium N-chloro-p-toluenesulfonamide: Milliliter*	Initial normality	Final normality of blank
1	H	40.00	20.99	0.1907	
2			21.01	0.1905	
3			21.03		0.1903
4			20.99		0.1907
Mean				0.1906	0.1905
Deviation				0.0001	0.0002
1	I	40.00	21.05	0.1901	
2			21.00	0.1906	
3			20.99		0.1907
4			21.03		0.1903
Mean				0.1904	0.1905
Deviation				0.0002	0.0002
1	J	40.00	22.50	0.1779	
2			21.50	0.1861	
3			Lost		
Mean				0.1820	
Deviation				0.0041	
1	K	50.00	15.89	0.3147	
2			15.90	0.3145	
3			15.89		0.3147
4			15.87		0.3151
Mean				0.3146	0.3149
Deviation				0.0001	0.0002

TABLE 16. (Concluded)

Determination Number	Standardization Number	Arsenious acid: Milliliter of 0.1000N	Sodium N-chloro-p-toluenesulfonamide: Milliliter*	Initial normality	Final normality of blank
1	L	50.00	15.87	0.3151	
2			15.90	0.3145	
3			15.88		0.3149
4			15.85		0.3155
Mean				0.3148	0.3152
Deviation				0.0003	0.0003
1	M	50.00	15.65	0.3195	
2			15.59	0.3207	
3			17.55		0.2849
4			17.28		0.2894
Mean				0.3201	0.2872
Deviation				0.0006	0.0022

TABLE 17. STANDARDIZATION OF SODIUM HYDROGEN SULFITE

Determination Number	Potassium permanganate	Sodium hydrogen sulfite		
	Milliliter of 0.2002N	Milliliter	Normality	Molarity
1	30.19	40.34	0.1498	0.0749
2	30.12	40.22	0.1499	0.0750
3	30.21	40.35	0.1499	0.0750
4	30.08	40.23	0.1497	0.0748
5	30.29	40.45	0.1499	0.0750
Mean				0.0749
Deviation				0.0001
1	30.39	40.53	0.1501	0.0750
2	29.96	40.03	0.1498	0.0749
3	30.01	40.05	0.1500	0.0750
4	30.29	40.40	0.1501	0.0750
Mean				0.0750
Deviation				0.0000
1	30.00	40.04	0.1500	0.0750
2	30.13	40.23	0.1499	0.0750
3	30.15	40.25	0.1500	0.0750
4	30.12	40.25	0.1498	0.0749
Mean				0.0750
Deviation				0.0000
1	29.96	39.89	0.1499	0.0750
2	30.12	40.23	0.1499	0.0750
3	30.14	40.17	0.1502	0.0751
4	29.98	39.98	0.1501	0.0750
Mean				0.0750
Deviation				0.0000

TABLE 16. STANDARDIZATION OF SODIUM HYDROXIDE

Determination Number	Sulfuric acid: Milliliter of 0.2000N	Hydrochloric acid: Milliliter of 0.1010N	Sodium hydroxide: Milliliter	Sodium hydroxide: Normality
1	51.93		10.42	0.9967
2	49.15		9.91	0.9919*
3	49.93		10.02	0.9966
4	49.91		10.02	0.9962
5	49.97		10.03	0.9964
Mean				0.9965
Deviation				0.0002
1		93.74	9.73	0.9730
2		91.91	9.54	0.9730
3		93.10	9.67	0.9724
4		94.20	9.78	0.9728
Mean				0.9728
Deviation				0.0002

Determination Number	Potassium hydrogen phthalate: Gram of 99.95 percent	Sodium hydroxide: Milliliter	Sodium hydroxide: Normality
1	1.0300	24.71	0.2040
2	1.1255	26.95	0.2044*
3	1.0497	25.19	0.2040
4	1.2090	29.00	0.2040
Mean			0.2040
Deviation			0.0000
1	1.1267	26.76	0.2061
2	1.2005	28.52	0.2060
3	1.2081	28.74	0.2057
4	1.3162	31.27	0.2060
Mean			0.2060
Deviation			0.0001

*Rejected observation.

TABLE 19. PURITY OF SODIUM PEROXYBORATE

Determination Number	Potassium permanganate	Sodium peroxyborate	
	Milliliter of 0.2006N	Gram	Percentage
1	32.07	0.5457	90.70
2	29.97	0.5080	91.05
3	30.12	0.5112	90.94
4	31.72	0.5360	91.34
5	34.16	0.5791	91.04
6	29.36	0.5000	90.63
Mean			90.95
Deviation			0.19

****

Preparation of solutions

Normality	Gram per milliliter
0.0480	0.004064
0.0961	0.008128
0.1441	0.012192
0.1922	0.016256

TABLE 20. STANDARDIZATION OF SULFURIC ACID

Determination Number	Sodium hydroxide	Sulfuric acid		
	Milliliter of 0.2040N	Milliliter	Normality	Molarity
1	39.98	40.75	0.2001	0.1000
2	39.95	40.74	0.2000	0.1000
3	40.43	41.20	0.2002	0.1001
4	40.24	41.00	0.2002	0.1001
Mean				0.1000
Deviation				0.0000
1	38.80	39.57	0.2000	0.1000
2	39.20	39.98	0.2000	0.1000
3	39.27	40.06	0.2000	0.1000
4	39.75	40.54	0.2000	0.1000
Mean				0.1000
Deviation				0.0000

TABLE 21. EFFECT OF FIFTY-VOLUME BATHS OF AQUEOUS POTASSIUM PERMANGANATE FOR FOUR HOURS ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Determination Number	Potassium permanganate Molarity	Temperature °C.	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.0000	15.0 ± 0.1	B61	2.2812	45.38	38.36
2			B64	2.2560	46.64	38.54
3			B67	2.2803	45.36	38.38
4			B70	2.2522	47.28	38.48
5			B73	2.2803	46.00	38.25
Mean						38.40
Deviation						0.09
1	0.0000	25.0 ± 0.1	B121	2.2482	47.64	38.49
2			B124	2.2351	49.25	38.40**
3			B127	2.2583	46.81	38.47
4			B130	2.2389	48.64	38.45
5			B133	2.2271	49.59	38.47
Mean						38.47
Deviation						0.01
1	0.0000	40.0 ± 0.1	B106	2.2351	48.95	38.46
2			B109	2.2559	47.14	38.45
3			B112	2.2671	46.05	38.47
4			B115	2.2668	46.35	38.42
5			B118	2.2523	47.60	38.42
Mean						38.44
Deviation						0.02
1	0.0200	15.0 ± 0.1	B1	2.2339	47.56	38.75
2			B4	2.2404	45.03	39.13
3			B7	2.2156	48.56	38.87
4			B10	2.2625	43.98	38.94
5			B13	2.2378	45.45	39.09
Mean						38.96
Deviation						0.12

*Original volume of alkali: 25.00 ml. 0.9965 N sodium hydroxide.
**Rejected observation.

TABLE 21. (Continued)

Determination Number	Potassium permanganate Molarity	Temperature °C.	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.0200	25.0 ± 0.1	B31	2.2036	48.35	39.12
2			B34	2.2396	45.06	39.13
3			B37	2.2346	44.96	39.24
4			B40	2.2181	48.15	38.91**
5			B43	2.2404	44.74	39.18
Mean						39.17
Deviation						0.04
1	0.0200	40.0 ± 0.1	B91	2.2446	42.81	39.48
2			B94	2.2454	42.77	39.48
3			B97	2.2612	42.37	39.28
4			B100	2.2536	43.27	39.24
5			B103	2.2516	42.25	39.47
Mean						39.39
Deviation						0.10
1	0.0330	15.0 ± 0.1	B46	2.2435	44.86	39.10
2			B49	2.2461	44.66	39.10
3			B52	2.2566	44.96	38.86
4			B55	2.2546	43.49	39.18
5			B58	2.2497	45.11	38.95
Mean						39.04
Deviation						0.11
1	0.0330	25.0 ± 0.1	B136	2.2414	44.05	39.29
2			B139	2.2241	45.27	39.36
3			B142	2.2392	44.01	39.34
4			B145	2.2146	46.32	39.33
5			B148	2.2359	45.02	39.21**
Mean						39.33
Deviation						0.02

TABLE 21. (Concluded)

Determination Number	Potassium permanganate Molarity	Temperature °C.	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.0330	40.0 ± 0.1	A61	2.2312	44.96	39.30
2			A64	2.2044	49.67	38.85**
3			A67	2.2250	45.98	39.21
4			A70	2.2312	45.34	39.23
5			A73	2.2297	46.16	39.09
Mean						39.21
Deviation						0.06

TABLE 22. EFFECT OF FIFTY-VOLUME BATHS OF AQUEOUS POTASSIUM PERMANGANATE FOR FOUR HOURS ON THE BREAKING STRENGTH OF THE WET WARP OF CELLULOSE-ACETATE RAYON

Determination	Breaking strength of wet warp of fabric								
	Potassium permanganate, molarity								
	0.0000			0.0200			0.0330		
	Temperature, °C.								
	15.0 ± 0.1	25.0 ± 0.1	40.0 ± 0.1	15.0 ± 0.1	25.0 ± 0.1	40.0 ± 0.1	15.0 ± 0.1	25.0 ± 0.1	40.0 ± 0.1
Number	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch
1	20A*	22A	22A	17A	18A	15A	15A	15A	12A
2	20A	20A	22A	18A	16A	15A	15A	14A	13A
3	20A	22A	21A	19A	16A	15A	15A	14A	12A
4	20A	19A	21A	18A	18A	15A	16A	15A	13A
5	20A	19A	20A	18B	16B	14A	16A	14A	12A
6	19B	20B	22B	16B	18B	15B	15B	15B	13B
7	18B	20B	22B	17B	18B	15B	13B	14B	11B
8	22B	20B	20B	17B	18B	14B	15B	16B	12B
9	20B	22B	20B	16C	17C	12B	15B	16B	12B
10	20B	20B	22B	18C	18C	15B	15B	15B	12B
11	20C	20C	22C	19C	18C	14C	16C	15C	12C
12	19C	22C	21C	19C	16C	15C	16C	15C	12C
13	19C	22C	20C	19D	18D	15C	15C	15C	12C
14	20C	22C	20C	20D	18D	15C	16C	15C	12C
15	20C	22C	21C	19D	19D	15C	15C	15C	12C
16	20D	20D	22D	18D	17D	15D	16D	15D	12D
17	22D	22D	21D	19E	19E	14D	17D	15D	12D
18	19D	21D	20D	16E	19E	15D	15D	14D	10D
19	20D	20D	22D	19E	16E	14D	15D	15D	10D
20	20D	20D	16D**	18E	18E	15D	17D	15D	13D
Mean	20	21	21	18	18	15	15	15	12
Deviation	0	1	1	1	1	0	1	0	0

*Letter designates parallel determinations.
**Rejected observation.

TABLE 23. EFFECT OF FIFTY-VOLUME BATHS OF AQUEOUS POTASSIUM PERMANGANATE IN FOUR HOURS ON THE COPPER NUMBER OF CELLULOSE-ACETATE RAYON

Determination Number	Potassium permanganate Molarity	Temperature °C.	Fabric Rectangle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0514N	Copper number
1	0.0000	15.0 ± 0.1	B63	2.2686	741.0	21.38	3.07
2			B66	2.2621		22.92	3.30
3			B69	2.2644		23.77	3.42
4			B72	2.2762		22.37	3.20
5			B75	2.2779		21.67	3.10
Mean							3.22
Deviation							0.11
1	0.0000	25.0 ± 0.1	B123	2.2429	735.0	19.95	2.89
2			B126	2.2578		20.67	2.98
3			B129	2.2411		20.97	3.04
4			B132	2.2405		21.03	3.05
5			B135	2.2266		21.35	3.12
Mean							3.02
Deviation							0.06
1	0.0000	40.0 ± 0.1	B108	2.2406	741.0	19.45	2.82
2			B111	2.2700		20.37	2.92
3			B114	2.2671		20.55	2.95
4			B117	2.2455		20.84	3.02
5			B120	2.2733		21.35	3.06
Mean							2.95
Deviation							0.07

*Blank: 0.09 ml. permanganate.

**Rejected observation.

TABLE 23. (Continued)

Determination Number	Potassium permanganate Molarity	Temperature °C.	Fabric Rectangle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0514N	Copper number
1	0.0200	15.0 ± 0.1	B3	2.2199	737.2	26.39	3.87
2			B6	2.2327		26.36	3.84
3			B9	2.2322		25.73	3.75
4			B12	2.2525		25.60	3.70
5			B15	2.2399		26.18	3.81
Mean							3.79
Deviation							0.06
1	0.0200	25.0 ± 0.1	M92	1.9256	737.2	20.97	3.54
2			M93	1.7828		19.87	3.63
3			M94	1.7760		20.25	3.71
4			M96	1.7702		20.07	3.69
5			M97	1.7823		20.57	3.75
Mean							3.66
Deviation							0.06
1	0.0200	40.0 ± 0.1	M6	1.1040	735.0	12.43	3.65
2			M7	1.1272		12.28	3.53
3			M8	1.1081		12.29	3.60
4			M9	1.1156		12.34	3.59
5			M10	1.1080		12.95	3.79**
Mean							3.59
Deviation							0.03
1	0.0330	15.0 ± 0.1	B48	2.2479	733.0	26.36	3.82
2			B51	2.2436		26.16	3.80
3			B54	2.2270		26.66	3.90
4			B57	2.2404		26.63	3.87
5			B60	2.2584		27.04	3.90
Mean							3.86
Deviation							0.04

TABLE 23. (Continued)

Determination Number	Potassium permanganate Molarity	Temperature °C.	Fabric Rectangle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0514N	Copper number
1	0.0330	25.0 ± 0.1	B138	2.2332	733.0	26.16	3.81
2			B141	2.2167		25.61	3.76
3			B144	2.2266		25.62	3.75
4			B147	2.2433		25.94	3.77
5			B150	2.2523		27.49	3.98**
Mean							3.77
Deviation							0.02
1	0.0330	40.0 ± 0.1	M49	1.1051	733.0	13.18	3.87
2			M50	1.1012		13.20	3.89
3			M55	1.1078		13.22	3.87
4			M56	1.1109		13.20	3.86
5			M58	1.1068		13.45	3.94**
Mean							3.87
Deviation							0.01

TABLE 24. EFFECT OF FIFTY-VOLUME BATHS OF AQUEOUS POTASSIUM PERMANGANATE FOR FOUR HOURS ON THE WEIGHT AND ASH OF CELLULOSE-ACETATE RAYON

Determination	Temperature	Potassium permanganate	Fabric				Ash	
			Rectangle	Weight				
				Original	Residual			
Number	°C.	Molarity	Number	Gram	Gram	Percentage	Gram	Percentage
1	15.0 ± 0.1	0.0000	B62	2.2613	2.2546	99.70	0.0016	0.07
2			B65	2.2441	2.2362	99.65	0.0014	0.06
3			B68	2.2826	2.2754	99.68	0.0013	0.06
4			B71	2.2704	2.2625	99.65	0.0010	0.04
5			B74	2.2469	2.2400	99.69	0.0011	0.05
Mean						99.67		0.06
Deviation						0.02		0.01
1	25.0 ± 0.1	0.0000	B122	2.2373	2.2300	99.67	0.0017	0.08
2			B125	2.2338	2.2258	99.64	0.0013	0.06
3			B128	2.2343	2.2264	99.65	0.0014	0.06
4			B131	2.2577	2.2500	99.66	0.0015	0.07
5			B134	2.2364	2.2281	99.63	0.0015	0.07
Mean						99.65		0.07
Deviation						0.01		0.01
1	40.0 ± 0.1	0.0000	B107	2.2450	2.2360	99.60	0.0007	0.03
2			B110	2.2723	2.2628	99.58	0.0008	0.04
3			B113	2.2756	2.2663	99.59	0.0010	0.04
4			B116	2.2705	2.2621	99.63	0.0012	0.05
5			B119	2.2433	2.2340	99.59	0.0010	0.04
Mean						99.60		0.04
Deviation						0.01		0.00

*Rejected observation.

TABLE 24. (Continued)

Determination Number	Temperature °C.	Potassium permanganate Molarity	Fabric: Rectangle Number	Fabric: Weight: Original Gram	Fabric: Weight: Residual Gram	Fabric: Weight: Residual Percentage	Ash Gram	Ash Percentage
1	15.0 ± 0.1	0.0200	B2	2.2175	2.2211	100.16	0.0092	0.41
2			B5	2.2589	2.2630	100.18	0.0096	0.42
3			B8	2.2401	2.2446	100.20	0.0094	0.42
4			B11	2.2585	2.2630	100.20	0.0094	0.42
5			B14	2.2527	2.2568	100.18	0.0094	0.42
Mean						100.18		0.42
Deviation						0.01		0.00
1	25.0 ± 0.1	0.0200	B32	2.2408	2.2494	100.38	0.0123	0.55
2			B35	2.2306	2.2387	100.36	0.0119	0.53
3			B38	2.2292	2.2370	100.35	0.0126	0.57
4			B41	2.2346	2.2426	100.36	0.0123	0.55
5			B44	2.2378	2.2455	100.34	0.0122	0.55
Mean						100.36		0.55
Deviation						0.01		0.01
1	40.0 ± 0.1	0.0200	B92	2.2523	2.2726	100.90	0.0209	0.93
2			B95	2.2544	2.2734	100.84	0.0206	0.91
3			B98	2.2511	2.2704	100.86	0.0212	0.94
4			B101	2.2600	2.2802	100.89	0.0215	0.95
5			B104	2.2298	2.2481	100.82	0.0202	0.91
Mean						100.86		0.93
Deviation						0.03		0.01

TABLE 24. (Concluded)

Determination Number	Temperature °C.	Potassium permanganate Molarity	Fabric: Rectangle Number	Weight: Original Gram	Weight: Residual Gram	Weight: Residual Percentage	Ash Gram	Ash Percentage
1	15.0 ± 0.1	0.0330	B137	2.2453	2.2564	100.49	0.0102	0.45
2			B140	2.1964	2.2071	100.49	0.0099	0.45
3			B143	2.2169	2.2276	100.48	0.0111	0.50
4			B146	2.2657	2.2776	100.53	0.0112	0.49
5			B149	2.2411	2.2505	100.42	0.0110	0.49
Mean						100.48		0.48
Deviation						0.03		0.02
1	25.0 ± 0.1	0.0330	B77	2.2468	2.2561	100.41	0.0135	0.60
2			B80	2.2565	2.2662	100.43	0.0138	0.61
3			B83	2.2501	2.2595	100.42	0.0146	0.65*
4			B86	2.2520	2.2623	100.46	0.0137	0.61
5			B89	2.2493	2.2568	100.33*	0.0132	0.59
Mean						100.43		0.60
Deviation						0.02		0.01
1	40.0 ± 0.1	0.0330	B47	2.2582	2.2536	99.80	0.0107	0.47
2			B50	2.2531	2.2487	99.80	0.0107	0.47
3			B53	2.2265	2.2208	99.74	0.0107	0.48
4			B56	2.2469	2.2440	99.87	0.0124	0.55
5			B59	2.2416	2.2329	99.61*	0.0093	0.41
Mean						99.80		0.48
Deviation						0.03		0.03

TABLE 25. EFFECT OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE, 0.0500M AS TO SULFURIC ACID, FOR FOUR HOURS ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Determination Number	Potassium permanganate Molarity	Temperature °C.	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.0000	15.0 ± 0.1	A16	2.1906	52.47	38.54
2			A19	2.2514	47.36	38.48
3			A22	2.2553	47.00	38.48
4			A25	2.2291	49.65	38.42
5			A28	2.2548	47.58	38.38
Mean						38.46
Deviation						0.05
1	0.0000	25.0 ± 0.1	A91	2.2608	47.18	38.36
2			A94	2.2542	47.22	38.46
3			A97	2.2568	47.26	38.41
4			A100	2.2346	49.01	38.45
5			A103	2.2643	46.74	38.38
Mean						38.41
Deviation						0.03
1	0.0000	40.0 ± 0.1	A76	2.2377	48.95	38.41
2			A79	2.2396	48.55	38.45
3			A82	2.2450	48.93	38.29**
4			A85	2.2478	48.16	38.39
5			A88	2.2410	48.85	38.37
Mean						38.40
Deviation						0.02
1	0.0200	15.0 ± 0.1	A1	2.2426	41.78	39.72
2			A4	2.2269	40.80	40.19
3			A7	2.2577	39.18	39.95
4			A10	2.2143	42.77	40.03
5			A13	2.1917	43.17	40.36
Mean						40.05
Deviation						0.18

*Original volume of alkali: 25.00 ml. 0.9965 sodium hydroxide.
**Rejected observations.

TABLE 25. (Continued)

Determination Number	Potassium permanganate Molarity	Temperature °C.	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.0200	25.0 ± 0.1	A31	2.2544	43.07	39.26**
2			A34	2.2424	38.80	40.30
3			A37	2.2438	38.47	40.34
4			A40	2.2283	39.96	40.33
5			A43	2.2308	40.66	40.15
Mean						40.28
Deviation						0.06
1	0.0200	40.0 ± 0.1	A46	2.2378	64.07	35.47
2			A49	2.2287	68.20	34.81
3			A52	2.2271	61.61	36.12
4			A55	2.2369	66.14	35.08
5			A58	2.2185	57.84	37.00
Mean						35.70
Deviation						0.69
1	0.0330	15.0 ± 0.1	B16	2.2401	39.58	40.19
2			B19	2.2285	44.78	39.38
3			B22	2.2532	41.18	39.65
4			B25	2.2503	40.10	39.91
5			B28	2.2127	43.97	39.82
Mean						39.79
Deviation						0.22
1	0.0330	25.0 ± 0.1	B84	2.2318	42.18	39.83
2			B85	2.2396	46.67	38.82
3			B87	2.2546	44.27	39.03
4			B88	2.2388	47.86	38.60
5			B90	2.2590	41.07	39.56
Mean						39.17
Deviation						0.42

TABLE 26. EFFECT OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE, 0.0500 M AS TO SULFURIC ACID, FOR FOUR HOURS ON THE BREAKING STRENGTH OF THE WET WARP OF CELLULOSE-ACETATE RAYON

Determination	Breaking strength of wet warp of fabric								
	Potassium permanganate, molarity								
	0.0000			0.0200			0.0330		
	Temperature, °C.								
	15.0 ± 0.1	25.0 ± 0.1	40.0 ± 0.1	15.0 ± 0.1	25.0 ± 0.1	40.0 ± 0.1	15.0 ± 0.1	25.0 ± 0.1	40.0 ± 0.1
Number	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch
1	19A*	19A	20A	9A**	5A	***	6A	***	***
2	20A	18A	20A	9A**	4A	***	7A	***	***
3	20A	20A	20A	10A**	6A	***	7A	***	***
4	20A	20A	20A	10A**	6A	***	7A	***	***
5	19A	20A	20A	10A**	6A	***	6A	***	***
6	20B	20B	20B	10B	6B	***	7D	***	***
7	20B	19B	21B	10B	6B	***	8B	***	***
8	19B	20B	20B	10B	6B	***	7B	***	***
9	20B	22B	19B	9B	7B	***	7B	***	***
10	20B	19B	22B	10B	2B	***	7B	***	***
11	20C	20C	19C	10B	4C	***	7B		
12	19C	20C	20C	9B	7C	***	6C		
13	20C	20C	20C	9B	7C	***	7C		
14	19C	22C	19C	9C	8C	***	7C		
15	20C	20C	22C	10C	6C	***	7C		
16	19D	20D	20D	10C	6D	***	6C		
17	20D	19D	19D	12C	7D	***	8D		
18	20D	22D	15D****	11D	8D	***	8D		
19	20D	19D	20D	12D	6D	***	7D		
20	20D	19D	20D	10D	8D	***	7D		
21				10D					
22				10E					
23				10E					
24				9E					
Mean	20	20	20	10	6		7		
Deviation	0	1	0	0	1		0		

*Letter designates parallel determinations.

**Dried and broken wet after one hour in water five days after treatment.

***Disintegrated.

****Rejected observation.

TABLE 27. (Continued)

Determination Number	Potassium permanganate Molarity	Temperature °C.	Fabric Reot-angle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0514N	Copper number
1	0.0200	15.0 ± 0.1	E38	0.8929	738.0	28.52	10.40
2			E42	0.8896		28.95	10.60
3			E59	0.8946		30.27	11.02
4			E61	0.8952		30.82	11.22
Mean							10.81
Deviation							0.31
1	0.0200	25.0 ± 0.1	E26	0.8464	738.0	33.17	12.77
2			E31	0.8721		33.47	12.51
3			E46	0.8521		30.97	11.84
4			E55	0.8531		31.42	12.00
Mean							12.28
Deviation							0.36
1	0.0200	40.0 ± 0.1	E28	0.7332	738.0	24.67	10.95
2			E29	0.8075		26.17	10.55
3			E30	0.8075		27.47	11.08
4			E49	0.8390		29.77	11.56
Mean							11.04
Deviation							0.28
1	0.0330	15.0 ± 0.1	M30	1.1245	733.0	44.79	12.99
2			M31	1.1121		46.88	13.75**
3			M32	1.1101		43.27	12.71
4			M33	1.1005		42.77	12.67
5			M34	1.1164		43.95	12.84
Mean							12.80
Deviation							0.11
1	0.0330	25.0 ± 0.1	M36	1.1158	733.0	51.24	14.98
2			M37	1.1063		51.49	15.18
3			M38	1.1101		50.57	14.86
4			M39	1.1050		50.01	14.76
5			M40	1.1128		52.01	15.25
Mean							15.01
Deviation							0.17

TABLE 27. EFFECT OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE, 0.0500 M AS TO SULFURIC ACID, IN FOUR HOURS ON THE COPPER NUMBER OF CELLULOSE-ACETATE RAYON

Determination	Potassium permanganate	Temperature	Fabric		Barometric pressure	Potassium permanganate	Copper number
			Rectangle	Weight			
Number	Molarity	°C.	Number	Gram	Millimeter of mercury	Milliliter of 0.0514N	
1	0.0000	15.0 ± 0.1	A18	2.2476	741.0	21.32	3.09
2			A21	2.2454		21.36	3.10
3			A24	2.2468		18.25	2.64
4			A27	2.2535		18.20	2.63
5			A30	2.2566		19.58	2.82
Mean							2.86
Deviation							0.19
1	0.0000	25.0 ± 0.1	A93	2.2449	736.5	21.92	3.18
2			A96	2.2307		21.55	3.14
3			A99	2.2334		21.09	3.07
4			A102	2.2447		20.52	2.97
5			A105	2.2582		21.27	3.06
Mean							3.08
Deviation							0.06
1	0.0000	40.0 ± 0.1	A78	2.2383	741.0	21.05	3.06
2			A81	2.2560		21.22	3.06
3			A84	2.2485		21.19	3.07
4			A87	2.2511		20.67	2.99
5			A90	2.2441		21.85	3.17
Mean							3.07
Deviation							0.04

*Blank: 0.09 ml. permanganate.

**Rejected observation.

TABLE 28. EFFECT OF FIFTY-VOLUME BATHS OF POTASSIUM PERMANGANATE, 0.0500 M AS TO SULFURIC ACID, FOR FOUR HOURS ON THE WEIGHT AND ASH OF CELLULOSE-ACETATE RAYON

Determination Number	Temperature °C.	Potassium permanganate Molarity	Fabric Rectangle Number	Fabric Weight Original Gram	Fabric Weight Residual Gram	Fabric Weight Residual Percentage	Ash Gram	Ash Percentage
1	15.0 ± 0.1	0.0000	A17	2.2485	2.2441	99.80	0.0014	0.06
2			A20	2.2444	2.2400	99.80	0.0013	0.06
3			A23	2.2378	2.2335	99.81	0.0013	0.06
4			A26	2.2383	2.2328	99.75	0.0014	0.06
5			A29	2.2389	2.2351	99.83	0.0013	0.06
Mean						99.80		0.06
Deviation						0.02		0.00
1	25.0 ± 0.1	0.0000	A92	2.2514	2.2444	99.69	0.0013	0.06
2			A95	2.2315	2.2254	99.73	0.0011	0.05
3			A98	2.2531	2.2466	99.71	0.0011	0.05
4			A101	2.2524	2.2456	99.70	0.0012	0.05
5			A104	2.2480	2.2415	99.71	0.0012	0.05
Mean						99.71		0.05
Deviation						0.01		0.00
1	40.0 ± 0.1	0.0000	A77	2.2371	2.2308	99.72	0.0014	0.06
2			A80	2.2487	2.2423	99.72	0.0013	0.06
3			A83	2.2408	2.2336	99.68	0.0014	0.06
4			A86	2.2688	2.2622	99.71	0.0014	0.06
5			A89	2.2365	2.2288	99.66	0.0012	0.05
Mean						99.70		0.06
Deviation						0.02		0.00

*Rejected observation.

**All samples so badly degraded that washing had to be effected by decantation.

TABLE 28. (Continued)

Determination Number	Temperature °C.	Potassium permanganate Molarity	Rectangle Number	Fabric Weight Original Gram	Fabric Weight Residual Gram	Fabric Weight Residual Percentage	Ash Gram	Ash Percentage
1	15.0 ± 0.1	0.0200	A2	2.2371	2.2230	99.37	0.0057	0.25
2			A5	2.2139	2.2011	99.42	0.0063	0.28
3			A8	2.2192	2.2064	99.42	0.0069	0.31
4			A11	2.1866	2.1753	99.48	0.0069	0.32
5			A14	2.2542	2.2401	99.37	0.0060	0.27
Mean						99.41		0.29
Deviation						0.03		0.02
1	25.0 ± 0.1	0.0200	A32	2.2412	2.2115	98.67	0.0058	0.26
2			A35	2.2240	2.1974	98.80*	0.0061	0.27
3			A38	2.2474	2.2169	98.64	0.0046	0.20
4			A41	2.2188	2.1887	98.64	0.0052	0.23
5			A44	2.2386	2.2083	98.65	0.0039	0.17
Mean						98.65		0.23
Deviation						0.01		0.03
1	40.0 ± 0.1	0.0200	A47	2.2268	2.0268	91.02	0.0057	0.26
2			A50	2.2396	2.0911	93.37	0.0057	0.25
3			A53	2.2402	2.0530	91.64	0.0059	0.26
4			A56	2.2232	2.0683	93.03	0.0076	0.34*
5			A59	2.2285	2.0546	92.20	0.0054	0.24
Mean						92.25		0.25
Deviation						0.76		0.01

TABLE 28. (Concluded)

Determination Number	Temperature °C.	Potassium permanganate Molarity	Fabric: Rectangle Number	Weight: Original Gram	Weight: Residual Gram	Weight: Residual Percentage	Ash Gram	Ash Percentage
1	15.0 ± 0.1	0.0330	A107	2.2475	2.2240	98.95	0.0040	0.18
2			A110	2.2605	2.2369	98.96	0.0037	0.16
3			A113	2.2487	2.2243	98.91	0.0037	0.16
4			A116	2.2424	2.2178	98.90	0.0039	0.17
5			A119	2.2208	2.1961	98.89	0.0036	0.16
Mean						98.92		0.17
Deviation						0.03		0.01
1	25.0 ± 0.1	0.0330	A137	2.2398	2.1610	96.48	0.0040	0.18
2			A140	2.2353	2.1441	95.92	0.0041	0.18
3			A143	2.2450	2.1426	95.44	0.0044	0.20
4			A146	2.2486	2.1549	95.83	0.0040	0.18
5			A149	2.2483	2.1230	94.43*	0.0045	0.20
Mean						95.92		0.19
Deviation						0.28		0.01
1	40.0 ± 0.1	0.0330	A122	2.2107	1.1811	53.43**	0.0064	0.29
2			A125	2.2168	1.3758	62.06	0.0085	0.38
3			A128	2.2319	1.3449	60.26	0.0087	0.39
4			A-BS-9B	2.1756	1.0377	47.70	0.0054	0.25
5			A-BS-9C	2.1676	1.0585	48.83	0.0041	0.19
Mean						54.46		0.30
Deviation						5.36		0.07

TABLE 29. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, IN TWO HOURS AT THE BOILING POINT OF WATER ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Determination Number	Sodium peroxyborate Normality	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.0000	F48	2.2852	41.18	37.97
2		F49	2.2996	41.42	37.69**
3		F50	2.2903	39.98	38.12
4		F51	2.2773	41.04	38.13
5		F53	2.2721	42.28	37.98
Mean					38.05
Deviation					0.08
1	0.0480	F25	2.2638	50.55	36.53
2		F26	2.2862	53.51	35.61**
3		F27	2.2759	50.75	36.30
4		F28	2.2937	50.17	36.13
5		F29	2.2822	50.85	36.18
Mean					36.28
Deviation					0.13
1	0.0961	F30	2.2814	77.30	31.16
2		F32	2.2880	79.22	30.70
3		F33	2.3088	77.88	30.68
4		F34	2.3070	74.84	31.27
5		F35	2.3072	73.36	31.55
Mean					31.07
Deviation					0.31

*Original volume of alkali: 25.00 ml. 0.9728 N sodium hydroxide.

**Rejected observation.

TABLE 29. (Continued)

Determination Number	Sodium peroxyborate Normality	Cellulose-acetate rayon Rectangle Number	Cellulose-acetate rayon Weight Gram	Hydrochloric acid Milliliter* of 0.1010N	Acetyl Percentage
1	0.1441	F36	2.2813	97.38	27.33
2		F37	2.2973	98.30	26.97
3		F39	2.2620	99.10	27.23
4		F40	2.2694	102.30	26.53**
5		F41	2.2721	98.98	27.13
Mean					27.16
Deviation					0.12
1	0.1922	F42	2.2905	123.47	22.27
2		F43	2.2827	119.24	23.15
3		F44	2.2808	121.58	22.72
4		F46	2.2835	119.89	23.02
5		F47	2.2921	121.09	22.70
Mean					22.77
Deviation					0.25

TABLE 30. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, IN TWO HOURS AT THE BOILING POINT OF WATER ON THE BREAKING STRENGTH OF THE WET WARP OF CELLULOSE-ACETATE RAYON

Determination	Breaking strength of wet warp of fabric				
	Normality of sodium peroxyborate				
	0.0000	0.0480	0.0961	0.1441	0.1922
Number	Pound per inch	Pound per inch	Pound per inch	Pound per inch	Pound per inch
1A*	18	16	14	13	14
2A	18	16	14	14	11
3A	18	16	14	10	11
4A	18	16	18	12	11
5A	18	18	14	13	10
6B	18	16	16	16	11
7B	17	14	14	11	11
8B	19	17	15	11	11
9B	18	14	15	11	11
10B	16	17	14	16	10
11C	18	18	15	11	11
12C	19	18	13	12	11
13C	16	17	14	13	11
14C	20	18	17	14	9
15C	18	18	13	13	8
16D	18	17	14	13	11
17D	18	17	18	15	9
18D	20	17	17	14	13
19D	20	16	16	14	9
20D	19	17	16	13	10
Mean	18	17	15	13	11
Deviation	1	1	1	1	1

*Letter designates parallel determinations.

TABLE 31. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, IN TWO HOURS AT THE BOILING POINT OF WATER ON THE COPPER NUMBER OF CELLULOSE-ACETATE RAYON

Determination	Sodium peroxyborate	Fabric		Barometric pressure	Potassium permanganate	Copper number
		Rectangle	Weight			
Number	Normality	Number	Gram	Millimeter of mercury	Milliliter* of 0.0511N	
1	0.0000	F7	2.2712	731.3	22.17	3.16
2		F8	2.2699		22.92	3.27
3		F9	2.2759		23.62	3.36
4		F11	2.3022		22.75	3.20
5		F12	2.2980		22.67	3.19
Mean						3.24
Deviation						0.06
1	0.0480	F13	2.3084	744.8	20.18	2.83
2		F14	2.2934		21.42	3.02
3		F15	2.2903		21.16	2.99
4		F16	2.2912		21.27	3.00
5		F18	2.2974		19.79	2.79
Mean						2.93
Deviation						0.09
1	0.0961	F19	2.3008	732.6	18.20	2.56
2		F20	2.2982		18.28	2.57
3		F21	2.3057		20.10	2.82
4		F22	2.3198		19.84	2.77
5		F23	2.2821		19.05	2.70
Mean						2.68
Deviation						0.10

*Blank: 0.09 ml. permanganate.
**Rejected observation.

TABLE 31. (Continued)

Determination Number	Sodium peroxyborate Normality	Fabric Rectangle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0511N	Copper number
1	0.1441	F60	2.2981	747.9	17.82	2.51
2		F61	2.2807		17.18	2.43
3		F62	2.2826		17.43	2.47
4		F63	2.2732		17.53	2.49
5		F64	2.2870		16.62	2.35**
Mean						2.48
Deviation						0.02
1	0.1922	F65	2.2801	747.9	14.83	2.10
2		F67	2.2845		14.68	2.07
3		F68	2.2833		15.01	2.12
4		F69	2.2816		15.93	2.26
5		F70	2.2869		16.23	2.29
Mean						2.17
Deviation						0.09

TABLE 31A. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, IN EIGHT HOURS AT 40.0±0.1°C. ON THE COPPER NUMBER OF CELLULOSE-ACETATE RAYON

Determination Number	Sodium peroxyborate Normality	Fabric Rectangle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0511N	Copper number
1	0.0000	A121	2.2214	731.3	19.49	2.84
2		A123	2.2179		19.26	2.81
3		A124	2.2138		20.17	2.95
4		A126	2.2513		20.77	2.98
5		A127	2.2295		20.40	2.96
Mean						2.91
Deviation						0.07
1	0.0480	A129	2.2291	732.6	21.17	3.07
2		A130	2.2339		21.15	3.06
3		A132	2.2510		21.29	3.06
4		A133	2.2214		19.80	2.88**
5		A135	2.2374		20.97	3.03
Mean						3.06
Deviation						0.01
1	0.0961	A136	2.2666	732.6	20.05	2.86
2		A138	2.2342		20.62	2.98
3		A139	2.2390		21.17	3.06
4		A141	2.2276		20.87	3.03
5		A142	2.2380		21.58	3.12
Mean						3.01
Deviation						0.07

*Blank: 0.09 ml. permanganate.
**Rejected observation.

TABLE 31A. (Continued)

Determination Number	Sodium peroxyborate Normality	Fabric Rectangle Number	Fabric Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0511N	Copper number
1	0.1441	A144	2.2272	744.8	18.36	2.66
2		A145	2.2308		19.57	2.84
3		A147	2.2548		21.67	3.11
4		A148	2.2377		22.51	3.25
5		A150	2.2305		21.27	3.08
Mean						2.99
Deviation						0.19
1	0.1922	F1	2.2951	738.7	20.97	2.96
2		F2	2.2960		21.60	3.04
3		F4	2.2777		21.54	3.06
4		F5	2.2833		20.42	2.89
5		F6	2.2837		21.90	3.10
Mean						3.01
Deviation						0.07

TABLE 32. EFFECT OF FIFTY VOLUME BATHS OF SODIUM PEROXYBORATE, 0.3 PER CENT AS TO SOAP, IN TWO HOURS AT THE BOILING POINT OF WATER ON THE WEIGHT OF CELLULOSE-ACETATE RAYON

Determination	Sodium peroxyborate	Cellulose-acetate rayon			
		Rectangle	Weight		
			Original	Residual	
Number	Normality	Number	Gram	Gram	Percentage
1	0.0000	F54	2.2713	2.2554	99.30
2		F55	2.2792	2.2618	99.24
3		F56	2.2732	2.2562	99.25
4		F57	2.2804	2.2630	99.24
5			2.2788	2.2615	99.24
Mean					99.25
Deviation					0.02
1	0.0480	B17	2.2259	2.1608	97.08
2		B20	2.2472	2.1806	97.04
3		B23	2.2160	2.1495	97.00
4		B26	2.2019	2.1452	97.42
5		B29	2.2186	2.1620	97.45
Mean					97.20
Deviation					0.19
1	0.0961	A62	2.2293	2.0736	93.02
2		A65	2.2310	2.0757	93.04
3		A68	2.2394	2.0692	92.40
4		A71	2.2349	2.0661	92.45
5		A74	2.2359	2.0769	92.89
Mean					92.76
Deviation					0.27

TABLE 32. (Continued)

Determination Number	Sodium peroxyborate Normality	Cellulose-acetate rayon: Rectangle Number	Weight: Original Gram	Residual Gram	Residual Percentage
1	0.1441	M41	2.2282	1.9778	88.76
2		M47	2.2110	1.9533	88.34
3		M53	2.2029	1.9474	88.40
4		M59	2.2136	1.9608	88.58
5		M65	2.2093	1.9689	89.12
Mean					88.64
Deviation					0.24
1	0.1922	M71	2.1915	1.8599	84.87
2		M77	2.1957	1.8469	84.11
3		M83	2.1796	1.8357	84.22
4		M89	2.2099	1.8617	84.24
5		M95	2.2164	1.8810	84.87
Mean					84.46
Deviation					0.33

TABLE 33. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE AND SODIUM N-CHLORO-p-TOLUENESULFONAMIDE ON THE ACETYL OF CELLULOSE ACETATE RAYON

Determination	Bleaching bath				Temperature	Time	Fabric		Hydrochloric acid	Acetyl
							Rectangle	Weight		
Number	Salt	Initial normality	Final normality of blank	Standardization	°C.	Hour	Number	Gram	Milliliter* of 0.1010N	Percentage
1	None	0.0000	0.0000		25.0 ± 0.1	2	F77	2.2935	38.98	38.25**
2							F78	2.2997	37.79	38.38
3							F79	2.3073	37.09	38.38
4							F81	2.2860	39.36	38.31
5							F82	2.2711	40.38	38.36
Mean										38.36
Deviation										0.02
1	None	0.0000	0.0000		25.0 ± 0.1	4	F89	2.2421	42.81	38.39
2							F90	2.2529	42.05	38.35
3							F91	2.2485	42.09	38.42
4							F92	2.2341	42.81	38.53**
5							F93	2.2310	43.77	38.39
Mean										38.39
Deviation										0.02

*Original volume of alkali: 25.00 ml. 0.9728 N sodium hydroxide.
**Rejected observation.

TABLE 33. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Fabric: Weight Gram	Hydrochloric acid: Milliliter* of 0.1010N	Acetyl: Percentage
1	None	0.0000	0.0000		40.0 ± 0.1	4	F100	2.2370	43.09	38.42
2							F101	2.2582	40.98	38.47
3							F103	2.2349	43.07	38.46
4							F104	2.2555	42.41	38.24**
5							F105	2.2565	41.36	38.42
Mean Deviation										38.44 ± 0.02
1	Calcium hypochlorite	0.0970	0.0955	A	25.0 ± 0.1	2	F107	2.2430	42.37	38.46
2							F108	2.2366	42.37	38.57
3							F110	2.2432	41.97	38.53
4							F111	2.2413	42.67	38.43
5							F112	2.2280	43.77	38.44
Mean Deviation										38.49 ± 0.05
1	Calcium hypochlorite	0.1040	0.0975	B	25.0 ± 0.1	4	F128	2.1977	45.54	38.62
2							F129	2.1909	45.88	38.68
3							F131	2.2003	46.56	38.38
4							F132	2.2110	46.92	38.12
5							F133	2.2281	lost	
Mean Deviation										38.45 ± 0.20

TABLE 33. (Continued)

Determination	Bleaching bath				Temperature	Time	Fabric		Hydrochloric acid	Acetyl
							Rectangle	Weight		
Number	Salt	Initial normality	Final normality of blank	Standardization	°C.	Hour	Number	Gram	Milliliter* of 0.1010N	Percentage
	Calcium									
1	hypochlorite	0.1026	0.0802	C	40.0 ± 0.1	4	F134	2.2087	43.99	38.74
2							F135	2.2028	44.57	38.73
3							F136	2.2016	45.18	38.63
4							F138	2.2281	43.57	38.48**
5							F139	2.2411	41.57	38.65
Mean										38.69
Deviation										0.05
	Sodium N-chloro-p-toluenesulfonamide									
1		0.1012	0.1012	F	40.0 ± 0.1	4	F146	2.2471	42.37	38.39
2							F147	2.2406	42.75	38.43
3							F148	2.2308	43.97	38.36
4							F149	2.2437	42.21	38.48
5							F150	2.2389	42.47	38.51
Mean										38.43
Deviation										0.05

TABLE 33. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Fabric: Weight Gram	Hydrochloric acid: Milliliter* of 0.1010N	Acetyl: Percentage
	Sodium N-chloro-p-toluenesulfonamide									
1		0.1904	0.1905	I	40.0 ± 0.1	4	F157	2.2421	42.47	38.45
2							F159	2.2310	44.37	38.28**
3							F160	2.2343	42.97	38.49
4							F161	2.2355	43.38	38.39
5							F162	2.2333	42.77	38.45
Mean										38.44
Deviation										0.03
	Sodium N-chloro-p-toluenesulfonamide									
1		0.3148	0.3152	L	40.0 ± 0.1	4	F163	2.2260	44.05	38.42
2							F164	2.2209	44.15	38.49
3							F166	2.2349	42.76	38.52
4							F167	2.2317	43.17	38.50
5							F168	2.2225	43.07	38.68**
Mean										38.48
Deviation										0.03

TABLE 34. EFFECT OF FIFTY-VOLUME BATHS OF WATER ON THE BREAKING STRENGTH OF THE WET WARP OF CELLULOSE-ACETATE RAYON

Determination Number	Breaking strength of wet warp of fabric			
	Period and temperature of immersion			
	2 Hour, 25.0±0.1 °C.	4 Hour, 25.0±0.1 °C.	4 Hour, 40.0±0.1 °C.	4 Hour, 100 °C.
	Pound per inch	Pound per inch	Pound per inch	Pound per inch
1A*	20	20	19	17
2A	18	18	20	19
3A	20	19	20	18
4A	20	21	18	18
5A	20	20	20	18
6B	20	21	20	19
7B	20	18	18	19
8B	18	21	20	16
9B	20	19	20	20
10B	20	19	20	18
11C	19	18	18	19
12C	20	20	18	20
13C	19	20	21	16
14C	20	18	20	20
15C	19	18	20	20
16D	18	18	20	16
17D	19	20	18	16
18D	18	20	19	17
19D	20	18	20	20
20D	18	18	19	18
Mean	19	19	19	18
Deviation	1	1	1	1

*Letter designates parallel determinations.

TABLE 35. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE ON THE BREAKING STRENGTH OF THE WET WARP OF CELLULOSE-ACETATE RAYON

Determination Number	Breaking strength of wet warp of fabric		
	Normality of bleaching bath		
	Initial	0.0970	0.1040	0.1026
	Final, of blank	0.0955	0.0975	0.0802
	Standardization	A	B	C
	Period and temperature of immersion		
	Hour °C.	Hour °C.	Hour °C.
	2 25.0±0.1	4 25.0±0.1	4 40.0±0.1
	Pound per inch	Pound per inch	Pound per inch
1A*	20	18	13
2A	18	21	14
3A	20	18	13
4A	20	21	13
5A	19	18	16
6B	18	16	14
7B	20	20	16
8B	18	20	18
9B	17	18	14
10B	21	18	15
11C	21	16	14
12C	19	21	14
13C	19	18	14
14C	18	19	14
15C	19	20	14
16D	19	20	14
17D	19	18	14
18D	20	19	16
19D	21	17	14
20D	19	18	13
Mean	19	19	14
Deviation	1	1	1

*Letter designates parallel determinations.

TABLE 36. EFFECT OF FIFTY-VOLUME BATHS OF SODIUM N-CHLORO-p-TOLUENESULFONAMIDE IN FOUR HOURS ON THE BREAKING STRENGTH OF THE WET WARP OF CELLULOSE-ACETATE RAYON

Determination	Breaking strength of wet warp of fabric
	Normality of bleaching bath
	Initial: 0.00965
	Final, of blank: 0.00856
	Standardization: D
	Temperature of immersion, °C.
	100
Number	Pound per inch
1A*	17
2A	17
3A	17
4A	17
5A	18
6B	14
7B	16
8B	17
9B	16
10B	14
11C	16
12C	18
13C	14
14C	16
15C	18
16D	16
17D	16
18D	18
19D	14
20D	16
Mean	16
Deviation	1

*Letter designates parallel determinations.

TABLE 36. (Continued)

Determination	Breaking strength of wet warp of fabric		
	Normality of bleaching bath		
	Initial	0.1011	0.1012	0.0994
	Final, of blank	0.1014	0.1012	0.0912
	Standardization	E	F	G
	Temperature of immersion, °C.		
	25.0 ± 0.1	40.0 ± 0.1	100
Number	Pound per inch	Pound per inch	Pound per inch
1A*	18	18	10
2A	18	18	8
3A	18	20	9
4A	18	18	10
5A	18	18	9
6B	19	19	7
7B	18	16	9
8B	18	19	8
9B	19	18	8
10B	18	18	8
11C	19	21	8
12C	18	21	8
13C	18	17	8
14C	18	20	8
15C	17	17	8
16D	17	18	8
17D	20	18	9
18D	18	18	9
19D	18	20	8
20D	18	18	8
Mean	18	18	8
Deviation	0	1	0

*Letter designates parallel determinations.

TABLE 36. (Continued)

Determination Number	Breaking strength of wet warp of fabric		
	Normality of bleaching bath		
	Initial: 0.1906	0.1904	0.1820
	Final, of blank: 0.1905	0.1905	lost
	Standardization: H	I	J
	Temperature of immersion, °C.		
	25.0 ± 0.1	40.0 ± 0.1	100
	Pound per inch	Pound per inch	Pound per inch
1A*	21	20	**
2A	18	19	**
3A	18	18	**
4A	20	21	**
5A	20	19	**
6B	18	21	**
7B	21	21	**
8B	18	19	**
9B	18	21	**
10B	19	20	**
11C	18	19	**
12C	21	21	**
13C	20	21	**
14C	18	21	**
15C	20	21	**
16D	19	19	**
17D	18	19	**
18D	18	19	**
19D	18	20	**
20D	21	21	
Mean	19	20	
Deviation	1	1	

*Letter designates parallel determinations.

**Disintegrated.

TABLE 36. (Continued)

Determination Number	Breaking strength of wet warp of fabric		
	Normality of bleaching bath		
	Initial	0.3146	0.3148	0.3201
	Final, of blank	0.3149	0.3152	0.2872
	Standardization	K	L	M
	Temperature of immersion, °C.		
	25.0 ± 0.1	40.0 ± 0.1	100
	Pound per inch	Pound per inch	Pound per inch
1A*	19	18	**
2A	18	20	**
3A	19	20	**
4A	20	19	**
5A	19	19	**
6B	19	14	**
7B	18	17	**
8B	18	20	**
9B	19	17	**
10B	18	17	**
11C	19	21	
12C	21	19	
13C	18	19	
14C	20	21	
15C	21	21	
16D	18	19	
17D	18	18	
18D	18	19	
19D	19	18	
20D	20	20	
Mean	19	19	
Deviation	1	1	

*Letter designates parallel determinations.

**Disintegrated.

TABLE 37. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE AND SODIUM N-CHLORO-p-TOLUENESULFONAMIDE ON THE COPPER NUMBER OF CELLULOSE-ACETATE RAYON

Determination	Bleaching bath				Temperature	Time	Fabric		Barometric pressure	Potassium permanganate	Copper number
							Rectangle	Weight			
Number	Salt	Initial normality	Final normality of blank	Standardization	°C.	Hour	Number	Gram	Millimeter of mercury	Milliliter* of 0.0511N	
1	None	0.0000			25.0 ± 0.1	2	F71	2.2932	747.0	20.37**	2.87
2							F72	2.2868		21.27	3.01
3							F74	2.2928		21.24	3.00
4							F75	2.2796		21.35	3.03
5							F76	2.3075		23.12	3.24**
Mean											2.98
Deviation											0.05
1	None	0.0000			25.0 ± 0.1	4	F83	2.2754	747.0	21.12	3.00
2							F84	2.2766		21.03	2.99
3							F85	2.2865		20.87	2.95
4							F86	2.2981		21.69	3.05
5							F88	2.2420		20.07	2.90
Mean											2.98
Deviation											0.04

*Blank: 0.09 ml. permanganate.

**Rejected observation.

TABLE 37. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Fabric: Weight Gram	Barometric pressure Millimeter of mercury	Potassium permanganate Milliliter* of 0.0511N	Copper number
1	None	0.0000			40.0 ± 0.1	4	F94	2.2211	738.6	20.67	3.01
2							F96	2.2384		20.79	3.00
3							F97	2.2496		21.47	3.09
4							F98	2.2364		21.27	3.08
5							F99	2.2432		21.52	3.10
Mean											3.06
Deviation											0.04
1	Calcium hypochlorite	0.0970	0.0955	A	25.0 ± 0.1	2	F115	2.2170	738.6	23.08	3.37
2							F117	2.2034		22.72	3.34
3							F118	2.1913		21.87	3.23
4							F113	2.2085		20.57	3.01
5							F114	2.2126		21.67	3.17
Mean											3.22
Deviation											0.11

TABLE 37. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Fabric: Weight Gram	Barometric pressure: Millimeter of mercury	Potassium permanganate: Milliliter* of 0.0511N	Copper number
1	Calcium hypochlorite	0.1040	0.0975	B	25.0 ± 0.1	4	F122	2.2119	741.5	27.01	3.95
2							F124	2.2048		26.34	3.87
3							F125	2.2217		27.16	3.96
4							F126	2.2146		26.81	3.92
5							F127	2.1902		26.21	3.87
Mean											3.91
Deviation											0.04
1	Calcium hypochlorite	0.1026	0.0802	C	40.0 ± 0.1	4	E34	0.9587	741.5	15.47**	5.21
2							E37	1.0000		18.00	5.82
3							E41	0.9574		16.18	5.46
4							E44	0.9633		17.53	5.88
5							E48	0.9493		16.18	5.51
Mean											5.58
Deviation											0.22

TABLE 37. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Root-angle Number	Fabric: Weight Gram	Barometric pressure: Millimeter of mercury	Potassium permanganate: Milliliter* of 0.0511N	Copper number
	Sodium N-chloro-p-toluenesulfonamide										
1		0.1012	0.1012	F	40.0 ± 0.1	4	F140	2.2339	746.3	17.66	2.55
2							F141	2.2390		18.06	2.61
3							F142	2.2315		21.15	3.07
4							F143	2.2457		20.45	2.95
5							F145	2.2362		19.30	2.79
Mean											2.79
Deviation											0.17
	Sodium N-chloro-p-toluenesulfonamide										
1		0.1904	0.1905	I	40.0 ± 0.1	4	F152	2.2421	746.0	17.26	2.49
2							F153	2.2391		17.36	2.51
3							F154	2.2354		19.06	2.76
4							F155	2.2314		18.75	2.72
5							F156	2.2365		19.80	2.86
Mean											2.67
Deviation											0.13

TABLE 37. (Concluded)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Fabric: Weight Gram	Barometric pressure: Millimeter of mercury	Potassium permanganate: Milliliter* of 0.0511N	Copper number
1	Sodium N-chloro-p-toluenesulfonamide	0.3148	0.3152	L	40.0 ± 0.1	4	F169	2.2447	730.7	18.66	2.69
2							F170	2.2449		19.15	2.76
3							F171	2.2516		18.64	2.68
4							F173	2.2229		17.66	2.57
5							F174	2.2424		18.20	2.62
Mean											2.66
Deviation											0.06

TABLE 38. EFFECT OF FIFTY-VOLUME BATHS OF CALCIUM HYPOCHLORITE AND SODIUM N-CHLORO-p-TOLUENESULFONAMIDE ON THE WEIGHT OF CELLULOSE-ACETATE RAYON

Determination	Bleaching bath				Temperature	Time	Fabric			
							Rectangle	Weight		
								Original	Residual	
Number	Salt	Initial normality	Final normality of blank	Standardization	°C.	Hour	Number	Gram	Gram	Percentage
1	None	0.0000	0.0000		25.0 ± 0.1	2	E1	2.2803	2.2739	99.72
2							E2	2.2905	2.2843	99.73
3							E3	2.2862	2.2802	99.74
4							E4	2.2725	2.2665	99.74
5							E5	2.2738	2.2684	99.76
Mean										99.74
Deviation										0.01
1	None	0.0000	0.0000		25.0 ± 0.1	4	E6	2.2458	2.2412	99.80
2							E7	2.2418	2.2355	99.72
3							E8	2.2505	2.2456	99.78
4							E9	2.2385	2.2327	99.74
5							E10	2.2590	2.2524	99.71
Mean										99.75
Deviation										0.03

TABLE 38. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Weight: Original Gram	Residual Gram	Residual Percentage
1	None	0.0000	0.0000		40.0 ± 0.1	4	E11	2.2457	2.2380	99.66
2							E12	2.2314	2.2226	99.61
3							E13	2.2284	2.2195	99.60
4							E14	2.2387	2.2305	99.63
5							E15	2.2652	2.2570	99.64
Mean										99.63
Deviation										0.02
1	Calcium hypochlorite	0.0970	0.0955	A	25.0 ± 0.1	2	M11	2.2053	2.2002	99.77
2							M17	2.1832	2.1779	99.76
3							M23	2.2004	2.1955	99.78
4							M29	2.1896	2.1845	99.77
5							M35	2.2427	2.2366	99.73
Mean										99.76
Deviation										0.01
1	Calcium hypochlorite	0.1040	0.0975	B	25.0 ± 0.1	4	E16	2.2399	2.2355	99.80
2							E17	2.2527	2.2475	99.77
3							E18	2.2501	2.2454	99.79
4							E19	2.2685	2.2634	99.78
5							E20	2.2695	2.2642	99.77
M										
Mean										99.78
Deviation										0.01

TABLE 38. (Continued)

Determination Number	Bleaching bath: Salt	Initial normality	Final normality of blank	Standardization	Temperature °C.	Time Hour	Fabric: Rectangle Number	Weight: Original Gram	Residual Gram	Residual Percentage
1	Calcium hypochlorite	0.1026	0.0802	C	40.0 ± 0.1	4	E21	2.2624	2.2346	98.77
2							E22	2.2749	2.2481	98.82
3							E23	2.2625	2.2359	98.82
4							E24	2.2411	2.2146	98.82
5							E25	2.2495	2.2241	98.87
Mean										98.82
Deviation										0.02
1	Sodium N-chloro-p-toluenesulfonamide	0.1012	0.1012	F	40.0 ± 0.1	4	F38	2.2725	2.2659	99.71
2							F45	2.2864	2.2797	99.70
3							F52	2.2803	2.2746	99.75
4							F59	2.2867	2.2803	99.72
5							F66	2.2740	2.2682	99.74
Mean										99.72
Deviation										0.02

TABLE 38. (Concluded)

Determination	Bleaching bath				Temperature	Time	Fabric			
							Rectangle	Weight		
								Original	Residual	
Number	Salt	Initial normality	Final normality of blank	Standardization	°C.	Hour	Number	Gram	Gram	Percentage
	Sodium N-chloro-p-toluenesulfonamide									
1		0.1904	0.1905	I	40.0 ± 0.1	4	F3	2.2818	2.2818	100.00
2							F10	2.2851	2.2855	100.02
3							F17	2.3010	2.3008	99.99
4							F24	2.2696	2.2693	99.99
5							F31	2.3119	2.3115	99.98
Mean										100.00
Deviation										0.01
	Sodium N-chloro-p-toluenesulfonamide									
1		0.3148	0.3152	L	40.0 ± 0.1	4	F73	2.2977	2.2944	99.86
2							F80	2.3081	2.3052	99.87
3							F87	2.2403	2.2367	99.84
4							F95	2.2229	2.2214	99.93
5							F102	2.2485	2.2472	99.94
Mean										99.89
Deviation										0.04

TABLE 39. EFFECT OF STEAM IN 1.5 HOURS ON THE ACETYL OF CELLULOSE-ACETATE RAYON

Determination Number	Steam: Gauge pressure: Pound per square inch	Steam: Temperature °C.	Fabric: Rectangle Number	Fabric: Weight Gram	Hydrochloric acid: Milliliter* of 0.1010N	Acetyl: Percentage
1	-	Room	F175	2.2352	43.57	38.36
2			F176	2.2395	43.57	38.28
3			F177	2.2435	42.97	38.33
4			F178	2.2308	43.77	38.39
Mean						38.34
Deviation						0.04
1A**	10 ± 1	115.2	F209	2.2068	46.14	38.34
2A			F210	2.2152	45.43	38.34
3B			F211	2.2167	45.84	38.23***
4B			F212	2.2333	44.02	38.30
Mean						38.33
Deviation						0.02
1A	30 ± 1	134.5	F204	2.2171	46.26	38.14
2A			F205	2.2138	47.85	37.89
3B			F206	2.2099	47.37	38.05
4B			F208	2.2234	46.44	38.00
Mean						38.02
Deviation						0.08
1A	60 ± 1	153.0	F195	2.1989	50.47	37.63
2A			F196	2.2214	48.56	37.62
3B			F192	2.2199	47.42	37.87**
4B			F194	2.2009	50.23	37.64
Mean						37.63
Deviation						0.01

*Original volume of alkali: 25.00 ml. 0.9728 N sodium hydroxide.
**Letter designates parallel determinations.
***Rejected observation.

TABLE 40. EFFECT OF STEAM IN 1.5 HOURS ON THE BREAKING STRENGTH OF THE WET WARP OF THE FABRICS

Determination	Breaking strength of wet warp of fabric							
	Gauge pressure and temperature							
	Pound per square inch	°C.	Pound per square inch	°C.	Pound per square inch	°C.	Pound per square inch	°C.
	-	Room	10±1	115.2	30±1	134.5	60±1	153.0
Number	Pound per inch		Pound per inch		Pound per inch		Pound per inch	
	a. Cotton cellulose, unbleached							
1	64		60A*		49A		18A	
2	70		69A		51A		19A	
3	68		55A**		44C		18A	
4	65		66A		45C		19A	
5	72		63A		45C		18A	
6	70		63B		43B		18B	
7	63		63B		48B		16B	
8	57		68B		49B		14B	
9	72		67B		47B		16B	
10	70		64B		32B**		16B	
Mean	67		65		47		17	
Deviation	4		2		2		1	
Percentage of wet strength at room temperature	100		97		70		25	

*Letter designates parallel determinations.

**Rejected observation.

TABLE 40. (Continued)

Determination	Breaking strength of wet warp of fabric							
	Gauge pressure and temperature							
	Pound per square inch	°C.	Pound per square inch	°C.	Pound per square inch	°C.	Pound per square inch	°C.
	-	Room	10±1	115.2	30±1	134.5	60±1	153.0
Number	Pound per inch		Pound per inch		Pound per inch		Pound per inch	
			b. Cotton cellulose, bleached					
1	60		67A*		57A		34A	
2	70		73A		56A		35A	
3	70		69A		60A		36A	
4	56		67A		58A		36A	
5	69		70A		57A		34A	
6	70		72B		58B		37B	
7	65		63B		58B		45B**	
8	74		59B		60B		34B	
9	60		60B		55B		34B	
10	70		60B		56B		36B	
Mean	66		66		58		35	
Deviation	5		4		1		1	
Percentage of wet strength at room temperature	100		100		88		53	

TABLE 40. (Continued)

Determination	Breaking strength of wet warp of fabric							
	Gauge pressure and temperature							
	Pound per square inch	°C.	Pound per square inch	°C.	Pound per square inch	°C.	Pound per square inch	°C.
	-	Room	30±1	134.5	45±1	144.6	60±1	153.0
Number	Pound per inch		Pound per inch		Pound per inch		Pound per inch	
			c. Regenerated-cellulose rayon					
1	25		26A*		26A		21A	
2	26		28A		24A		21B	
3	25		28A		25A		20A	
4	23		27A		25A		21A	
5	26		23A		21A		19A	
6	26		26B		22B		19B	
7	28		30B		23B		20B	
8	26		27B		23B		18B	
9	26		26B		25B		19B	
10	26		27B		23B		19B	
Mean	26		27		24		20	
Deviation	1		1		1		1	
Percentage of wet strength at room temperature	100		104		92		77	

TABLE 40. (Concluded)

Determination	Breaking strength of wet warp of fabric									
	Gauge pressure and temperature									
	Pound per square inch	°C.	Pound per square inch			°C.	Pound per square inch		°C.	Pound per square inch	°C.
	-	Room	10±1			115.2	30±1		134.5	60±1	153.0
Number	Pound per inch		Pound per inch				Pound per inch			Pound per inch	
			d. Cellulose-acetate rayon								
1	19		10A*	19B	12C	16D	8A			5A	
2	18		10A	18B	10C	12D	8A			6A	
3	18		14A	21B	10C	13D	8A			6A	
4	19		16A	23B	10C	13D	7A			6A	
5	21		21A	23B	12C	13D	7A			6A	
6	20				10C	16D	8B			6B	
7	19				10C	16D	8B			6B	
8	20				10C	18D	8B			5B	
9	18				10C	14D	7B			6B	
10	21				10C	23D	8B			6B	
Mean	19		14	21	10	15	8			6	
Deviation	1		3	2	0	2	0			0	
Percentage of wet strength at room temperature	100		74	111	53	79	42			32	

TABLE 41. EFFECT OF STEAM IN 1.5 HOURS ON THE COPPER NUMBER OF THE FABRICS

Determination Number	Steam: Gauge pressure, Pound per square inch	Steam: Temperature, °C.	Fabric: Rectangle Number	Fabric: Weight, Gram	Barometric pressure, Millimeter of mercury	Potassium permanganate, Milliliter* of 0.0511N	Copper number
	a. Cotton cellulose, unbleached						
1		Room	S7	2.5969	741.8	2.07	0.25
2			S9	2.6846		2.18	0.25
3			S10	2.7829		2.06	0.23
4			S11	2.7340		2.21	0.25
Mean							0.24
Deviation							0.01
1A**	10±1	115.2	S29	2.5082	738.0	2.31	0.29
2A			S30	2.5498		2.31	0.28
3B			S31	2.4522		2.71	0.35***
4B			S32	2.4217		2.16	0.28
Mean							0.28
Deviation							0.00
1A	30±1	134.5	S19	2.3761	735.5	7.43	1.00***
2B			S21	2.6274		9.42	1.15
3B			S22	2.5698		9.04	1.13
4C			S60	2.6425		10.19	1.24
Mean							1.17
Deviation							0.04
1A	60±1	153.0	S14	2.7513	720.8	26.18	3.08
2A			S15	2.4234		25.22	3.37
3B			S16	2.4128		26.57	3.57
4B			S17	2.4188		25.30	3.12
Mean							3.28
Deviation							0.18

*Blank: 0.09 ml. permanganate.
**Letter designates parallel determinations.
***Rejected observation.

TABLE 41. (Continued)

Determination Number	Steam: Gauge pressure, Pound per square inch	Steam: Temperature, °C.	Fabric: Rectangle Number	Fabric: Weight, Gram	Barometric pressure, Millimeter of mercury	Potassium permanganate, Milliliter* of 0.0511N	Copper number
		b. Cotton cellulose, bleached					
1		Room	S7	2.3325	741.8	0.92	0.12
2			S9	2.5453		0.97	0.11
3			S10	2.3726		0.90	0.11
4			S11	2.3372		0.95	0.12
Mean							0.12
Deviation							0.00
1A**	10±1	115.2	S29	2.3975	738.0	1.20	0.15
2A			S30	2.3938		1.29	0.16
3B			S31	2.4049		1.02	0.13
4B			S32	2.3597		1.04	0.13
Mean							0.14
Deviation							0.01
1A	30±1	134.5	S19	2.3899	735.5	2.03	0.26
2A			S20	2.3913		2.13	0.28
3B			S21	2.3391		1.91	0.25
4B			S22	2.3151		2.02	0.27
Mean							0.26
Deviation							0.01
1A	60±1	153.0	S16	2.3148	720.8	7.83	1.09
2A			S17	2.3011		8.38	1.17
3B			S12	2.3363		6.93	0.95
4B			S60	2.2677		7.01	0.99
Mean							1.05
Deviation							0.08

TABLE 41. (Continued)

Determination Number	Steam: Gauge pressure, Pound per square inch	Steam: Temperature, °C.	Fabric: Rectangle Number	Fabric: Weight, Gram	Barometric pressure, Millimeter of mercury	Potassium permanganate, Milliliter* of 0.0511N	Copper number
		c. Regenerated-cellulose rayon					
1		Room	S4	2.2149	742.8	6.83	0.99
2			S5	2.1885		7.73	1.13
3			S6	2.2173		7.58	1.10
4			S7	2.1816		6.95	1.02
Mean							1.06
Deviation							0.06
1A**	30±1	134.5	S19	2.1040	739.8	11.12	1.70
2A			S20	2.1174		11.19	1.70
3B			S21	2.1097		9.74	1.49
4B			S22	2.1152		10.44	1.59
Mean							1.62
Deviation							0.08
1A	45±1	144.6	S14	2.1170	738.0	18.62	2.84
2A			S15	2.1338		17.72	2.68
Mean							2.76
Deviation							0.08
1A	60±1	153.0	S59	2.1955	720.8	32.30	4.77***
2A			S60	2.1834		27.57	4.09
3B			S51	2.1758		27.37	4.07
4B			S52	2.1735		25.17	3.74
Mean							3.97
Deviation							0.15

TABLE 41. (Concluded)

Determination Number	Steam: Gauge pressure: Pound per square inch	Steam: Temperature: °C.	Fabric: Rectangle Number	Fabric: Weight: Gram	Barometric pressure: Millimeter of mercury	Potassium permanganate: Milliliter* of 0.0511N	Copper number
		d. Cellulose-acetate rayon					
1		Room	F180	2.2330	742.8	20.34	2.95
2			F181	2.2308		20.84	3.02
3			F182	2.2342		20.42	2.96
4			F184	2.2116		19.81	2.90
Mean							2.96
Deviation							0.03
1A	10±1	115.2	F213	2.2205	735.5	21.23	3.09
2A			F215	2.2240		23.99	3.49***
3B			F216	2.2236		22.03	3.21
4B			F217	2.2216		21.01	3.06
Mean							3.12
Deviation							0.06
1A	30±1	134.5	F199	2.2138	739.8	26.02	3.80
2A			F201	2.2130		25.88	3.71***
3B			F202	2.2205		26.75	3.90
4B			F203	2.2079		26.25	3.85
Mean							3.85
Deviation							0.03
1A**	60±1	153.0	F197	2.2159	732.0	25.88	3.78
2A			F198	2.2124		24.68	3.61***
3B			F188	2.2186		25.83	3.77
4B			F189	2.2249		25.78	3.75
Mean							3.77
Deviation							0.01

TABLE 42. EFFECT OF STEAM IN 1.6 HOURS ON THE WEIGHT OF THE FABRICS

Determination Number	Steam: Gauge pressure, Pound per square inch	Steam: Temperature, °C.	Fabric: Rectangle Number	Fabric: Weight: Original, Gram	Fabric: Weight: Residual, Gram	Fabric: Weight: Residual, Percentage
	a. Cotton cellulose, unbleached					
1	-	Room	T2	5.2290	5.0562	96.70
2			T4	5.2689	5.1036	96.86*
3			T6	5.0738	4.9101	96.77
4			T8	5.3068	5.1321	96.71
Mean						96.73
Deviation						0.03
1A**	10±1	115.2	S34	2.5525	2.4818	97.23
2A			S35	2.4416	2.3686	97.01*
3B			S36	2.4749	2.4056	97.20
4B			S37	2.5537	2.4823	97.20
Mean						97.21
Deviation						0.01
1A	30±1	134.5	S24	2.7398	2.6025	94.99*
2B			S26	2.5122	2.3736	94.48
3B			S27	2.4429	2.3066	94.42
4C			S12	2.7798	2.6234	94.37
Mean						94.42
Deviation						0.04
1A	60±1	153.0	S3	2.4979	2.3028	92.19
2A			S8	2.6405	2.4354	92.23
3B			S13	2.6565	2.4562	92.46
4B			S18	2.4454	2.2592	92.39
Mean						92.32
Deviation						0.11

*Rejected observation.
**Letter designates parallel determinations.

TABLE 42. (Continued)

Determination	Steam		Fabric			
	Gauge pressure	Temperature	Rectangle	Weight		
				Original	Residual	
Number	Pound per square inch	°C.	Number	Gram	Gram	Percentage
		b. Cotton cellulose, bleached				
1	-	Room	T22	4.7011	4.6923	99.81
2			T24	4.7168	4.7067	99.79
3			T26	4.6851	4.6748	99.78
4			T28	4.5373	4.5297	99.83
Mean Deviation						99.80 0.02
1A**	10±1	115.2	S34	2.3329	2.3332	100.01*
2A			S35	2.3597	2.3607	100.04
3B			S36	2.3565	2.3578	100.06
4B			S37	2.4083	2.4095	100.05
Mean Deviation						100.05 0.01
1A	30±1	134.5	S24	2.3808	2.3784	99.90
2A			S25	2.3684	2.3680	99.98
3B			S26	2.3752	2.3748	99.98
4B			S27	2.3108	2.3050	99.75*
Mean Deviation						99.95 0.04
1A	60±1	153.0	S13	2.3862	2.3751	99.53
2A			S18	2.3308	2.3212	99.59
3B			S57	2.2631	2.2568	99.72*
4B			S59	2.2896	2.2803	99.59
Mean Deviation						99.57 0.03

TABLE 42. (Continued)

Determination Number	Steam: Gauge pressure (Pound per square inch)	Steam: Temperature (°C.)	Fabric: Rectangle Number	Fabric: Weight Original (Gram)	Fabric: Weight Residual (Gram)	Fabric: Weight Residual Percentage
	c. Regenerated-cellulose rayon					
1	-	Room	T2	4.5452	4.5311	99.73
2			T4	4.5935	4.5812	99.73
3			T6	4.5043	4.4864	99.60*
4			T8	4.4527	4.4420	99.76
Mean						99.74
Deviation						0.01
1A**	30±1	134.5	S24	2.1053	2.0983	99.67
2A			S25	2.1196	2.1140	99.74
3B			S26	2.1079	2.0979	99.53*
4B			S27	2.1293	2.1222	99.67
Mean						99.69
Deviation						0.03
1A	45±1	144.6	S30	2.1374	2.1345	99.86
2A			S31	2.1389	2.1344	99.79
Mean						99.82
Deviation						0.04
1A	60±1	153.0	S56	2.2140	2.1968	99.22
2A			S57	2.2043	2.1892	99.31
3B			S54	2.1421	2.1198	98.96*
4B			S55	2.1636	2.1487	99.31
Mean						99.28
Deviation						0.04

TABLE 42. (Concluded)

Determination	Steam		Fabric			
	Gauge pressure	Temperature	Rectangle	Weight		
				Original	Residual	
Number	Pound per square inch	°C.	Number	Gram	Gram	Percentage
		d. Cellulose-acetate rayon				
1	-	Room	F109	2.2423	2.2334	99.60
2			F116	2.2330	2.2243	99.61
3			F123	2.2067	2.1995	99.67*
4			F130	2.2022	2.1939	99.62
Mean						99.61
Deviation						0.01
1A**	10±1	115.2	F207	2.2184	2.2126	99.74
2A			F214	2.2284	2.2229	99.75
3B			F221	2.2254	2.2196	99.74
4B			F228	2.2112	2.2076	99.84*
Mean						99.74
Deviation						0.00
1A	30±1	134.5	F179	2.2282	2.2170	99.50
2A			F183	2.2043	2.1958	99.61
3B			F186	2.2221	2.2124	99.56
4B			F193	2.1892	2.1772	99.45
Mean						99.53
Deviation						0.06
1A	60±1	153.0	F158	2.2340	2.2146	99.13*
2A			F165	2.2183	2.1976	99.07
3B			F172	2.2365	2.2162	99.09
4B			F137	2.2385	2.2176	99.07
Mean						99.08
Deviation						0.01