Supplement to Bibliography on Molecular or Short Path Distillation

By S. B. DETWILER, JR.
U. S. REGIONAL SOYBEAN INDUSTRIAL PRODUCTS LABORATORY,[1] URBANA, ILLINOIS

INCREASED use of molecular distillation as a tool in organic research and industry has been responsible during the past 2 years for a considerable number of new articles and patents on the subject, and has made it desirable to prepare a supplement that will bring up to date a bibliography previously published in this Journal.[2]

Although at present molecular distillation is not a highly efficient process, thermally or from the standpoint of completeness of fractionation, it has been successfully employed for the purification of a large number of organic substances whose low vapor pressure or thermal instability makes difficult or impossible their distillation by ordinary methods. Perhaps the most important industrial application at present is in the preparation of vitamin concentrates from fish liver oils. A complete list of materials to which the technique has been applied might be classified under the following headings:

Vegetable, animal, and marine oils for edible and drying oil purposes
Solid fats
Petroleum oils and jellies
Long-chain hydrocarbons
Aromatic hydrocarbons and derivatives
Vegetable and fruit waxes
Carbohydrates
Vitamins
Sterols and sterol esters
Hormones
Saponins
Amino acids, polypeptides, and derivatives
Condensation polymers
Phthaloyl esters
Dyes
Drugs, including quinine and caffeine
Miscellaneous substances, including digitonin, cholanic acid, quebrachol, cinchocerotin, bile, and fungoid growths

The present supplement contains over a hundred citations on molecular distillation not listed in the earlier bibliography. In addition, several references on high-vacuum pumps, low-pressure gages, vacuum technique, etc., have been selected from the extensive literature on these subjects.

Where available, the Chemical Abstract (CA) reference has been included with each citation. Patents are indicated by an asterisk. In general, dates appended to patents include not only the application date but also the date of final approval or of publication.

The U. S. Patent Office, at Washington, is prepared to furnish copies of United States patents, when identified by patent numbers or dates of issue and names of the patentees, for ten cents each in cash. Photostat copies of foreign patents are furnished for twenty cents per sheet.

It is expected that in the near future, abstracts of the citations in this and the previous bibliography can be published in mimeographed form. Such abstracts, arranged in chronological order, with suitable cross-references and notations of corresponding foreign patents, etc., should be of considerable usefulness to those engaged in molecular distillation. Copies of the publication will be available, upon request, from the Regional Soybean Laboratory.

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[2] Oil and Soap, *16*, 2 (1939).

Molecular Stills and Applications

Almquist, H. J. J. Biol. Chem. *120*, 635 (1937). Further studies on the antihemorrhagic vitamin. (CA 31:8626.)

Almquist, H. J. Proc. Seventh World's Poultry Congr. and Expos. (Cleveland) 139 (1939). Properties of vitamin K.

Almquist, H. J., and Klose, A. A. J. Am. Chem. Soc. *61*, 745 (1939). The isolation of vitamin K as a choleic acid. (CA 33:3853.)

Almquist, H. J., and Klose, A. A. J. Am. Chem. Soc. *61*, 1610 (1939). Color reactions in vitamin K concentrates. (CA 33:5899.)

Almquist, H. J., and Klose, A. A. J. Am. Chem. Soc. *61*, 2557 (1939). Synthetic and natural antihemorrhagic compounds. (CA 33:8729.)

Almquist, H. J., and Klose, A. A. J. Biol. Chem. *130*, 791 (1939). A derivative of vitamin K1. (CA 34:97.)

*Bancroft, Frank E., and Associated Electrical Industries, Ltd. Brit. pat. 428,719. Improvements in vacuum distillation apparatus. Appl. Feb. 28, 1934; acc. May 17, 1935. (CA 29:6805.)

*Baxter, James G. (to Distillation Products, Inc.). U. S. pat. 2,169,192. Hydrocarbons from vacuum distillation of fish oil. Appl. June 12, 1936, patd. Aug. 8, 1939. (CA 33:9698.)

*Baxter, James G., and Edwards, Robert L. (to Distillation Products, Inc.). U. S. pat. 2,197,546. Purification of esters. Appl. Dec. 1, 1937, patd. Apr. 16, 1940. (CA 34:5464.)

Baxter, J. G., and Robeson, C. D. Science *92*, 203 (1940). Crystalline vitamin A palmitate and vitamin A alcohol.

Bills, C. E., Massengale, O. N., Hickman, K. C. D., and Gray, E. LeB. J. Biol. Chem. *126*, 241 (1938). A new vitamin D in codliver oil. (CA 33:696.)

Bömer, A. Z. Unters. Nahrgs.- u. Genussm. *28*, 586 (1914). Glycerides of coconut oil.

Bömer, A., and Hüttig, H. Z. Unters. Lebensmittel *75*, 1 (1938). Contribution to the knowledge of the glycerides of fats and oils. XV. Glycerides of babassu oil. (CA 32:3645.)

Breusch, Fritz. Z. physiol. Chem. *227*, 242 (1934). New method of bile analysis. (CA 28:7282.)

*British Drug Houses, Ltd., Carr, Francis H., and Jewell, William. Ger. pat. 670,016. Process and apparatus for preparation of vitamin concentrates. Appl. Jan. 17, 1934, publ. Jan. 10, 1939. (CA 33:3079.) (Corresponds to Brit. pat. 415,088, British Drug Houses.)

Brönsted, J. N., and von Hevesy, G. Nature *107*, 619 (1921). The separation of the istopes of chlorine. (CA 16:17.)

Burch, C. R., and van Dijck, W. J. D. J. Soc. Chem. Ind. *58*, 39 (1939). Theory and development of high-vacuum distillation. (CA 33:3210.)

Burrows, Godfrey. J. Soc. Chem. Ind. *58*, 50 (1939). The general technique of molecular distillation. Part II. General design of molecular distillation equipment. (CA 33:3210.)

*Canadian Industries, Ltd. (assignee of E. W. Fawcett). Can. pat. 378,403. Drying oil. Appl. Jan. 31, 1936, patd. Dec. 20, 1938. (CA 33:2355.) (Similar to Brit. pat. 442,000, Imperial Chem. Ind., Fawcett, and Walker.)

*Canadian Industries, Ltd. (assignee of E. W. Fawcett). Can. pat. 378,404. Fat and oil refining process. Appl. Jan. 31, 1936, patd. Dec. 20, 1938. (CA 33:2358.) (Corresponds to Brit. pat. 438,056, Fawcett and Imperial Chem. Ind.)

*Carothers, Wallace H. (to E. I. du Pont de Nemours and Co.). U. S. pat. 2,071,250. Linear condensation polymers. Appl. July 3, 1931, patd. Feb. 16, 1937. (CA 31:2714.)

*Carothers, Wallace H. (to E. I. du Pont de Nemours and Co.). U. S. pat. 2,071,251. Fiber and method of producing it. Appl. Mar. 14, 1933, patd. Feb. 16, 1937. (CA 31:2715.)

Carr, Francis H., and Jewell, William. Nature *131*, 92 (1933). Characteristics of highly active vitamin A. (CA 27:2185.)

Dam, Henrik. Ann. Rev. Biochem. *9*, 353 (1940). Fat-soluble vitamins.

Dam, Henrik, and Lewis, Liese. Biochem. J. *31*, 17 (1937). The chemical constitution of vitamin K. (CA 31:3970.)

Dam, Henrik, and Schönheyder. Nord. med. Tidsskr. *12*, 1097 (1936). (Sublimation of vitamin K in high vacuum.)

Detwiler, Jr., S. B., and Markley, K. S. Ind. Eng. Chem., Anal. Ed. *12*, 348 (1940). Laboratory-type molecular or short-path still for vegetable and animal fats and oils.

*Eastman Kodak Co. (assignee of K. C. D. Hickman). Brit. pat. 485,614. Improved process of distillation of linseed and similar oils. Appl. Aug. 18, 1936, acc. May 18, 1938. (CA 32:8813.)

*Eastman Kodak Co. (assignee of G. G. R. Smith). Brit. pat. 487,367. Vitamins. Appl. Sept. 17, 1937, acc. June 20, 1938. (CA 33:322.) (Similar to U. S. pat. 2,207,385, Smith.)

*Eastman Kodak Co. (assignee of K. C. D. Hickman and John C. Hecker). Brit. pat. 487,697. Improvements in high vacuum distillation process. Appl. Jan. 29, 1937, acc. June 24, 1938. (CA 33:6.) (Corresponds to U. S. pat. 2,126,467, Hickman and Hecker.)

*Eastman Kodak Co. (assignee of K. C. D. Hickman). Brit. pat. 488,878. Improved process of high vacuum distillation. Appl. Feb. 20, 1937, acc. July 15, 1938. (CA 33:6.) (Similar to U. S. pat. 2,150,684, Hickman.)

*Eastman Kodak Co. (assignee of K. C. D. Hickman and A. O. Tischer). Brit. pat. 489,623. Improvement in high vacuum distillation of materials containing sterols and related compounds. Appl. Jan. 29, 1937, acc. July 29, 1938. (CA 33:814.)

*Eastman Kodak Co. (assignee of K. C. D. Hickman). Brit. pat. 490,433. Improvements in processes of high vacuum short path distillation. Appl. Feb. 15, 1937, acc. Aug. 15, 1938. (CA 33:903.) (Corresponds to U. S. pat. 2,165,378, Hickman.)

*Eastman Kodak Co. (assignee of J. G. Baxter). Brit. pat. 501,841. An improved process for obtaining hydrocarbons from marine animal oils. Appl. July 2, 1937, acc. Mar. 2, 1939. (CA 33:6630.) (Corresponds to U. S. pat. 2,169,192, Baxter.)

*Eastman Kodak Company. Brit. pat. 511,070. Purifying esters of low vapor pressure. Aug. 14, 1939. (CA 34:5464.)

*Eastman Kodak Co. French pat. 49,278. Improvements in vacuum distillation processes. Appl. Oct. 23, 1937, granted Nov. 12, 1938. (CA 33:4828.) (Addn. to French pat. 834,937, Eastman Kodak Co.; similar to Brit. pat. 500,195, Kodak, Ltd.)

*Eastman Kodak Co. French pat. 825,406. Vitamins. Publ. Mar. 3. 1938. (CA 32:6404.) (See U. S. pat. 2,169,195, Hickman and Tischer.)

*Eastman Kodak Co. French pat. 831,255. Improvements in the process of refining soybean oil. Appl. Dec. 24, 1937, granted May 30, 1938. (CA 33:2749.) (Corresponds to Brit. pat. 484,736, Kodak, Ltd.)

*Eastman Kodak Co. French pat. 834,532. Improvements in vacuum distillation processes. Appl. July 6, 1937, granted Aug. 22, 1938. (CA 33:4070.) (Corresponds to Brit. pat. 482,880, Kodak, Ltd.)

*Eastman Kodak Co. French pat. 834,540. Improvements in the vacuum distillation of vitamin-containing oils. Appl. Nov. 27, 1937, granted Aug. 22,1938. (CA 33:4070.) (Corresponds to U. S. pat. 2,180,356, Hickman.)

*Eastman Kodak Co. French pat. 834,935. Improvements in vacuum distillation. Appl. July 6, 1937, granted Sept. 12, 1938. (CA 33:4472.) (Corresponds to Brit. pat. 482,881, Kodak, Ltd.)

*Eastman Kodak Co. French pat. 834,936. Process of vacuum distillation. Appl. July 6, 1937, granted Sept. 12, 1938. (CA 33:4472.) (Corresponds to Brit. pat. 482,882, Kodak, Ltd.)

*Eastman Kodak Co. French pat. 834,937. Improvements in process of vacuum distillation. Appl. July 6, 1937, granted Sept. 12, 1938. (CA 33:4472.) (Corresponds to Brit. pat. 482,883, Kodak, Ltd.)

*Eastman Kodak Co. German pat. 664,745. Process for the production of vitamin A preparations. App. Aug. 20, 1936, publ. Sept. 5, 1938. (CA 33:322.) (Corresponds to U. S. patent 2,169,195, Hickman and Tischer.)

Emerson, Oliver H., Emerson, Gladys A., and Evans, Herbert M. Science *89*, 183 (1939). Occurrence of gamma tocopherol in corn embryo oil. (CA 33:6405.)

Emerson, Oliver H., Emerson, Gladys A., Mohammad, Ali, and Evans, Herbert M. J. Biol. Chem. *122*, 99 (1937). The chemistry of vitamin E. Tocopherols from various sources. (CA 32:1305.)

Fawcett, E. W. M. J. Soc. Chem. Ind. *58*, 43 (1939). The general technique of molecular distillation. Part I. The characteristics and scope of the process. (CA 33:2385.)

Fawcett, E. W. Kolloid-Z. *86*, 34 (1939). Molecular distillation. (CA *33:2385.*)

*Fawcett, Eric W., and Burrows, Godfrey (to Imperial Chem. Ind., Ltd.). U. S. pat. 2,186,669. Apparatus for high vacuum distillation. Appl. Aug. 7, 1937, patd. Jan. 9, 1940. (CA 34:3142.) (Corresponds to Brit. pat. 480,265, Fawcett and Burrows.)

*Fawcett, Eric W., and Imperial Chemical Industries, Ltd. Brit. pat. 501,194. Improvements in or relating to the production and utilization of antioxidants. Appl. June 18, 1837, acc. Feb. 20, 1939. (CA 33:6078.)

*Fawcett, E. W., McCowen, J. L., and Imperial Chemical Industries, Ltd. Brit. pat. 435,032. Improvements in and relating to the vacuum distillation of materials yielding a solid distillate or residue. Appl. Mar. 7, 1934, acc. Sept. 9, 1935. (CA 30:912.)

*Fawcett, Eric W., Myles, James R., and Imperial Chemical Industries, Ltd., Brit. pat. 487,771. Distilling stigmasterol. Appl. Sept. 22, 1936, acc. June 22, 1938. (CA 33:182.)

Fiaccadori, Alceo. Chimica e industria (Italy) *21*, 199 (1939). Molecular distillation. (CA 33:7635.)

Furter, M. Mitt. Lebensm. Hyg. *30*, 200 (1939). New problems of distillation. Molecular distillation. (CA 34:1881.)

Gilchrist, Helen S., and Karlik, Berta. J. Chem. Soc. *1932*, 1992. Separation of normal long-chain hydrocarbons by fractional distillation in high vacuum. (CA 26:5543.)

Gillam, A. E., Heilbron, I. M., Jones, W. E., and Lederer, E. Biochem. J. *32*, 405 (1938). On the occurrence and constitution of the 693 mmu chromogen (vitamin A_2?) of fish liver oils. (CA 32:4724.)

Gray, E. LeB. J. Biol. Chem. *131*, 317 (1939). Comparison of vitamins A and A_2 by distillation. (CA 34:142.)

Gray, E. LeB., and Cawley, John D. J. Biol. Chem. *134*, 397 (1940). The influence of structure on the elimination maximum. I. The structure of vitamin A_2. (CA 34:5500.)

Gray, E. LeB., Hickman, K. C. D., and Brown, Elizabeth F. J. Nutrition *19*, 39 (1940). The state of vitamin A in the liver of the rat after feeding various forms of the vitamin. (CA 34:2037.)

Heilbron, I. M., Heslop, R. N., Morton, R. A., Webster, E. T., Rea, J. L., and Drummond, J. C. Biochem. J. *26*, 1178 (1932). Characteristics of highly active vitamin A preparations. (CA *27*:524.)

Hickman, K. J. Opt. Soc. Am. *18*, 69 (1929). (Also J. Soc. Chem. Ind. *48*, 365 (1929).) A still for liquids of high boiling point. (CA 23:3602.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,136,774. Treatment of oils. Appl. Nov. 7, 1935, patd. Nov. 15, 1938. (CA 33:1450.)

*Hickman, K. C. D. (to Distillation Products, Inc.). U. S. pat. 2,146,894. Vacuum distillation. Appl. Oct. 11, 1935, patd. Feb. 14, 1939. (CA 33:3973.)

*Hickman, K. C. D. (to Distillation Products, Inc.). U. S. pat. 2,150,683. Distillation process. Appl. Oct. 26, 1935, patd. Mar. 14, 1939. (CA 33:4744.)

*Hickman, K. C. D. (to Distillation Products, Inc.). U. S. pat. 2,150,684. Distillation of solids. Appl. Feb. 21, 1936, patd. Mar. 14, 1939 (CA *33:4744.)*

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,165,378. Vacuum distillation. Appl. Feb. 15, 1936. patd. July 11, 1939. (CA 33:8434.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,176,498. Vacuum rectifying column. Appl. July 2, 1937, patd. Oct. 17, 1939. (CA 34:913.) (Similar to Brit. pat. 477,955, Kodak, Ltd.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,180,050. Vacuum distillation apparatus. Appl. Oct. 1, 1937, patd. Nov. 14, 1939. (CA 34:1519.) (Corresponds to part of Brit. pat. 482,883, Kodak. Ltd.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,180,051. Removal of gases from organic liquids. Appl. Dec. 1, 1937. patd. Nov. 14, 1939. (CA 34:1823.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,180 053. Distillation apparatus. Appl. June 29, 1938, patd. Nov. 14, 1939. (CA 34:1519.) (Corresponds to part or all of Brit. pat. 500,195, Kodak. Ltd.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,180,356. Vacuum distillation of oils containing vitamins. Appl. Nov. 27. 1936, patd. Nov. 21, 1939. (CA 34:1823.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,197,539. Degassing apparatus. Appl. Dec. 1, 1937, patd. April 16, 1940. (CA 34:6061.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,199,994. Vacuum distillation. Appl. Nov. 13, 1937, patd. May 7, 1940. (CA 34: 6021.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,199,995. Preparation of vitamin compositions. Appl. March 15, 1938, patd. May 7, 1940. (CA 34:6021.)

*Hickman, Kenneth C. D. (to Distillation Products, Inc.). U. S. pat. 2,205,925. Fat soluble vitamin concentrate. Appl. Aug. 24, 1935, patd. June 25, 1940.

*Hickman, Kenneth C. D., and Hecker, John C. (to Distillation Products, Inc.). U. S. pat. 2,180,052. Vacuum distillation apparatus. Appl. Mar. 9, 1938, patd. Nov. 14, 1939. (CA 34:1519.)

*Hickman, Kenneth C. D., and Tischer, Arthur O. (to Distillation Products, Inc.). U. S. pat. 2,169,195. Production of vitamin A esters. Appl. Dec. 28, 1935, patd. Aug. 8, 1939. (CA 33:9554.)

*Imperial Chemical Industries, Ltd. Brit. pat. 437,895. Improvements in the treatment of solids. Appl. May 7, 1934, acc. Nov. 7, 1935. (CA 30:2429.)

*Imperial Chemical Industries, Ltd. Dutch pat. 35,201. Process and apparatus for the separation of low molecular constituents from products obtained by the polymerization of drying oils, by means of high vacuum distillation. Appl. Dec. 20, 1932, publ. April 15, 1935. (Similar to Brit. pat. 422,941, Imperial Chem. Ind.)

*Imperial Chemical Industries, Ltd. Dutch pat. 37,435. Method for the preparation of a concentrate of vitamins and related substances, particularly provitamins, from natural and synthetic products, by distillation in vacuo. Appl. Feb. 23, 1933, publ. Feb. 15, 1936.

*Imperial Chemical Industries, Ltd. French pat. 815,150. Improvements in apparatus for high vacuum distillation. Appl. Dec. 17, 1936, publ. July 6. 1937. (Similar to Brit. pat. 458,117, Vigers and McCowen.)

*Imperial Chemical Industries, Ltd. French pat. 830,023. Stigmasterol. Granted July 19, 1938. (CA 33:182.) (Corresponds to Brit. pat. 487,771, Fawcett, Myles. Imperial Chem. Ind.)

*Imperial Chemical Industries, Ltd. German pat. 643,993. Process for improving the properties of stand oils. Appl. Dec. 20, 1933, publ. Apr. 22, 1937.

*Imperial Chemical Industries, Ltd. German pat. 658,844. Process for improvement of stand oils from fish oils. Appl. Nov. 18, 1934, publ. Apr. 20, 1938. (CA 32:6485.) (Corresponds to Brit. pat. 442,000, Imperial Chem. Ind., Fawcett, and Walker.)

Jewell, W., Mead, T. H., and Phipps, J. W. J. Soc. Chem. Ind. *58*, 56 (1939). The application of molecular distillation to the concentration of vitamins. (CA 33:4616.)

Johnston, W. B., and Bradley, T. F. Abstracts of Papers, 100th Meeting, Am. Chem. Soc., Sept. 9-13 (1940), Section N, p. 11. Drying oils and resins. IX. Purification of polymerized methyl linoleate by molecular distillation.

Kass, J. P., Loeb, H. G., Norris, F. A., and Burr, G. O. Oil and Soap *17*, 118 (1940). The thiocyanogen value of linolenic acid.

Klose, A. A., and Almquist, H. J. J. Am. Chem. Soc. *61*, 532 (1939). The use of phosphotungstic acid in the preliminary refining of extracts containing vitamin K. (CA 33:2935.)

Klose, A. A., and Almquist, H. J. J. Biol. Chem. *132*, 469 (1940). Synthesis of vitamin K_1. (CA 34:1987.)

*Kodak, Ltd. (assignee of Eastman Kodak Co.). Brit. pat. 482,880. Method for the preparation of vitamin D in high yields. Appl. July 6, 1936, acc. Apr. 6, 1938. (CA 32:7217.)

*Kodak, Ltd. (assignee of Eastman Kodak Co.). Brit. pat. 493,948. Improved method of high vacuum distillation. Appl. Apr. 20, 1937, acc. Oct. 18, 1938. (CA 33:2372.)

*Kodak, Ltd. (assignee of Eastman Kodak Co.). Brit. pat. 500,195. Improvements in and relating to high vacuum distillation. Appl. July 29, 1937, acc. Jan. 30, 1939. (CA 33:5237.)

*Kodak, Ltd. (assignee of Eastman Kodak Co.). Brit. pat. 507,471. Improvements in treating animal and vegetable oils and fats for retarding oxidation and the development of rancidity. Appl. Sept. 10, 1937, acc. June 12, 1939. (CA 34:656.)

*Kodak, Ltd. (assignee of K. C. D. Hickman). Brit. pat. 508,469. Vacuum distillation of oils containing fat soluble vitamins. Acc. June 27, 1939. (CA 34:2537.) (Corresponds to U. S. pat. 2,180,356, Hickman.)

Lovern, J. A., Mead, T. H., and Morton, R. A. Biochem. J. *33*, 338 (1939). Halibut intestinal oil. (CA 33:6627.)

Mead, Thomas H. Biochem. J. *33*, 589 (1939). Crystalline esters of vitamin A. I. Preparation and properties. (CA 33:8250.)

Morse, R. S. Abstracts of papers, 99th meeting Am. Chem. Soc., Apr. 8-12 (1940), Sec. N, p. 12. Molecular distillation of polymerized drying oils.

Morton, Avery A., Mahoney, John F., and Richardson, Graham. Ind. Eng. Chem., Anal. Ed. *11*, 460 (1939). Vacuum sublimation and molecular distillation apparatus. (CA 33:7150.)

Müller, Alex. Proc. Roy. Soc. *A120*, 437 (1928). A further x-ray investigation of long chain compounds (n-hydrocarbon). (CA 23:30.)

Rawlings, Herbert W. Oil and Soap *16*, 231 (1939). Molecular distillation of soybean and corn oils. (CA 34:902.)

Riemenschneider, R. W., Swift, C. E., and Sando, Chas. E. Oil and Soap *17*, 145 (1940). Molecular distillation and low temperature crystallization of cottonseed oil and the stability of the molecularly distilled fractions.

*Smith, Gerald G. R. (to Distillation Products, Inc.). U. S. pat. 2,207,385. Preparation of vitamin concentrate. Appl. Sept. 21, 1936, patd. July 9. 1940.

Smith, W. Harold, and Wing, Henry J. J. Res. Nat. Bur. Standards *22*, 529 (1939). Behavior of rubber hydrocarbon in a molecular still. (CA 33:5700.)

*Vigers, Brian E. A., and McCowen, John L. (to Imperial Chem. Ind.). U. S. pat. 2,137,553. Apparatus for high-vacuum distillation. Appl. June 15, 1936. patd. Nov. 22, 1938. (CA 33:1550.) (Corresponds to Brit. pat. 458,117, Vigers and McCowen.)

Waterman, H. I., and van Vlodrop, C. Rev. chim. ind. (Paris) *48*, 314 (1939). Molecular or short path distillation. (CA 34:1888.)

*Waterman, Hein I., and van Vlodrop, Cornelus (to Imperial Chem. Ind., Ltd.). Dutch pat. 43,250. Flavoring and vitaminic substances from butter fat. Appl. Dec. 16, 1933, publ. May 16, 1938. (CA 33:3018.)

*Waterman, Hein I., and van Vlodrop, Cornelus (to Imperial Chem. Ind., Ltd.). U. S. pat. 2,144,906. Flavoring matters and their application. Appl. Dec. 11, 1934, patd. Jan. 24, 1939. (CA 33:3018.) (Similar to Dutch pat. 43,250. Waterman and Van Vlodrop.)

*Waterman, Hein I., and van Vlodrop, Cornelus (to Shell Development Co.). U. S. pat. 2,159,303. Multistage evaporator. Appl. Feb. 26, 1937, patd. May 23, 1939. (CA 33:6662.)

*Waterman, H. I., van Vlodrop, Cornelus, and van Dijk, Johannes A. (to Imperial Chem. Ind., Ltd.). U. S. pat. 2,143,587. Treatment of vitamin-containing oils and products obtained therefrom. Appl. Feb. 20, 1936.

patd. Jan. 10, 1939. (CA 33:3079.) (Similar to Brit. pat. 452,442, Waterman.)
Anon. Synthetic Organic Chemicals (Eastman Kodak Co.) *2*, No. 3 (*1929*). Tackling difficult distillations.

Accessory Apparatus and Technique

*Baxter, James G. (to Distillation Products, Inc.). U. S. pat. 2,147,479. Condensation pumps using organic liquids. Feb. 14, 1939. (CA 33:3635.)
*British Thomson-Houston Co., Ltd. Brit. pat. 488,162. Diffusion pumps. July 1, 1938. (CA 33:14.)
Copley, M. J., Simpson, O. C., Tenney, H. M., and Phipps, T. E. Rev. Sci. Instruments *6*, 265 (1935). A study of the speed of divergent nozzle pumps.
Dunicz, Boleslaw L. Ind. Eng. Chem., Anal. Ed. *11*, 28 (*1939*). Improvement of vacuum distillation. (CA 33:1545.)
*Eastman Kodak Co. Brit. pat. 495,109. Organic liquids for use in condensation pumps. Nov. 7, 1938. (CA 33:2774.)
Ebert, H., and Gielesen, J. Glass u. App. *20*, 167, 177, 189 (1939). Progress in vacuum technique. (CA 34:5702.)
*Embree, Norris D. (to Distillation Products, Inc.). U. S. pat. 2,139,740. Sorption pumps for producing high vacuum. Dec. 13, 1938. (CA *33:1997*.)
Etzrodt, A. Chem. App. *25*, 51 (1938). General principles of vacuum technic. (CA 32:4016.)
Etzrodt, A. Chem. App. *25*, *321* (1938). Pressure measurement in vacuum technic. (CA 33:438.)
*Hickman, K. C. D. (to Distillation Products, Inc.). U. S. pat. 2,150,685. Condensation pumps for high-vacuum distillation. Mar. 14, 1939. (CA 33:4744.)
*Hickman, K. C. D. (to Distillation Products, Inc.). U. S. pat. 2,153,189. Condensation pump using organic liquids. Apr. 4, 1939. (CA 33:4828.)
*Hickman, K. C. D., and Baxter, James G. (to Distillation Products, Inc.). U. S. pat. 2,147,488. Organic liquids for use in condensation pumps. Feb. 14, 1939. (CA 33:3635.)
Hughes, A. L. Rev. Sci. Instruments *8*, 409 (1937). A simple Knudsen gage. (CA 32:1520.)
Lockenvitz, Arthur E. Rev. Sci. Instruments *9*, 417 (1938). A radiometer-type vacuum gage. (CA 33:902.)
Matricon, M. J. phys. radium *10*, 385 (1939). High-speed oil-vapor condensation pumps. (CA 34:4308.)
More, K. R., Humphreys, R. F., and Watson, W. W. Rev. Sci. Instruments *8*, 263 (1937). Trap for use with an oil diffusion pump. (CA 31:6513.)
Nikliborc, J. Acta Phys. Polon. *6*, 19 (1937). A new quartz manometer. (CA 32:6508.)
Penning, F. M. Physica *4*, 71 (1937). New manometer for low gas pressures, especially between 10^{-3} and 10^{-5} mm. (CA 31:2866.)
Rosenberg, Paul. Rev. Sci. Instruments *10*, 131 (1939). The design of an accurate McLeod gage. (CA 33:4467.)
Van Atta, C. M., and Van Atta, L. C. Phys. Rev. *51*, 377 (1937). Highspeed multijet oil diffusion pumps of metal construction. (CA 32:5262.)
Werner, Sven. Z. tech. Physik. *20*, 13 (1939). A simple Knudsen manometer. (CA 33:3211.)

Pot Cook Cellulose Yield Committee Report

OBJECT

The object of this committee was (1) to study the pot cook yield method and recommend improvements to same and (2) to collect data as to its accuracy.

IMPROVEMENTS IN METHOD

Lint Mixing

In the method as published in Oil and Soap, August issue 1937, the lint mixing is done by hand. By the hand mixing procedure some bran is dusted out if the operator is not careful. It also is a dusty, time consuming job. In view of this a mechanical mixer has been developed in the Pulp Plant Chemical Division, Buckeye Cotton Oil Co., which does a good mixing job in less time, with no dust and no separation of the hull pepper.

A comparison of yields obtained using the hand mix and mechanical mixer is given below.

For the present either the hand or mechanical mixing is permissible. To do a foolproof mixing job the mechanical procedure is superior. A blueprint of this mixer is available.

Oven

No mention of drying ovens were mentioned in the method of August 1937 under "apparatus." Drying oven specifications are given in the revised pot cook procedure. This is not a change of procedure but merely giving more details.

Laboratory Preparation of Sample

The old lint preparation procedure was modified to include the mechanical mixer so that either the hand mix or the mechanical mixer could be used.

Other Changes in Method

In order to clarify the old procedure a few words have been added here and there. They do not change the procedure in any way.

Results of Check Analyses by Different Laboratories

Samples were not sent out by the committee as this has been done previously to most of the laboratories equipped with mechanical washers. Five of the six men on this committee received samples and reported their results at that time. These analyses are given below.

The following table gives the average yields obtained on samples of lint sent out to various laboratories. All results calculated to 8.0% moisture lint or hull fibre.

TABLE II

	Lint			Hull Fibre		Group
Laboratory	A	B	C	D	E	Aver.
Lab. No. 1	79.4	74.2	63.6	69.7	55.3	68.44
Lab. No. 2	79.7	73.9	63.9	70.0	56.1	68.72
Lab. No. 3	79.4	74.0	62.5	69.8	55.0	68.14
Lab. No. 4	79.6	74.1	62.7	69.4	55.2	68.20
Lab. No. 5	79.2	73.6	62.9	69.3	55.0	68.00
Lab. No. 6	79.6	74.0	63.4	69.9	56.4	68.66
Lab. No. 7	79.3	74.1	63.3	69.7	61.6	69.60
Lab. No. 8	78.4	72.8	63.1	68.7	57.4	68.08
Overall Aver.	79.33	73.84	63.18	69.56	56.50	68.49
Av. omitting Lab. No. 8 A, B, D, E, & Sample E Lab. No. 7	79.46	73.99	63.18	69.69	55.50	68.36

The following table gives (1) the points deviation from the overall average for each mill on each sample and (2) the points deviation from the average obtained omitting Lab. No. 8 results on sample A, B, D, & E and Lab. No. 7 Sample E.

TABLE III

Laboratory	Points Deviation											
	A		B		C		D		E		A.	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Lab. No. 1	.07	.06	.36	.21	.42	.42	.14	.01	1.20	.20	.05	.08
Lab. No. 2	.37	.24	.06	.09	.72	.72	.44	.31	.40	.60	.23	.36
Lab. No. 3	.07	.06	.16	.01	.68	.68	.24	.11	1.50	.50	.35	.22
Lab. No. 4	.27	.14	.26	.11	.48	.48	.16	.29	1.30	.30	.29	.16
Lab. No. 5	.13	.26	.24	.39	.28	.28	.26	.39	1.50	.50	.49	.36
Lab. No. 6	.27	.14	.16	.01	.22	.22	.34	.21	.10	.90	.17	.30
Lab. No. 7	.03	.16	.26	.11	.12	.12	.14	.01	5.10	...	1.11	...
Lab. No. 8	.93	...	1.04	...	.08	.08	.86	...	.90	...	.41	...
Av. Deviation Points	∢.27	.15	.32	.13	.38	.38	.32	.19	1.50	.50	.39	.25
Av. Deviation Per Cent	∢.34	.19	.43	.18	.60	.60	.46	.27	2.65	.90	.57	.37

TABLE I

Type	No. of Tests each mix	Yield Hand Mix Average	Yield Hand Mix Maximum Deviation	Average % Deviation	Yield Machine Mix Average	Yield Machine Mix Maximum Deviation	Aver.% Deviation
Lint 1	24	77.79	∢1.79	∢0.475	77.70	∢0.80	∢0.285
Lint 2	24	75.36	∢0.94	∢0.662	75.07	∢0.73	∢0.430
Lint 3	12	71.54	∢0.84	∢0.690	71.65	∢0.65	∢0.454
Fiber 1	12	73.68	∢0.98	∢0.600	74.31	∢0.59	∢0.393
Fiber 2	24	65.56	∢0.56	∢0.450	65.91	∢0.61	∢0.346
Fiber 3	24	61.42	∢1.38	∢0.655	61.34	∢0.76	∢0.597
Average	120	70.90	∢0.915	∢0.588	70.99	∢0.690	∢0.418
Lint Average	60	74.89	∢1.19	∢0.609	74.81	∢0.73	∢0.389
Fiber Average	60	66.89	∢0.973	∢0.568	67.18	∢0.653	∢0.445