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PUBLICATIONS
ON
FIBER STRUCTURE
AND
INDUSTRIAL UTILIZATION OF WASTE LAND PRODUCTS

CONTENTS

- I. Insulating board, pressboard, maizolith, paper, and other cellulose products from farm wastes
- II. Utilization of sweet potato starch sizing in textiles and paper
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- V. Electrometric and colorimetric pH and other physical chemical test methods

PUBLICATIONS ON FIBER STRUCTURE
AND
INDUSTRIAL UTILIZATION OF WASTE LAND PRODUCTS

INTRODUCTION

This Letter Circular is prepared as a ready reference to the publications of the National Bureau of Standards on the industrial utilization of farm wastes; on the physical and chemical structure of the fibers; on the use of sweet potato starch sizing; on some test methods developed for analysis of specific products from farm waste fibers; and on electrometric and colorimetric pH and other physical chemical test methods. Other articles, when published, will be listed in an appendix. Several related publications from other laboratories are also listed.

The first section deals with cost of production, collection, and transportation of farm wastes and their present uses, and the development of semicommercial processes and equipment suitable for the industrial utilization of cornstalks, straws, peanut shells, cottonseed hulls, bagasse, etc., millions of tons of which are produced annually in America. In particular the articles on insulating board, pressed board, binder's board, paper, maizolith, and elimination of obnoxious odors in the kraft process are abstracted in detail. A number of reports giving extensive unpublished laboratory, field, and semicommercial data on production, collection, and transportation of raw materials; on competitive products and markets; and on the above processes and materials are available for inspection.

The second section deals with laboratory, semicommercial, and mill scale studies of the properties of sweet potato starch sizing and its utilization in the manufacture of textiles and paper.

The third section deals with laboratory methods of isolating and purifying xylose sugar; a semicommercial process and plant for the manufacture of xylose; and suggested uses for this pentose sugar which can now be considered economically available. An extensive detailed report on the data obtained in the semicommercial manufacture of xylose is in the Bureau's files for inspection. Another report on the laboratory purification of xylose is on hand for distribution.

The fourth section deals with various test methods for the analysis of plant fibers, extracts, and derivatives. Particular mention should be made of the methods of determination of aldose sugars, of pentosan derivatives, and of furfural. A mimeographed report on refining cottonseed oil on a small scale is available for distribution.

The fifth section deals with electrometric and colorimetric methods and equipment for measuring and controlling the pH values of paper, pulp, acids, and other fiber derivatives, transference numbers and contact potentials; pH adjustment and salt errors of indicators; aeration and stabilization of indicators and buffers; grounding and shielding of potentiometers and glass electrodes; and purification and tests of pH of water.

GENERAL INFORMATION

Some of these articles on fiber structure were printed in the regular series of publications of the Bureau and others in the various scientific and technical journals. Copies can usually be consulted at the leading libraries of the larger cities.

For ready reference and convenience in ordering the separate papers of the Bureau, they have been listed with the serial letter and number in one column, and the price in the second column. Where no price is noted, the separate paper is no longer obtainable. In some instances reprints are available upon request to the author until the supply is exhausted. A complete list of Bureau publications (Circular No. 24 and Supplement) is also generally available at the above libraries.

Where the price is noted, the publication may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The prices quoted are for delivery to addresses in the United States and its possessions, and to Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama. When remitting for delivery to countries other than the above, include in the remittance one-third of the total cost of publications to cover postage. Remittances should be made payable to the "Superintendent of Documents, Government Printing Office, Washington, D. C." and sent to him with the order.

Serial letters are used to designate Bureau publications:

- RP = "Research Paper". These are reprints of articles appearing in the "Bureau of Standards Journal of Research" (BS J Research) and the "Journal of Research of the National Bureau of Standards" (J. Research NBS), the latter being the title of this periodical since July, 1934 (volume 13, number 1).
- M = "Miscellaneous Publication of the National Bureau of Standards".

Papers in other journals are listed as follows:

- Bul = "Bulletin". An official publication of Iowa State College, Ames, Iowa. Reprints may possibly be obtained upon request.
- * = Papers which have appeared in other scientific and technical journals, and mimeographed reports from the National Bureau of Standards. Reprints are still available in some cases and may be obtained gratis by writing the Fiber Structure Section, Organic and Fibrous Materials Division, National Bureau of Standards, Washington, D. C.

I. INSULATING BOARD, PRESSBOARD, PAPER, MAIZOLITH, AND OTHER CELLULOSE PRODUCTS FROM FARM WASTES.

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Kellogg, E.H. Shaw, M.B. Bicking, G.W.	Seed flax straw as papermaking material. Paper Trade J. (5), 77, 42 (1923)
			Owing to the immense quantities of seed flax available, most of which is at present wasted, this material has attracted considerable attention as a source of papermaking fiber. An investigation of its use for this purpose was made, using both the whole straw and the tow. The material was pulped by the sulphate process. Pulping tests made in the experimental mill were repeated in a commercial mill to obtain reliable cost data. The pulp obtained from both sources was made into paper on the experimental paper machine. The results indicate that there would be no difficulty in producing papers equal in quality to those obtained from wood. The cost data show, however, that at the present time both the initial and the conversion costs of flax straw would be greater than those of wood.
*		Shaw, M.B. Bicking, G.W. Rumsey, R.R.	Cotton stalks as papermaking materials. Paper Trade J. (5), 81, 50 (1925) World's Paper Trade Rev., 21 (84) 1634 (1925).
			Severe chemical treatment and long cooking time were required for pulping. The yield of fiber was good but the paper had poor quality, being suitable only for low grade wrapping or board. The results indicate that this material is not commercially useful for making paper, at least if the ordinary papermaking methods are used.
*		Markley, K.S.	Composition and economic possibilities of the cotton bur. J. Am. Soc. Agronomy (10) 20, 1097 (1928).
			Analyses of cotton burs show a cellulose content which might make them valuable as a source of pulp for paper, rayon, etc.

Three reports entitled "Wealth from land wastes", "Manufacture of insulating board", and "Feasibility of making alum at an insulating board plant", by G. M. Rommel for the National Bureau of Standards are also on file for reference.

The following four publications by G. M. Rommel are based on a field study made by him for the Department of Agriculture.

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Rommel, G.M.	Cellulose resources. I. The annual crop. Ind. Eng. Chem. <u>20</u> , 498 (1928) The article gives the yields of wood crops per acre in various regions, the cost of wood pulp laid down in consuming centers, and the economics of lumber mill wastes.
*		Rommel, G.M.	Cellulose resources. II. Cellulose from field crops. Ind. Eng. Chem. <u>20</u> , 587 (1928) The article gives data on the yields per acre of cellulose wastes from corn, small grain, flax, hemp, soybeans, etc., some analyses, and a discussion of the economics of their utilization.
*		Rommel, G.M.	Cellulose resources. III. Cost of field crops for cellulose. Ind. Eng. Chem. <u>20</u> , 716 (1928) The article deals with the cost of collection and transportation of farm wastes and bagasse and their bearing on the problem of their industrial utilization.
*		Rommel, G.M.	Farm Products in Industry. Book. R.D. Henkle Co., Inc., New York, 1928. This book presents a survey with extensive statistics of the normal amounts of farm products available and possible industrial utilization of various agricultural wastes. The subjects covered include livestock, cotton, forests, corn and small grains, rubber, oils, cellulose, and other items. The book contains a large number of illustrations and valuable tables taken from reports by the Bureau of Standards, Department of Commerce and U.S. Department of Agriculture, and by numerous private authors. Includes extensive bibliography.
*		Emley, W.E.	Insulating board from cornstalks. Paper Trade J., June 20, 1929. The availability of cornstalks as a waste land product offers possibilities for use in the manufacture of insulating board. The Bureau of Standards is cooperating with Iowa State College to erect and operate a semicommercial mill at Ames, Iowa.

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
M108	\$.05	Hartford, C.E.	Manufacture and properties of a cellulose product (maizolith) from cornstalks and corncobs. Misc. Pub. B.S. <u>108</u> , 10 pp. (1930). Maizolith is a bonelike substance made by cooking cornstalks or corncobs with caustic soda, washing the residue, beating it to a jell, and drying. The optimum conditions for the manufacture of maizolith are given with the properties and possible uses.
Bul 98		Sweeney, O.R. Arnold, L.K.	Cornstalks as an industrial raw material. Bulletin 98, Engineering Experiment Station, Iowa State College, Ames, Iowa; 48 pp.; June 18, 1930. A study of the commercial utilization of cornstalks giving chemical and physical characteristics, probable cost of raw material as well as its segregation in relation to other materials used in processing, the availability, cost of labor, and market for the finished products.
*		Lofton, R.E.	The physical structure of cornstalks and wheat straw. Paper Trade J., July 31, 1930. The physical and microscopical characteristics of cornstalks and wheat straw are given with drawings and photomicrographs.
Bul 100		Sweeney, O.R. Arnold, L.K.	The production of paper from cornstalks. Bulletin 100, Engineering Experiment Station, Iowa State College, Ames, Iowa, 78 pp.; Sept. 10, 1930. The results of researches undertaken at Iowa State College to determine the conditions under which it is possible to produce paper from cornstalks. Various processes have been used, and the physical characteristics, and yields of the paper produced are given and compared. Full bibliography.
M112	\$.10	Sweeney, O.R. Emley, W.E.	Manufacture of insulating board from cornstalks. Misc. Pub. BS <u>112</u> , 27 pp. (1930) The experimental work on the manufacture of insulating board from cornstalks, from the first laboratory experiments through to semicommercial production, is described. Details of ways of making pulp, types of equipment, test methods and specifications, and comparisons with similar products are given. Possible outlets as a commercial product are discussed.

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
Bul 102		Sweeney, O.R. Hartford, C.E. Richardson, R.W. Whittemore, E.R.	Experimental studies on the production of insulating board from cornstalks. Bulletin 102, Engineering Experiment Station, Iowa State College, Ames, Iowa, 64 pp. June 10, 1931.

This paper sets forth the results of researches undertaken at Iowa State College on conditions of treatments for preparing cornstalks for the manufacture of insulating board in the laboratory and on a semicommercial scale. Methods of preparation and testing are given together with various types of machinery suitable for this work.

*		Gordon, W.O. Creitz, E.E.	Elimination of obnoxious gases in the sulfate pulping process. Ind. and Eng. Chem. <u>26</u> , 565 (1934).
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The sulfate process is a comparatively new development in the pulp industry, and during the process of cooking wood chips in a solution of caustic soda and sodium sulfide, gases of offensive odor are formed. The mercaptans and alkyl sulfides can be removed from the noncondensable gases present in the relief vapors from the digesters by means of a solution of hypochlorite sprayed into the gas stream. The odor of the organic sulfur compounds in the distillate is removed, but the liquors are not rendered entirely odorless by this treatment. Other means are suggested for eliminating these obnoxious odors.

M147	\$.05	Weber, C.G. Shaw, M.B. O'Leary, M.J.	Papermaking quality of cornstalks. Misc. Pub. NBS <u>147</u> , 9 pp.; (1935). Study of the papermaking quality of cornstalks was made at the National Bureau of Standards to find the practical possibilities of utilizing this form of waste farm product as a raw material for paper. The cortex (prepared at the Ames Station) was pulped by both the kraft-sulphate and the caustic-soda processes. White writing papers and greaseproof specialties from bleached pulp, and also wrapping papers from unbleached pulp, were made. Higher costs due to low yields of pulp, based on the amount of cornstalks used, place them at a disadvantage with wood as a raw material at present, but may be counterbalanced by utilization of the pith, fine fibers, lignins, and pentosans in special fields.
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<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
M148	\$.05	Whittemore, E.R. Overman, C.B. Wingfield, B.	A separation of cornstalks into long fibers, piths and fines. Misc. Pub. NBS <u>148</u> , 8 pp. (1935) A mechanical wet method of separating cornstalks into (1) long fibers suitable for papermaking; (2) pith, a low density, highly heat insulating material; and (3) fine fibers. Yields and possible uses are given.
*		Whittemore, E.R. Overman, C.B. Wingfield, B.	Semi-commercial drying of pressboard by measuring its electrical resistance. Experimental study. Ind. and Eng. Chem. <u>27</u> , 831 (1935) A method for determining the minimum drying time of pressboard by measuring its electrical resistance.

II. UTILIZATION OF SWEET POTATO STARCH SIZING IN TEXTILES AND PAPER

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
RP623	\$.05	Schreiber, W.T. Geib, M.N.V. Moore, O.C.	Consistency of potato-starch size. BS J. Research <u>11</u> , 765 (1933) RP623.

Potato starch sizes are more or less unstable and the continuous heating and agitation in processing tend to cause a decrease in the consistency. Laboratory experiments show that the decrease in consistency of size is dependent upon the temperature of cooking, speed of agitation, and length of the cooking period, and may also be due to the catalytic action of liquefying enzymes of amylase which might be present in the starch. Although various treatments calculated to remove or destroy such enzymes failed to stabilize the size, the addition of a solution containing small quantities of dispersed lecithin and lanum to the sweet potato starch size materially retarded the decrease in consistency. The consistency can be greatly increased by washing the starch with certain simple solutions.

M150	\$.05	Weber, C.G. Shaw, M.B. O'Leary, M.J.	Suitability of sweet potato starch for the beater sizing of paper. Misc. Pub. BS 150. 7 pp. (1935).
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Cull sweet potatoes are a farm waste which may be utilized to produce starch. The paper section of the National Bureau of Standards made a semicommercial study of the comparative values of the starches from sweet potatoes, corn and cassava when used in beater sizing of book papers. The sweet potato starch was as good as the others in relation to strength and opacity of the papers, and better for retention of filler and closing the pores of the sheet to improve printing quality.

Schreiber, W.T. Sweet potato starch makes good sizing.
Textile World 85, 1884 (1935)

In mill scale use of sweet potato starch sizing on textiles it was found that the slashing, weaving, de-sizing, drying, and finishing operations, and the final cloth, were as satisfactory as they are with high grade Irish potato starch.

III. XYLOSE SUGAR FROM FARM WASTES

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Markley, K.S.	Composition of cottonseed hull bran. J. Am. Soc. Agron. 20, 102 (1928).
			Approximately 1,250,000 tons of cottonseed hull bran are produced annually in the United States and used as roughage in cattle feed. Analysis gives about 45 percent crude cellulose fiber, 21 percent lignin, 3 percent crude protein, 12 percent moisture, 1.2 percent ash, and 50 percent nitrogen free extract. The bran yields about 38 percent reducing sugar, chiefly xylose, when boiled with 2.5 percent HCl; and about 22 percent furfural with boiling 12 percent HCl. The bran is a good source of xylose.
*		Emley, W.E.	Xylose from cottonseed bran. Ind. Eng. Chem. News Letter, (21) 6, 3 (1928).
			A discussion of the availability and present use of peanut shells and cottonseed hull bran, analyses of their constituents, production of xylose and alpha cellulose therefrom, and possible markets for xylose.
RP152	\$.05	Hall, W.L. Slater, C.S. Acree, S.F.	Preliminary investigations upon two cellulosic wastes as sources for xylose. BS J. Research 4, 329 (1930); RP152.
			Technical methods to isolate and utilize the sugar, lignins and cellulose in cellulosic wastes were begun with a preliminary investigation of peanut hulls and cottonseed hull bran. Cottonseed hull bran proved to be an excellent source for the commercial production of the pentose sugar xylose. An improved method to produce xylose was developed. The process was run experimentally on a semicommercial scale so as to obtain xylose in 100-pound-per-day batches.
*		Emley, W.E.	Economic and industrial prospects of xylose. Chem. and Met. Eng. (5) 37, 283 (1930).
			Xylose is the first five-carbon sugar to be successfully produced on a semicommercial scale. A complete diagram giving a method of manufacture from 100 pound lots of air-dried cottonseed hull bran, as operated at Anniston, Alabama, is given.

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Schreiber, W.T. Geib, M.N.V. Wingfield, B. Acree, S.F.	Semicommercial production of xylose. Ind. and Eng. Chem. <u>22</u> , 497 (1930). Describes the operation of a semicommercial plant for recovering crystalline xylose from cottonseed hull bran. Includes pretreatment of the bran, extraction, and processing of the extract.
*		Emley, W.E.	Xylose. J. Chem. Education (10) <u>7</u> , 2403 (1930). A brief discussion of the production and possible uses of xylose.
*		Kline, G.M. Acree, S.F.	Consumption of nitric acid in the oxidation of xylose. Ind. and Eng. Chem. <u>22</u> , 975 (1930). A study of the loss of nitric acid versus sugar acid production. The effects of varying quantities of sugar and nitric acid, the concentration of the nitric acid, and the time of oxidation were determined.
*		Montgomery, J.P.	A new varnish from xylose and aniline. Ind. Eng. Chem. <u>23</u> , 761 (1931). By heating crude xylose and aniline in equimolecular proportions 10 minutes at 75-80° C one mole of water is evolved. An acetone soluble varnish is formed, which is not affected by water, alkalies or acids, except nitric acid. The estimated cost of the raw materials is \$1.00 per gallon of varnish.

IV. TEST METHODS FOR PENTOSANS AND OTHER FIBER DERIVATIVES

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Slater, C.S. Acree, S.F.	Method for estimating aldose sugars by titration with iodine and alkali. Ind. and Eng. Chem., Anal. Ed., <u>2</u> , 274 (1930). Under specified conditions aldose sugars react quantitatively with two equivalents of iodine and form two equivalents of hydriodic acid and one of aldonic acid. By neutralizing the sugar solutions and adding both standard iodine and alkali in several portions until a small excess of each is present, and allowing the mixture to stand about 15 minutes, the excess of iodine can be determined by standard thiosulfate and that of alkali by standard acid. The method has been applied in the analysis of xylose solutions made semicommercially from cottonseed hull bran.
*		Kline, G.M. Acree, S.F.	Estimation of aldose sugars by titrating with standard iodine and alkali: Modified method. Ind. and Eng. Chem., Anal. Ed., <u>2</u> , 413 (1930). Modified form of method previously described by Slater and Acree.
RP247	\$.10	Kline, G.M. Acree, S.F.	A study of the method for titrating aldose sugars with standard iodine and alkali. BS J. Research, <u>5</u> , 1063 (1930). RP247. Modification of the iodine-alkali method is recommended, based on the observation that alkali added slowly to a solution of aldose sugar containing a small amount of iodine will tend not to form sodium iodate, but to react very rapidly with the sugar. The slow addition of small portions of iodine and alkali alternately to the sugar solution results in the nearly quantitative utilization of the reagents in the oxidation of the sugar.
RP398	\$.05	Kline, G.M. Acree, S.F.	Volumetric determination of pentoses and pentosans. BS J. Research, <u>8</u> , 101 (1932) RP398. This paper describes a study of the standard and steam distillation procedures for the formation and separation of furfural from xylose; compares the volumetric bromine methods and the gravimetric thio-barbituric methods for determining furfural; and gives the effect of the various chemical substances and experimental conditions on the yield of furfural.

Series Price Author Title, Reference, Abstract

* Hughes, E.E.
 Acree, S.F. Quantitative estimation of
 furfural at 0° C with bro-
 mine.
 Ind. and Eng. Chem., Anal.
 Ed., 6, 123 (1934).

A method is given for the quantitative estimation of furfural by treating it 5 minutes at 0° C with an excess of 0.1 N potassium bromate plus potassium bromide in 3 percent hydrochloric acid, and determining the unused bromine with potassium iodide and 0.1 N thio-sulfate. At higher temperatures rapid consumption of one mole of bromine is followed by slower addition of a second mole of bromine. When determinations are made at variable room temperatures the large temperature co-efficient of the second reaction introduces considerable error. At 0° C, however, the addition of the second mole is inhibited and quantitative estimation is based upon the furfural combining with one mole of bromine.

* Hughes, E.E.
 Acree, S.F. Volumetric estimation of 5 -
 bromo- 2 - furoic acid with
 standard bromate.
 Ind. and Eng. Chem., Anal.
 Ed., 6, 292 (1934).

The bromination method applied to products of bromination and oxidation of furfural at 0° C and 21° C show that quantitative estimation of 5-bromo-2-furoic acid may be based upon the addition of two molecular equivalents of bromine at room temperature within a short time.

V. ELECTROMETRIC AND COLORIMETRIC pH AND OTHER PHYSICAL
CHEMICAL TEST METHODS

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Fawcett, E.H. Acree, S.F.	The problem of dilution in colorimetric H-ion measurements. I. Isohydric indicator methods for accurate determinations of pH in very dilute solutions. J. of Bact., (3) <u>17</u> , (1929). A study of buffer-dilution effects, changes of solution due to varying CO ₂ content, and variations caused by differences in the pH value of indicator solutions. The technic of the isohydric indicator method for more accurate pH determinations is given.
*		Acree, S.F. Fawcett, E.H.	The problem of dilution in colorimetric H-ion measurements. II. Use of isohydric indicators and superpure water for accurate measurement of hydrogen-ion concentrations and salt errors. Ind. and Eng. Chem., Anal. Ed. <u>2</u> , 78 (1930). Precision data are obtained by the adjustment of the pH of standard indicator solutions, the use of isohydric indicator methods, the use of superpure water (pH 7.0), and corrections applied for salt and protein errors.
RP302	\$.05	Fawcett, E.H. Acree, S.F.	Stabilization of boric acid buffers by aeration. BS J. Research, <u>6</u> (1931) RP302. The commonly used M/20 boric acid-M/20 potassium chloride-sodium hydroxide buffer mixtures can be stabilized by aerating them with ordinary fresh air until they reach a state of approximate equilibrium with atmospheric CO ₂ . The practical alkaline limit for air-stable M/20 boric acid buffers is about pH 9.4. The ionization constant of boric acid was calculated from the data and found to be about $K_a = 0.75 \times 10^{-9}$.

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Wehmhoff, B.L.	<p>Preliminary report on the determination of pH values and total acidity of paper. Address at annual meeting of Tech. Assn. Pulp and Paper Ind., Feb. 19, 1930, published by U. S. Gov't. Printing Office, and in Tech. Assn. Papers, p. 231, (May, 1930); p. 387, (May, 1931).</p> <p>The article covers cooperative research by the National Bureau of Standards, Bureau of Chemistry and Soils, and Government Printing Office on the measurement of the pH values and the total acidities of extracts of various types of paper. The electrometric and colorimetric pH values agree if the Acree-Fawcett isohydric indicator method is employed, but unadjusted indicators may give as much as 1.5 pH errors. Ordinary distilled and super-pure water give about the same results. The effects of methods of extraction, CO₂, type of indicator, and nature of the paper used are discussed in detail.</p>
RP369	\$.05	Acree, S.F. Murray, C.N.	<p>The use of saturated ammonium chloride in the elimination of contact potentials. BS J. Research <u>7</u>, 713 (1931) RP369.</p> <p>In the electrometric measurement of the concentrations of the various ions in plant extracts and other organic mixtures the potential of the junction between two electrode liquids is a source of error unless this contact potential is calculated, measured, or eliminated. The study of various concentrations of ammonium chloride up to saturated (5.66 N) gives a practical method for annulling the contact potential to within ± 1.0 mv.</p>
RP403	\$.05	Kline, G.M. Meacham, M.R. Acree, S. F.	<p>On elimination of liquid contact potentials with potassium chloride and ammonium chloride. BS J. Research <u>8</u>, 101 (1932), RP403.</p> <p>The Bjerrum method for correction for contact potential by use of an extrapolated value and the Loomis-Acree method of eliminating contact potential by the use of 4.1 N (saturated) potassium chloride solution are compared for the system HgCl-O.1 N KCl-x KCl-O.1 N HCl-H₂-Pt, and for systems in which organic acids and acid salts replace the highly ionized hydrochloric acid.</p>

<u>Series</u>	<u>Price</u>	<u>Author</u>	<u>Title, Reference, Abstract</u>
*		Scribner, B.W. Burton, J.O. Acree, S.F.	Proposed TAPPI official testing method for the hydrogen ion concentration (pH) of paper extracts. Printed as report by B. W. Scribner, Chairman of Paper Testing Committee, TAPPI, and published in Paper Trade Journal, p. 38, September 6, 1934.
			The methods of grinding and extracting the paper; the procedure for use of the Acree-Fawcett isohydric indicator tests; and simple calomel-quinhydrone electrode equipment are described, together with equations for calculating the pH values from emf data.
RP634	\$.05	Burton, J.O. Matheson, H. Acree, S.F.	A glass electrode-potentiometer system for the determination of the pH values of weakly buffered solutions such as natural and treated waters. BS J. Research, <u>12</u> , 67 (1934) RP634.
			By adding Varley shunts to a modification of the vacuum-tube potentiometer used by Partridge, keeping the grid attached to the circuit, and using a Thompson glass electrode, emf readings can be made within 0.1 to 2.0 mv on weakly buffered solutions and distilled water, and the pH values agree with those obtained by the isohydric-indicator method. This apparatus is also suitable for measuring the pH of solutions containing active oxidizing or reducing agents, such as chlorine or tannins, where the hydrogen and quinhydrone electrodes and indicator methods might fail.
*		Burton, J.O. Matheson, H. Acree, S.F.	Glass and other electrodes for measuring pH values of very dilute buffers and of distilled water. Ind. and Eng. Chem., Anal. Ed. <u>6</u> , 79 (1934).
			Illustrative pH data on dilute solutions, and wiring diagram of glass electrode-potentiometer system are given.

