

Industrial Hygiene Foundation
4400 Fifth Avenue
Pittsburgh, Penna.

Abstract of preliminary report on a Foundation-supported study,
"An Evaluation of Present Exhaust Ventilation for the Control of
Industrial Health Hazards," by Theodore Hatch and Robert H.
Walpole, Jr., Department of Public Health and Preventive Medicine,
University of Pennsylvania, presented by Professor Hatch at sixth
annual meeting of Industrial Hygiene Foundation held at Mellon
Institute, Pittsburgh, Nov. 3, 1941.

Two important situations stand out with respect to the present procedures
in designing of systems of exhaust ventilation: 1. the design is almost entirely
empirical; 2. the performance of systems so designed has not been extensively
correlated with the degree of control which is produced. There is need for collec-
tion and tabulation of design data, the use of which will provide for more exact
control of dusts, fumes, vapors and gases.

Exhaust ventilation is applied to numberless industrial processes and to
many varieties of the same process. Because of the variables encountered, it is
stated that design problems cannot be reduced to basic engineering relationships
and that since great factors of safety must be employed power consumption is only
of secondary interest. Recognizing the importance of the variable factors involved
and the reliance which must be placed upon previous experience, it seems proper to
inquire to what extent empirical data, based upon experience, can be translated into
more basic data which will have some general application. One may also investigate
the possibilities of reducing power consumption without sacrificing efficiency of
control.

Dust and other contaminants are dispersed into the air by definite forces.
The function of an exhaust hood is to establish counter-forces which will prevent
the escape of the contaminant. In a basic engineering approach to the design of
exhaust hoods, the forces of dispersion must be recognized and evaluated and related
to hood performance. The major objective of the proposed investigation is to estab-
lish such relationships. It is recognized, however, that many problems cannot be
solved in this way and, also, that only a few of all the processes requiring venti-
lation can be studied.

A general revision of design procedures and the complete elimination of
empirical data are not anticipated. The development of a method of investigation
will, in itself, be of value. It is hoped, for example, that through the use of
such a method, the manufacturers of contaminant-producing equipment will be able to
study the characteristics of their own machines and develop standards of ventilation.
Such original studies will help to remove the present difficulties encountered in
applying ventilation to machines and processes as an after-thought, so to speak.

At the outset of this investigation, the recent literature on exhaust
ventilation has been collected and a bibliography, arranged by industry or process
prepared. The list of references is not complete but sufficiently so to show that
the volume of published material is not great. The importance of exhaust ventila-
tion in the control of industrial health hazards and the cost of installing and
operating such equipment are great enough today to warrant a more complete treatment
of the subject.

The bibliography is attached.

#####

PLAINTIFF'S EXHIBIT

WH-1083

REFERENCES ON EXHAUST VENTILATION

1930-1941

GENERAL

Air Dilution in Industrial Ventilation, Parts I, II, III, IV. W.C.L. Hemeon. Heating and Ventilating. I, 37, 39-43, Nov. 1940 -- II, 37, 42-46, Dec. 1940 -- III, 38, 40-42, Feb. 1941 -- IV, 38, 71-74, Mar. 1941.

Are We Controlling Dust? S.W. Gurney and D.S. Beyer. National Safety News. Liberty Mutual Insurance Co. Jan. 1935.

Are You Buying an Exhaust System? Part I, Fixing Suitable Branch Pressures and Obtaining Workable Piping. Z.F. Kravath. Heating and Ventilating. 36, 16-18, Aug. 1939.

Characteristics of Cloth Filters on Coal Dust-Air Mixtures. A.R. Mumford, A.A. Markson, T. Rawes. Trans. A.S.M.E. 62, 271, 281, May 1940.

Collection and Reclaiming Silicosis Dusts in Roofing Coating Industry. Penna. Dept. of Labor and Industry, Safe Practice Bulletin No. 3, 1939.

The Control of Industrial Dust; The Problem of Local Exhaust and General Ventilation. J.M. DallaValle. Mechan. Engr., 55, 621-624, Oct. 1933.

Design of Duct Work for Exhaust Systems. *Air Hygiene Foundation of America, Inc., Prev. Eng. Series Bulletin No. 1, Part 5, 1938.

Design of Exhaust Hoods. Air Hygiene Foundation of America, Inc., Prev. Eng. Series Bulletin No. 2, Part 4, April 1938.

Design of Exhaust Hoods for Dust Control Systems. T.F. Hatch. Jour. Ind. Hyg. & Tox. 18, No. 9, Nov. 1936.

Design of Industrial Exhaust Systems. John L. Alden. Published by Industrial Press, 149 Lafayette St., New York, N.Y. 220 Pages.

Determination of Cloth Area for Industrial Air Filters. C.E. Williams, Theodore Hatch, Leonard Greenburg. Heating, Piping, Air Conditioning, April, 1940.

The Determination and Control of Industrial Dust. J.J. Bloomfield; J.M. DallaValle. U.S. Pub. Health Bulletin No. 217, April 1935.

Dust and Fume Control -- A Practical Approach. H.B. Meller; F.S. Malletto. Occ. Hazards. 2, no. 11, 8-10, 12, 32, Sept. 1940.

Dust Collection Systems. Concrete, Cam. Mill Ed., 47, 147-149, April 1939.

Dust Collection. H.R.A. Davies. Jour. Ind. Heating Vent. Engrs. (British), 5, 317-336, 1937.

Dust Collection. C.A. Synder. National Safety News. 37, 16, 34, March 1938.

*Since this publication has been issued the name of the organization has been changed to Industrial Hygiene Foundation.

References on Exhaust Ventilation - 2.

Dust Control, Parts I, II, III. F.F. Kravath. Heating and Ventilating. 37, Part I, pp. 38-41, March 1940 -- 37, Part II, pp. 39-42, April 1940 -- 37, Part III, pp. 36-38, May 1940.

Dust Control Methods in an Asbestos Fabricating Plant. R.T. Page; J.J. Bloomfield. U.S. Public Health Reports. 52, 1713-1727, Nov. 26, 1937.

Dust Control, present and future design considerations. T.F. Hatch. Mechan. Engineering. 57, 154-156, March 1935.

Dust Control System Design, Installation and Operation from the Commonsense Standpoint. F.F. Kravath. Heat. & Vent. 38, 28-31, June 1941.

Dust, Fume, and Gas Elimination by Proper Prevention. R.A. Brehm. Occup. Hazards, 3, 6-10, 31-32, March 1941.

Economical Dust Control with Low Resistance Exhaust Systems. F.F. Kravath.
Part I. Analysis of the Problem. Heat. and Vent., 37, 40-42, Oct. 1940.
Part II. Hood and Branch Connections. Heat. and Vent. 37, 27-29, Nov. 1940.
Part III. Branch Junctions and Changes. Heat. and Vent. 37, 40-41, Dec. 1940.
Part IV. Filter Connection and Fan Selection. Heat. and Vent. 38, 33-35, Feb. 1941.
Part V. Summary - A Sample System. Heat. and Vent. 38, 33, Mar. 1941.
Part VI. Plenum Chamber System. Heat. and Vent. 38, 36-38, April 1941.

Economy in the Design of Exhaust Systems. T.F. Hatch. Industrial Medicine, Ind. Hyg. Sect., 1, 54-59, Oct. 1940.

Effective Exhaust Systems. John M. Kane. National Safety News, Aug. 1939.

Exhaust Hood, Collectors, and Fans Design to Control Dust. Brick and Clay Record. 98, 51-52, Feb. 1941.

Exhaust Ventilation -- Suction Versus Airflow. William N. Witheridge. Occup. Hazards. 2, No. 4, p. 21-22, 31, Sept. 1940.

Factors to Consider in Designing Dust Removal Systems. C.C. Hermann. Abrasives, 18, 14-16, 60, Sept. 1937.

Fan Selection & Nomenclature. A.A. Berostnoff. Refrigeration Engineering, 32, 175-179, 1936.

The Flow of Air and its Distribution Through Ducts. J.R. Zwickl.

Part I. Frictionless Flow and Velocity Head, Heat. and Vent., 36, 15-17, Feb. 1939.

Part II. Flow with Friction-Ducts with Equal Friction. Heat. and Vent., 36, March 1939.

Part III. Elbows and Miscellaneous Resistances. Heat. and Vent., 36, 51-53, April 1939.

Part IV. Duct Layouts. Heat. and Vent., 36, 48-50, May 1939.

Parts V and VI. Fan Laws and Fan Selection. Heat. and Vent., 36, 44-45, June 1939; 64-66, July 1939.

Fundamental Factors in the Design of Exhaust Systems. T.F. Hatch. Mechan. Engineering. Feb. 1936.

Fundamentals Relating to the Design and Operation of Exhaust Systems. T.F. Hatch et al. American Standards Exhaust Code Committee No. ASA-29. American Standards Assoc., 1936.

References on Exhaust Ventilation - 3.

Industrial Dust Control Through Exhaust Systems. W.O. Vedder. Craft Press, Inc., Fayetteville, Pa., 1936.

Industrial Dusts and Their Control. T.F. Hatch. Safety Engineering. 67, 26, June 1934.

Low Velocity Exhaust Systems. T.F. Hatch. Heat. and Vent., 37, 27-30, Oct. 1940.

How To Design Exhaust Hoods for Quartz Fuming Operations. E.C. Riley and J.M. DallaValle, Heat. and Vent., 37, 23, April 1940.

Methods for Controlling the Dust Hazard. A.D. Brandt, Sc.D. Metal Cleaning & Finishing. 9, 281-288, April, 1939.

Modern Methods of Removing Dust. F. Prockat. Staub, No. 6, 249-287, June 1938.

Operation and Maintenance of Cloth Screen Dust Collectors. W.F. Terry. Heating, Piping and Air Cond. 5, 259-304, May, June 1933.

Physical Methods for the Elimination of the Dust Hazard in Industry. H.L. Green; H.H. Wayson. Med. Research Council Spec. Report No. 299, 1935.

Prevention of Silicosis Through Engineering Control. Bulletin No. 21, Part 2. U.S. Dept. of Labor, 1933.

Practical Design of Exhaust and Filter Systems. E.W. Favalora. Edwin A. Scott Publishing Co., Inc. New York, N.Y., 1935. 269 pages.

Principles of Exhaust Hood Design. J.M. DallaValle. U.S. Public Health Service, 1939.

Profits in Air. C.F. Conn, Ltd., F.A. Westbrook. Heat. and Vent., 37, 39-40, June 1940.

Profits in Air-Ford Motor Co. C. Strock. Heat. and Vent., 37, 32-38, June 1940.

Profits in Air: Woodworking Plants. T.F. Hatch; R.B. Northrup. Heat. and Vent., 37, 33-38, Feb. 1940.

Progress in Industrial Sanitation with Special Reference to the Control of Industrial Dust. T.F. Hatch. Am.Jour.of Pub.Health, 27, 671-679, July 1937.

Protecting Plant Manpower-Preventive Measures. Theodore Hatch. Special Bulletin No. 3, Page 13, U.S. Dept. of Labor, Div. of Labor Standards.

Recent Dust Exhaust Apparatus. F. Prockat. Staub. No. 6, 249-287, 1937.

Removal of Dust and Fumes; New Departures. C.W. Price. Times Trade and Eng., 42, No. 888, Factory Welfare Sect. P.X. Feb. 1938.

The Size and Frequency of Industrial Dust. J.J. Bloomfield, U.S. Pub. Health Reports, 43, 961, 1933.

Studies in the Design of Local Exhaust Hoods. J.M. DallaValle; T.F. Hatch. Trans. Am. Soc. Mech. Engr. 54, 31-37, July 1932.

References on Exhaust Ventilation - 4.

Tentative Code of Recommended Practices for Testing and Measuring Air Flow in Exhaust Systems. J.R. Allan, Chr., Ind. Hygiene Codes Comm. Am. Foundrymen's Assoc. A.F.A. Reprint No. 36-27.

Velocity Characteristics of Hoods under Suction. J.M. DallaValle. Heating, Piping and Air Cond., 4, 370, 1932.

When is Dust Control Effective? J.J. Bloomfield. National Safety News. 32, 17, Dec. 1935.

ABRASIVE WHEELS, GRINDING AND PORTABLE GRINDING

Abrasive Wheel Manufacturing, Technical Control of Dust. F.F. Krevath. Fed. State Dept. of Labor and Industry, Safe Practice Bulletin No. 13, 1939.

Control of Abrasive Dust. F.B. Jacobs. Mill & Factory, 15-48, July 1936 -- 19, 50-52, 120, 1936 -- 19, 56-59, Sept. 1936.

Down-Drift Exhaust Aids Finishing Department. Steel, 107, 30, Nov. 11, 1940.

Grinding and Sanding Castings Without Dust. Iron Age. 146, 51, Sept. 12, 1940.

Portable Hand Grinders. Foundry Safety Liberty Mutual Ins. Co., 3, No. 1, June 1939.

Tentative Code of Recommended Practices for Grinding, Polishing, and Buffing Equipment Sanitation. J.R. Allan, Chr., Ind. Hyg. Codes Comm. A.F.A. Am. Foundrymen's Assoc. Reprint 36-28, Dec. 1, 1936.

CERAMIC

Dust Control in Industry. T.C. Angus. Industrial Welfare. 20, 171-177, May 1938.

Dust Hazards and their Control in a Ceramic Industry. T.C. Angus and Donald Stewart. Jour. Ind. Hyg. & Tox. 19, No. 1, Jan. 1937.

Dust Prevention and Elimination. Ceramic Ind. 28, 299-302, April 1937.

Elimination of Dust in a Porcelain Plant. A.M. Morris. Ceramic Industry, June 1939.

How to Control Dust in Clay Plants. John M. Kane. Brick and Clay Record. 91, 69-71, Aug. 1937.

Plant Engineering for Dust Elimination. A.M. Morris. Proceedings of the Ceramic Section, Div. Safety & Hygiene Ind. Comm. of Ohio, April 18, 19, 20

Redesign of Working Booths to Reduce Dust Counts. Ceramic Ind. 32, 60, Jan. 1939.

Reduce Dust Counts to a Minimum with Redesigned Booths. Ceramic Ind. 30, 53-70 April 1938.

What's the Best Way to Remove Dust? Ceramic Ind. 34, 65-66, 68, 70, 72, 74, 76, 78 April 1940.

References on Exhaust Ventilation - 5.

FOUNDRY

ABC's of Industrial Dust Control. Roy P. Warren. Occup Hazards and Safety. 1, 8-10, July 1939 -- 1, 11-13, Aug. 1939 -- 1, 14-18, Sept. 1939.

The Application of Dust Control Principles to Foundry Operations. R.R. Meigs. Second New England Regional Foundry Conference, M.B.T. April 8, 1938.

Calcimine and Good Housekeeping. Frank C. Steinbach. The Foundry Magazine. 64, 23 Mar. 1936.

A Case History of Dust. J.R. Lampazo. Occup. Hazards and Safety. 1, No. 1, 19-21, April, 1939.

Cleaner Air for the Foundry. E.O. Jones. National Safety News. Sept. 1934.

Dust Collection and Control. American Foundrymen's Assoc. Reprint 35-22.

Dust Collection Needs Correct Hood Design. J.G. Litrow. National Safety News. 42, 52, Aug. 1940.

Dust Collection in the Foundry. S.D. Moxley. Trans. Am. Foundrymen's Assoc. 43, 191-208, 1935.

Dust Concentration in Foundries. Theodore Hatch; C.E. Williams; B.G. Dolin. Ind. Bulletin. N.Y. State Dept. of Labor, 18, 89-95, Feb. 1939.

Dust Control in Foundries. W.T. Cameron. Proc. 11th All Ohio Safety Congress. 266-272, 1940.

Dust Control in the Foundry. C.A. Snyder. Metal Industry. 35, 349-350, July 1937.

Dust Control in the Foundry Industry. J.D. Leitch; L.B. Leppard. Mimeographed pamphlet No. 10. Div. Ind. Hygiene, Ontario Dept. of Health, Toronto, Ontario, Canada.

Dust Control; Silicosis Prevention. Verne A. Zimmer. Brass and Aluminum Foundry. No. 40, Nov. 9, 1940. -- No. 41, Dec. 7, 1940 -- Feb. 1941.

The Dust Hazard in Foundries. L.M. Merritt. Ohio Ind. Comm. Monitor, 13, 99-102 July 1940 -- Occup. Hazards, 2, No. 11, 18-20, Sept. 1940.

The Exhaust of Foundry Shakeouts. John M. Kane. Foundry Safety. Liberty Mutual Ins. Co. 3, No. 1, June 1939.

Exhaust Requirements for Foundry Dust Control. John M. Kane. Foundry Magazine. 66, 30-32, Jan. 1938.

Foundry Dust Control. Foundry Safety. Liberty Mutual Ins. Co. 1, No. 2, June 1937.

Foundry Dust Control Measures. T.F. Hatch. N.Y. State Dept. of Labor, Ind. Bulletin. 17, 114-118, Mar. 1938.

The Foundry Dust Hazard and its Control. M.F. Trice. Jour. American Pub. Health Assoc., 30, 760-765, July 1940.

References on Exhaust Ventilation - 6.

Good Housekeeping in the Foundry. E.G. Meiter. Am. Foundrymen's Assoc. Good Housekeeping Conference. Reprint 37-30; 34-38, 1937.

Good Housekeeping at Falk. The Foundry Magazine. Feb., Mar. 1933.

Good Housekeeping in a Steel Foundry. J.E. Turner. Safe Practice Bull. No. 69, Penna. Dept. of Labor and Ind. June 1941 -- Safety Engineering, 82, 11-14, Aug. 1941.

Methods of Dust Control. J.D. Leitch. Trans. Am. Foundrymen's Assoc. 43, 209-221 1935.

No Dust, Better Health, More Output. A. Van Vlissingen. Fact. Man. & Main. 93, 79-81, Sept. 1940.

The Removal of Dust in Foundry Shakeouts of Large Steel Castings. Safe Practice Bulletin No. 61, Penna. State Dept. of Labor and Ind. 1941.

The Removal of Silica Dust from Large Casting Thru Crane Sips. P.S. Tanner. Occup. Hazards. 2, No. 23, Feb. 1940.

Silicosis in the Foundry. Carey P. McCord. National Founders Assoc., 29 S. LaSalle St., Chicago.

Why Not a Dust-Free Foundry. C.B. Gordy. Fact. Man. & Main. 97, 79-80, Mar. 1939.

Won't Have Dust. Arthur Van Vlissingen. Fact. Man. & Main. 95, 83, Sept. 1937.

GRAIN

Dust Control. C. W. Elger. Am. Miller. 68, 24-25, May 1940.

Dust Control in Grain Elevators. Hylton R. Brown; J.O. Reed. Bulletin No. 1373, U.S. Dept. of Agriculture, 1929.

The Removal of Floating Dust in Grain Elevators. Report of Committee of Underwriters Laboratories, National Safety Council. 1924.

GRANITE CUTTING

Control of the Silicosis Hazard in the Hard Rock Industries -- A Laboratory Study of the Design of Dust Control Systems for Use with Pneumatic Granite Cutting Tools. T.F. Hatch; Philip Drinker; Sarah P. Choate. Jour. Ind. Hyg. & Tox. 12, No. 3, p. 75, Mar. 1930.

Dust Control. I. Exhaust Devices for Hand Pneumatic Tools. W.C.L. Hemeon. Heat. and Vent., 37, 41-45, June 1940.

Dust Control in the Granite Industry. W.C.L. Hemeon. Heat. and Vent., 37, 41-45, Aug. 1940.

Dust Control in the Granite Industry. John D. Leitch. Jour. Ind. Hyg. & Tox., 18, No. 10, Dec. 1936.

References on Exhaust Ventilation - 7.

Granite Dust Control. I. Banker Exhaust Ventilation. M. Bowditch, Dir., Mass. Dept. of Labor and Industries, Div. of Occupational Hygiene, May 1938.

Requirements for Dust Control in Stone Cutting. T.F. Hatch; W.B. Harris. N.Y. State Ind. Bulletin, 18, 379-381, Dec. 1939.

A Study of Efficiency of Dust Removal Systems in Granite Cutting Plants. U.S. Public Health Reports, 44, 2505-2522, Oct. 1929.

Ventilation in the Granite Industry. Edward C.J. Urban. Jour. Ind. Hyg. & Tox. 21, No. 3, March 1939.

Dust Control. II. Exhaust for Surfacing Machines & Abrasive Blasting. W.C.J. Hanson. Heat. and Vent., 37, 54-58, May 1940.

MELTING AND ORE CONCENTRATION OPERATIONS

Catching the Dust from a Hammer Mill. O.C. Ralston; J.A. Conley. U.S. Bureau of Mines Report on Investigations, 3538, 1941.

Dust: Its Hazard, Control and Collection with Especial Reference to Surface Plants. G. E. Lynch. Min. & Met. 19, 516-520, Dec. 1938.

Dust Control in Large Scale Ore Concentrating Operations. Robert T. Pring. Am. Inst. Min. & Met. Engr. T.P. 1225, Mining Tech. 4, Sept. 1940.

Dust Control at the Hollinger Milling Plant. P.J. Dunlop. Trans. The Canadian Institute of Mining and Metallurgy, 42, 164-184, 1939.

Dust Control in Mining Operations. J.T. McIntyre. Jour. Chem. Min. & Met. Soc. So. Africa, 38, 143-147, Sept. 1937.

Ore Concentration and Milling. E.W. Engelmann. Min. & Met. 21, 36-38, Jan. 1940.

Solving the Dust Problem. F.W. Ortman, Jr. Safety Engineering. 75, 13-16, Apr. 1938.

TANK VENTILATION

Health Hazards in Chromium Plating. J.J. Bloomfield; Wm. Blum. Public Health Reports, 43, 2330, 1928.

Control of Chromic Acid Mists from Plating Tanks. E.C. Riley; F.H. Goldman. Public Health Reports, 52, 172, 1937.

New Data for Practical Design of Ventilation for Electroplating. W.P. Battista; Theodore Hatch; Leonard Greenburg. Heating, Piping and Air Cond., 32, No. 2, pp. 81-85, Feb. 1941.

Ventilation of Plating Tanks. Allen D. Brandt. Ind. Med., 10, No. 7, July 1941.-- Ind. Hyg. Section, 2, section 3.

References on Exhaust Ventilation - 8.

Fundamental Factors in the Design of Lateral Exhaust Hoods for Industrial Tanks.
Leslie Silverman. Jour. Ind. Hyg. & Tox. 23, No. 5, May 1941.

Safe Operation of Degreasing Tanks using Trichlorethylene. W.B. Harris; C.B. Ford;
F.A. Patty; T.F. Hatch. Am. Jour. Pub. Health, 29, 603, 1939.

Trichlorethylene Degreasing Tanks and Their Safe Operation. W.B. Harris; C.B. Ford;
F.A. Patty; T.F. Hatch. Industrial Bull., N.Y. State Dept. of Labor, 18, 132-134,
Mar. 1939.

Ventilation of a Trichlorethylene Degreaser. W.N. Witheridge; H.T. Walworth. Jour.
Ind. Hyg. & Tox. 22, 175, 1940.

Ventilation of Wire Impregnating Tanks Using Chlorinated Hydrocarbons. S. Yaglou;
F.W. Sands; P. Drinker. Jour. Ind. Hyg. & Tox. 20, 401, 1938.

Essentials of Design for Steam Exhaust Hoods Based upon Open Tank Tests. T.F. Hatch;
W.P. Battista. N.Y. State Dept. of Labor Industrial Bulletin, 19, 115, May, June
1940.

PRODUCED BY
WESTINGHOUSE-NORTH CAROLINA