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Research Needs

NIOSH [1993] has developed a fiber research strategy that proposes the following:

- Research into the mechanisms for human fiber disease
- Epidemiologic studies of fiber-exposed workers for whom limited or no health data exist
- Toxicologic experiments with fibers for which health effects have not been established

The research strategy also considers the usefulness of integrating fiber data from various scientific disciplines (toxicology, epidemiology, industrial hygiene, occupational medicine) to elucidate the characteristics of fibers.

In addition, NIOSH recommends that the following steps be taken with regard to RCF research:

1. Conduct basic scientific investigations, including in vitro and in vivo animal studies, to delineate the mechanism of action for RCF toxicity.
2. Conduct comparable studies for other SVFs and natural fibers so that the mechanistic data can be compared. For instance, Coffin et al. [1992] examined the ability of different synthetic and natural fibers to induce mesotheliomas. They suggested that in addition to fiber length and width, currently undefined intrinsic surface characteristics of the fibers are directly related to their mesothelioma induction potency.
3. Conduct a series of in vitro and in vivo animal studies to ensure that fiber toxicity studies share a consistent, standardized approach. Such studies will ensure comparability of results in a variety of experiments that all use well-characterized, known concentrations of synthetic or natural fibers. A series of controlled, systematic in vitro studies of the factors believed to be involved in RCF pathogenicity should produce valuable data on their mechanism of action. In vitro studies provide an excellent opportunity to investigate fiber toxicity factors such as dose, dimension, surface area, and physicochemical composition. This information is an important supplement to data from chronic inhalation studies.
4. Assure that an independent agency or testing laboratory assembles and keeps a set of reference samples of RCFs (similar to the Union Internationale Contre le Cancer [UICC] asbestos samples). Well-characterized RCF material representative of that found in occupational exposures could serve as an important component of future animal toxicology research into the mechanisms of fiber-induced disease. Additional SVF such as fibrous glass, mineral wool, and other ceramic fibers should also be represented in this repository.
5. Initiate and continue occupational health surveillance for industries that

manufacture, process, install, or remove new fibrous materials. Understanding of this emerging industry is imperative so that exposures to synthetic fibrous materials can be avoided and industry-specific controls can be developed.

6. Continue and expand surveillance of RCF exposure in U.S. manufacturing facilities. Continue monitoring of airborne fiber and total particulate

concentrations and analyze them together with the health data using epidemiologic research methods. Extend surveillance efforts to include assessments of worker exposure in secondary facilities.

7. Assess the effects of variable work schedules (such as shifts longer than 8 hr) on RCF exposure concentrations and health effects.

References

- ACGIH [1998]. 1998 TLVs[®] and BEIs[®]: Threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- ACGIH [2000]. Annual reports of the Committees on threshold limit values (TLVs[®]) and biological exposure indices (BEIs[®]). Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- ACGIH [2004]. Industrial ventilation: a manual of recommended practice. 25th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, Publication No. 2093.
- ACGIH [2005]. 2004 TLVs[®] and BEIs[®]: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- Allshouse J [1995]. Memorandum of October 11, 1995, from John Allshouse, Everest Consulting Associates, Inc., to Kent Hatfield, Ph.D., Education and Information Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Public Health Service, U.S. Department of Health and Human Services.
- American Iron and Steel et al. v. OSHA et al. [1991]. D.C. Cir. 939 F.2d 975.
- Analytical Sciences Incorporated [1999]. Tumor incidence in control animals by route and vehicle of administration in F344/N rats. Report prepared for the National Institute of Environmental Health Sciences, p. 217.
- Asgharian B, Yu CP [1989]. Deposition of fibers in the rat lung. *J Aerosol Sci* 20:355–366.
- Assuncao J, Corn M [1975]. The effects of milling on diameters and lengths of fibrous glass and chrysotile asbestos fibers. *Am Ind Hyg Assoc J* 36(11):811–819.
- ATSDR [2002]. Toxicological profile for synthetic vitreous fibers. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Draft for public comment, September.
- Balmes JR [1990]. Medical surveillance for pulmonary endpoints. *Occup Med: State of the Art Rev* 5(3):499–513.
- Barnhart S [1994]. Irritant bronchitis. In: Rosenstock L, Cullen MR, eds. *Textbook of clinical occupational and environmental medicine*. Philadelphia, PA: W.B. Saunders Company.
- Baron PA [1996]. Application of the thoracic sampling definition to fiber measurement. *Am Ind Hyg Assoc J* 57(9):820–824.
- Becklake MR, Fournier-Massey GG, McDonald JC, Siemiatycki J, Rossiter CE [1970]. Lung function in relation to chest radiographic changes in Quebec asbestos workers. I. Methods, results, and conclusions. *Bull Physiopathol Respir* 6:637–659.

- Begin RO, Samet JM, Shaikh RA [1996]. Asbestos. Part I. Asbestos-related diseases, and Part II. Asbestos in buildings. In: Harber P, Schenker MB, Balmes JR, eds. Occupational and environmental respiratory disease. St. Louis, MO: Mosby-Year Book, Inc., pp. 293–329.
- Bellmann B, Muhle H, Pott F, Konig H, Kloppel H, Spurny K [1987]. Persistence of man-made mineral fibers (MMMF) and asbestos in rat lungs. *Ann Occup Hyg* 31(4B):693–709.
- Bellmann B, Muhle H, Creutzenberg O, Ernst H, Brown RC, Sebastien P [2001]. Effects of nonfibrous particles on ceramic fiber (RCF1) toxicity in rats. *Inhal Toxicol* 13:877–901.
- Bender JR, Hadley JG [1994]. Glass fiber manufacturing and fiber safety: the producer's perspective. *Environ Health Perspect* 102(Suppl 5):37–40.
- Berry G [1999]. Models for mesothelioma incidence following exposure to fibers in terms of timing and duration of exposure and the biopersistence of the fibers. *Inhal Toxicol* 11:111–130.
- Bignon J, Saracci R, Touray JC [1994]. Introduction: INSERM-IARC-CNRS workshop on biopersistence of respirable synthetic fibers and minerals. *Environ Health Perspect* 102(Suppl 5):3–5.
- Blake T, Castranova V, Schwegler-Berry D, Baron P, Deye GJ, Li C, Jones W [1998]. Effect of fiber length on glass microfiber cytotoxicity. *J Toxicol Environ Health* 54:243–259.
- Bolton RE, Vincent JH, Jones AD, Addison J, Beckett ST [1983]. An overload hypothesis for pulmonary clearance of UICC amosite fibres inhaled by rats. *Br J Ind Med* 40:264–272.
- Brain JD, Knudson DE, Sorokin WP, Davis MA [1976]. Pulmonary distribution of particles given by intratracheal instillation or by aerosol inhalation. *Environ Res* 11:13–33.
- Breysse PN, Lees PSJ, Rooney BC [1999]. Comparison of NIOSH Method 7400 A and B counting rules for assessing synthetic vitreous fiber exposures. *Am Ind Hyg Assoc J* 60:526–532.
- Breysse PN, Rice C, Aubroug A, Komoroski MF, Kalinowski M, Versen R, Goodson J, Carlton R, Lees PSJ [1990]. Cowl rinsing procedure for airborne fiber sampling. *Appl Occup Environ Hyg* 5:619–622.
- Brown DM, Fisher C, Donaldson K [1998]. Free radical activity of synthetic vitreous fibers: iron chelation inhibits hydroxyl radical generation by refractory ceramic fiber. *J Toxicol Environ Health* 53:545–561.
- Brown GM, Cowie H, Davis JMG, Donaldson K [1986]. *In vitro* assays for detecting carcinogenic mineral fibres: a comparison of two assays and the role of fibre size. *Carcinogenesis* 17(12):1971–1974.
- Brown RC, Sébastien P, Bellmann B, Muhle H [2000]. Particle contamination in experimental fiber preparations. *Inhal Toxicol* 12(Suppl 3):99–107.
- Brown SK [1992]. Characterization of the fiber diameter distributions of synthetic mineral fiber products and their dusts. *Am Ind Hyg Assoc J* 53(1):27–33.
- Buchta TM, Rice CH, Lockey JE, Lemasters GK, Gartside PS [1998]. A comparative study of the National Institute for Occupational Safety and Health 7400 “A” and “B” counting rules using refractory ceramic fibers. *Appl Occup Environ Hyg* 13(1):58–61.

- Bunn WB III, Chase GR, Hesterberg TW, Versen RA, Anderson R [1992]. Manmade mineral fibers. In: Sullivan JB, Krieger GR, eds. Hazardous materials toxicology, clinical principles of environmental health. Baltimore, MD: Williams and Wilkins, pp. 1139–1150.
- Bunn WB, Bender JR, Hesterberg TW, Chase GR, Konzen JL [1993]. Recent studies of man-made vitreous fibers. *J Occup Med* 35(2):101–113.
- Burge PS, Calvert IA, Trethowan WN, Harrington JM [1995]. Are the respiratory health effects found in manufacturers of ceramic fibers due to the dust rather than the exposure to fibers? *Occup Environ Med* 52:105–109.
- Cantor FL, Gorman RW [1987]. Health hazard evaluation report: Niagara Mohawk Power Corporation, Lycoming, NY. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HETA 85–493–1786.
- Carborundum [1992]. Workplace quality news: evaluation of machining techniques. Niagara Falls, NY: The Carborundum Company, Fibers Division, No. 4, Oct. 27.
- Carborundum [1993]. Workplace quality news: tamping procedure for RCF module furnace linings. Niagara Falls, NY: The Carborundum Company, Fibers Division, No. 6, March 16.
- CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
- Cheng RT, McDermott HJ, Gia GM, Cover TL, Duda MM [1992]. Exposures to refractory ceramic fiber in refineries and chemical plants. *Appl Occup Environ Hyg* 7(6):361–367.
- Cherrie J, Dodgson J, Groat S, Maclaren W [1986]. Environmental surveys in the European man-made mineral fiber production industry. *Scand J Work Environ Health* 12(Suppl 1):18–25.
- Christensen VR, Eastes W, Hamilton RD, Struss AW [1993]. Fiber diameter distributions in typical MMVF wool insulation products. *Am Ind Hyg Assoc J* 54(5):232–238.
- Christensen VR, Jensen SL, Guldberg M, Kamstrup O [1994]. Effect of chemical composition of man-made vitreous fibers on the rate of dissolution in vitro at different pHs. *Environ Health Perspect* 102(5):83–86.
- Churg A [1994]. Deposition and clearance of chrysotile asbestos. *Ann Occup Hyg* 38(4):625–633.
- Coffin DL, Cook PM, Creason JP [1992]. Relative mesothelioma induction in rats by mineral fibers: comparison with residual pulmonary mineral fiber number and epidemiology. *Inhal Toxicol* 4:273–300.
- Coin PG, Roggli VL, Brody AR [1992]. Deposition, clearance, and translocation of chrysotile asbestos from peripheral and central regions of the rat lung. *Environ Res* 58:97–116.
- Corn M, Esmen NA [1979]. Workplace exposure zones for classification of employee exposures to physical and chemical agents. *Am Ind Hyg Assoc J* 40:47–57.
- Corn M, Lees PSJ, Breyse PN [1992]. Final report. Characterization of end-user exposures to industrial (RCF) insulation products. Baltimore, MD: Johns Hopkins University.
- Cornett MJ, Rice C, Hertzberg VS, Lockey JE [1989]. Assessment of fiber deposition on the conductive sampling cowl in the refractory ceramic fiber industry. *Appl Ind Hyg* 4:201–204.

- Cowie HA, Beck J, Wild P, Massin N, Auburtin G, Piekarski C, Hutchison PA, Russell M, Tomain J-P, Cherrie JW, Groat S, Hurley JF, Soutar CA [1999]. A study of the respiratory health of workers in the European RCF industry. Vol. 2. IOM Research Report TM/99/01.
- Cowie HA, Wild P, Beck J, Auburtin G, Piekarski C, Massin N, Cherrie JW, Hurley JF, Miller BG, Groat S, Soutar CA [2001]. An epidemiological study of the respiratory health of workers in the European refractory ceramic fibre industry. *Occup Environ Med* 58:800–810.
- Creutzenberg O, Bellmann B, Muhle H [1997]. Biopersistence and bronchoalveolar lavage investigations in rats after a subacute inhalation of various man-made mineral fibres. *Ann Occup Hyg* 41(Suppl 1):213–218.
- Cullen RT, Miller BG, Davis JMG, Brown DM, Donaldson K [1997]. Short-term inhalation and *in vitro* tests as predictors of fiber pathogenicity. *Environ Health Perspect* 105(Suppl 5):1235–1240.
- Dankovic DA [2001]. Memorandum of January 22, 2001, from DA Dankovic, Education and Information Division, Risk Evaluation Branch, to Kathleen MacMahon, Education and Information Division, Document Development Branch, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Public Health Service, U.S. Department of Health and Human Services.
- Davis JMG, Addison J, Bolton RE, Donaldson K, Jones AD, Wright A [1984]. The pathogenic effects of fibrous ceramic aluminum silicate glass administered to rats by inhalation and peritoneal injection. In: *Biological effects of man-made mineral fibers. Proceedings of a WHO/IARC Conference. Vol. 2. Copenhagen, Denmark: World Health Organization/ International Agency for Research on Cancer*, pp. 303–322.
- Davis JMG, Addison J, Bolton RE, Donaldson K, Jones AD, Smith T [1986]. The pathogenicity of long versus short fibre samples of amosite asbestos administered to rats by inhalation and intraperitoneal injection. *Br J Exp Pathol* 67:415–430.
- Davis JMG, Jones AD [1988]. Comparisons of the pathogenicity of long and short fibres of chrysotile asbestos in rats. *Br J Exp Pathol* 69:717–737.
- Davis JMG, Brown DM, Cullen RT, Donaldson K, Jones AD, Miller BG, McIntosh C, Searl A [1996]. A comparison of methods of determining and predicting the pathogenicity of mineral fibers. *Inhal Toxicol* 8:747–770.
- DECOS [1995]. Man made mineral fibers: health based recommended occupational exposure limits. The Haag, Netherlands: The Health Council of the Netherlands, Dutch Expert Committee on Occupational Standards.
- Dement JM, Wallingford KM [1990]. Comparison of phase contrast and electron microscopic methods for evaluation of occupational asbestos exposures. *Appl Occup Environ Hyg* 5:242–247.
- Dement JM, Merchant JA, Green FHY [1986]. Asbestosis. In: Merchant JA, ed. *Occupational respiratory diseases*. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 86–102, pp. 287–327.
- DOD [1997]. Man-made vitreous fibers. Norfolk, VA: U.S. Department of Defense, U.S. Navy, Navy Environmental Health Center, Navy Environmental Health Center Technical Manual NEHC–TM6290.91–1, Rev. A.

- Dopp E, Schuler M, Schiffmann D, Eastmond DA [1997]. Induction of micronuclei, hyperdiploidy and chromosomal breakage affecting the centric/pericentric regions of chromosomes 1 and 9 in human amniotic fluid cells after treatment with asbestos and ceramic fibers. *Mutat Res* 377:77–87.
- Driscoll KE, Costa DL, Hatch G, Henderson R, Oberdorster G, Salem H, RB Schlesinger [2000]. Intratracheal instillation as an exposure technique for the evaluation of respiratory tract toxicity: uses and limitations. *Toxicol Sci* 55(1):24–35.
- Dunn KH, Venturin DE, Chen SH, and Treadway JC, Cecala AR, Shulman SA, Cleary JN [2000]. Engineering controls for sanding of refractory ceramic fiber (RCF) materials. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, ECTB Slides 246–05b. Presented at the American Industrial Hygiene Conference and Exposition, Orlando, FL, May 19–26.
- Dunn KH, Shulman SA, Cecala AB, Venturin DE [2004]. Evaluation of a local exhaust ventilation system for controlling refractory ceramic fibers during disc sanding. *J Occup Environ Hyg* 1:D107–D111.
- EPA [1973]. Refractory ceramic fibers (CASRN not found). Integrated Risk Information System (IRIS) Report 0647. Washinton, DC: U.S. Environmental Protection Agency, last revised 07/01/1993, accessed online 01/27/05 at www.epa.gov/iris/subst/0647.htm.
- Esmen NA, Corn M, Hammad YY, Whittier D, Kotsko N, Haller M, Kahn RA [1979]. Exposure of employees to man-made mineral fibers: ceramic fiber production. *Environ Res* 19:265–278.
- Everest [1998]. Review of fifth year workplace monitoring. Cranbury, NJ: Everest Consulting Associates (ECA).
- Everitt JI, Gelzleichter TR, Bermudez E, Mangum JB, Wong BA, Janszen DB, Moss OR [1997]. Comparison of pleural responses of rats and hamsters to subchronic inhalation of refractory ceramic fibers. *Environ Health Perspect* 105 (Suppl 5):1209–1213.
- Fayerweather WE, Bender JR, Hadley JG, Eastes W [1997]. Quantitative risk assessment for a glass fiber insulation product. *Regul Toxicol Pharmacol* 25:103–120.
- Ferris BG [1978]. Part II. Recommended respiratory disease questionnaires for use with adults and children in epidemiologic research: epidemiology standardization project. *Am Rev Respir Dis* 118(6, Part II):7–53.
- Fujino A, Hori H, Higashi T, Morimoto Y, Tanaka I, Kaji H [1995]. In-vitro biological study to evaluate the toxic potentials of fibrous materials. *Int J Occup Environ Health* 1:21–28.
- Gantner BA [1986]. Respiratory hazard from removal of ceramic fiber insulation from high temperature industrial furnaces. *Am Ind Hyg Assoc J* 47(8):530–534.
- Gelzleichter TR, Bermudez E, Mangum JB, Wong BA, Everitt JI, Moss OR [1996a]. Pulmonary and pleural responses in Fischer 344 rats following short-term inhalation of a synthetic vitreous fiber. I: Quantitation of lung and pleural fiber burdens. *Fund Appl Toxicol* 30:31–38.
- Gelzleichter TR, Bermudez E, Mangum JB, Wong BA, Moss OR, Everitt JI [1996b]. Pulmonary and pleural responses in Fischer 344 rats following short-term inhalation of a synthetic vitreous fiber. II: Pathobiologic responses. *Fund Appl Toxicol* 30:39–46.
- Gelzleichter TR, Bermudez E, Mangum JB, Wong BA, Janszen DB, Moss OR, Everitt JI [1999].

- Comparison of pulmonary and pleural responses of rats and hamsters to inhaled refractory ceramic fibers. *Toxicol Sci* 49:93–101.
- Gilmour PS, Beswick PH, Brown DM, Donaldson K [1995]. Detection of surface free radical activity of respirable industrial fibres using supercoiled oX174 RF1 plasmid DNA. *Carcinogenesis* 16(12):2973–2979.
- Gilmour PS, Brown DM, Beswick PH, MacNee W, Rahman I, Donaldson K [1997]. Free radical activity of industrial fibers: role of iron in oxidative stress and activation of transcription factors. *Environ Health Perspect* 105(Suppl 5):1313–1317.
- Gorman RW [1987]. Health hazard evaluation report: Morris Bean & Company, Yellow Springs, OH. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HETA 86–038–1807.
- Groat S, Kauffer E, Lovett M, Miller BG, Kidd MW, Davies LST, McIntosh C, Vigneron JC, Cherrie JW, Johnston A, Robertson A, Hurley JF [1999]. Workplace concentrations of airborne dust and fibres. Vol. 1. IOM Research Report TM/99/01.
- Hagopian JH, Bastress EK [1976]. Recommended industrial ventilation guidelines. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 76–162.
- Hammad Y, Simmons W, Abdel-Kader H, Reynolds C, Weill H [1988]. Effect of chemical composition on pulmonary clearance of man-made mineral fibers. *Ann Occup Hyg* 32(Suppl 1):769–779.
- Harris RL Jr, Timbrell V [1977]. The influence of fibre shape in lung deposition—mathematical estimates. In: Walton WH, ed. *Inhaled particles, IV*. Oxford: Pergamon Press, pp. 75–88.
- Hart GA, Newman MM, Bunn WB, Hesterberg TW [1992]. Cytotoxicity of refractory ceramic fibres to Chinese hamster ovary cells in culture. *Toxicol In vitro* 6(4):317–326.
- Hart GA, Kathman LM, Hesterberg TW [1994]. *In vitro* cytotoxicity of asbestos and man-made vitreous fibers: roles of fiber length, diameter and composition. *Carcinogenesis* 15(5):971–977.
- Hesterberg TW, Müller WC, McConnell EE, Chevalier J, Hadley JG, Bernstein DM, Thevenaz P, Anderson R [1993]. Chronic inhalation toxicity of size-separated glass fibers in Fischer 344 rats. *Fund Appl Toxicol* 20:464–476.
- Hewett DJ [1996]. Health hazard evaluation and technical assistance report: Standard Steel, Burnham, PA. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH Report No. HETA 94–0329.
- Hill GW [1983]. Fibres, man-made glass and mineral. In: Parmeggiani, L, ed. *Encyclopaedia of occupational health and safety*, Vol. 1. Geneva, Switzerland: International Labour Office, pp. 852–855.
- Hill IM, Beswick PH, Donaldson K [1996]. Enhancement of the macrophage oxidative burst by immunoglobulin coating of respirable fibers: fiber-specific differences between asbestos and man-made fibers. *Exp Lung Res* 22(2):133–148.
- Hillerdal G [1994]. The human evidence: parenchymal and pleural changes. *Ann Occup Hyg* 38(4):561–567.

- Hourihane O, Lessof L, Richardson PC [1966]. Hyaline and calcified plaques as an index of exposure to asbestos: a study of radiological and pathological features of 100 cases with a consideration of epidemiology. *Br Med J [Clin Res Ed]* 1:1069–1074.
- HSE [2004]. Refractory ceramic fibers. Health and Safety Commission Paper HSC/04/06. United Kingdom Health and Safety Executive, Health and Safety Commission, cleared May 17.
- IARC [1988]. IARC monographs on the evaluation of carcinogenic risks to Humans. Vol. 43. Man-made mineral fibers and radon. Lyon, France: World Health Organization. International Agency for Research on Cancer, pp. 33–171.
- IARC [2002]. IARC monographs on the evaluation of carcinogenic risks to humans. Vol. 81. Man-made vitreous fibers. Lyon, France: World Health Organization. International Agency for Research on Cancer.
- ICRP [1994]. Human respiratory tract model for radiological protection. International Commission on Radiological Protection Publication 66, Tarrytown, NY: Elsevier Science Inc.
- ILO [1980]. International classification of radiographs of pneumoconioses: standard films and guidelines. Occupational Safety and Health Series No. 22, Rev. ed. Geneva, Switzerland: International Labour Office.
- ILO [2000]. International classification of radiographs of pneumoconioses, Rev. ed. 2000. Geneva, Switzerland: International Labour Office.
- Janssen YMW, Heintz NH, Marsh JP, Borm PJA, Mossman BT [1994]. Induction of *c-fos* and *c-jun* Proto-oncogenes in target cells of the lung and pleura by carcinogenic fibers. *Am J Respir Cell Mol Biol* 11(5):522–530.
- Jaurand C [1997]. Mechanisms of fiber-induced genotoxicity. *Environ Health Perspect* 105(Suppl 5):1073–1084.
- Jones AD [1993]. Respirable industrial fibers: deposition, clearance and dissolution in animal models. *Ann Occup Hyg* 37(2):211–226.
- Kamp DW, Gracefa P, Pryor WA, Weitzman SA [1992]. The role of free radicals in asbestos-induced diseases. *Free Radical Biol Med* 12:293–315.
- Klaunig JE, Yong X, Isenberg JS, Bachowski S, Kolaja KL, Jiang J, Stevenson DE, Walborg EF Jr. [1998]. The role of oxidative stress in chemical carcinogenesis. *Environ Health Perspect* 106(Suppl 1):289–295.
- Kominsky JR [1978]. Health hazard evaluation determination report: Heppenstall Company, Pittsburgh PA. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HHE 77–115–473.
- Krantz S, Christensson B, Lundgren L, Paulsson B, Figler B, Persson A [1994]. Exposure to refractory ceramic fibers in smelters and foundries. *Arbets Miljo Institutet (National Institute of Occupational Health)* 34.
- Kromback F, Müunzing S, Allmeling A-M, Gerlach JT, Behr J, Dörger M [1997]. Cell size of alveolar macrophages: an interspecies comparison. *Environ Health Perspect* 105(Suppl 5):1261–1263.
- Lawson CC, LeMasters MK, LeMasters GK, Reutman SS, Rice CH, Lockey JE [2001]. Reliability and validity of chest radiograph surveillance programs. *Chest* 120:64–68.
- Leanderson P, Tagesson C [1989]. Cigarette smoke potentiates the DNA-damaging effect of manmade mineral fibers. *Am J Ind Med* 16:697–706.

- Leanderson P, Soderkvist P, Tagesson C [1989]. Hydroxyl radical mediated DNA base modification by manmade mineral fibres. *Br J Ind Med* 46:435–438.
- Lees PSJ, Breyse PN, McArthur BR, Miller ME, Rooney BC, Robbins CA, Corn M [1993]. End user exposure to man-made vitreous fibers: I. Installation of residential insulation products. *Appl Occup Environ Hyg* 8(12):1022–1030.
- Leidel NA, Busch KA [1994]. Statistical design and data analysis requirements. In: Harris RL, Cralley LV, eds. *Patty's industrial hygiene and toxicology*. 3rd ed. Vol. 3, Part A. New York: John Wiley and Sons, Inc., pp. 453–582.
- Leikauf GD, Fink SP, Miller ML, Lockey JE, Driscoll KE [1995]. Refractory ceramic fibers activate alveolar macrophage eicosanoid and cytokine release. *J Appl Physiol* 78(1):164–171.
- Leineweber JP [1984]. Solubility of fibres in vitro and in vivo. In: *Biological effects of man-made mineral fibres*. World Health Organization, pp. 87–101.
- Lemaire I, Ouellet S [1996]. Distinctive profile of alveolar macrophage-derived cytokine release induced by fibrogenic and nonfibrogenic mineral dusts. *J Toxicol Env Health* 47:465–478.
- Lemasters G, Lockey J, Rice C, McKay R, Hansen K, Lu J, Levin L, Gartside P [1991]. Pleural changes in workers manufacturing refractory ceramic fiber and products. Unpublished report.
- Lemasters G, Lockey J, Rice C, McKay R, Hansen K, Lu J, Levin L, Gartside P [1994]. Radiographic changes among workers manufacturing refractory ceramic fibre and products. *Ann Occup Hyg* 38(Supp. 1):745–751.
- Lemasters GK, Lockey JE, Levin L, McKay RT, Rice CH, Horvath EP, Papes DM, Lu JW, Feldman DJ [1998]. An industry-wide pulmonary study of men and women manufacturing refractory ceramic fiber. *Am J Epidemiol* 148(9):910–919.
- LeMasters GK, Lockey JE, Yiin JH, Hilbert TJ, Levin LS, Rice CH [2003]. Mortality of workers occupationally exposed to refractory ceramic fibers. *J Occup Environ Med* 45:440–450.
- Lentz TJ, Rice CH, Lockey JE, Succop PA, Lemasters GK [1999]. Potential significance of airborne fiber dimensions measured in the U.S. refractory ceramic fiber manufacturing industry. *Am J Ind Med* 36:286–298.
- Lewis TR, Morrow PE, McClellan RO, Raabe OG, Kennedy GL, Schwetz BA, Goehl TJ, Roycroft JH, Chhabra RS [1989]. Cotemporary issues in toxicology: establishing aerosol exposure concentrations for inhalation toxicology studies. *Toxicol Appl Pharm* 99:377–383.
- Lippmann M [1988]. Asbestos exposure indices. *Environ Res* 46:86–106.
- Lippman M [1990]. Man-made mineral fibers (MMMMF): human exposures and health risk assessment. *Toxicol Ind Health* 6(2):225–246.
- Ljungman AG, Lindahl M, Tagesson C [1994]. Asbestos fibres and man-made mineral fibres: induction and release of tumour necrosis factor- α from rat alveolar macrophages. *Occup Environ Med* 51:777–783.
- Lockey J, Lemasters G, Rice C, McKay R, Hansen K, Lu J, Levin L, Gartside P, Dimos J, Conkel B, Ausdenmoore K, Giles D [1990]. An industry-wide pulmonary morbidity study of workers manufacturing refractory ceramic fibers and RCF fibers. Stamford, CT: Thermal Insulation Manufacturers Association. Unpublished report.
- Lockey JE, Wiese NK [1992]. Health effects of synthetic vitreous fibers. *Clin Chest Med* 13(2):329–339.

- Lockey JE, Lemasters GK, Rice CH, McKay RT, Gartside PS [1993]. A retrospective cohort morbidity, mortality, and nested case-control study of the respiratory health of individuals manufacturing refractory ceramic fiber and RCF products. Cincinnati, OH: University of Cincinnati. Unpublished report.
- Lockey J, Lemasters G, Rice C, Hansen K, Levin L, Shipley R, Spitz H, and Wiot J [1996]. Refractory ceramic fiber exposure and pleural plaques. *Am J Respir Crit Care Med* 154:1405–1410.
- Lockey JE, Levin LS, Lemasters GK, McKay RT, Rice CH, Hansen Kr, Papes DM, Simpson S, Medvedovic M [1998]. Longitudinal estimates of pulmonary function in refractory ceramic fiber manufacturing workers. *Am J Respir Crit Care Med* 157:1226–1233.
- Lockey JE, LeMasters GK, Levin L, Rice C, Yiin J, Reutman S, Papes D [2002]. A longitudinal study of chest radiographic changes of workers in the refractory ceramic fiber industry. *Chest* 121:2044–2051.
- Luoto K, Holopainen M, Savolainen K [1994]. Scanning electron microscopic study on the changes in the cell surface morphology of rat alveolar macrophages after their exposure to man-made vitreous fibers. *Environ Res* 66(2):198–207.
- Luoto K, Holopainen M, Savolainen K [1995]. Durability of man-made vitreous fibres as assessed by dissolution of silicon, iron and aluminium in rat alveolar macrophages. *Ann Occup Hyg* 39(6):855–867.
- Luoto K, Holopainen M, Sarataho M, Savolainen K [1997]. Comparison of cytotoxicity of man-made vitreous fibres. *Ann Occup Hyg* 41(1):37–50.
- Lyman MD [1992]. Health hazard evaluation report: Thermal Ceramics, Augusta, GA. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH Report No. HETA 91–185.
- MacKinnon PA, Lentz TJ, Rice CH, Lockey JE, Lemasters GK, Gartside PS [2001]. Electron microscopy study of refractory ceramic fibers. *Appl Occup Environ Hyg J* 16(10):944–951.
- Manville Technical Center [1991]. Section 8e (Toxic Substances Control Act) report on refractory ceramic fibers. Washington, DC: U.S. Environmental Protection Agency, Office of Toxic Substances. EPA Document Control No. 8EHQ–0691–0553. Unpublished document.
- Mast RW, McConnell EE, Anderson R, Chevalier J, Kotin P, Bernstein DM, Thevenaz P, Glass LR, Müller WC, Hesterberg TW [1995a]. Studies on the chronic toxicity (inhalation) of four types of refractory ceramic fiber in male Fischer 344 rats. *Inhal Toxicol* 7:425–467.
- Mast RW, McConnell EE, Hesterberg TW, Chevalier J, Kotin P, Thevenaz P, Bernstein DM, Glass LR, Müller WC, Anderson R [1995b]. Multiple-dose chronic inhalation toxicity study of size-separated kaolin refractory ceramic fiber in male Fischer 344 rats. *Inhal Toxicol* 7:469–502.
- Mast RW, Maxim LD, Utell MJ, Walker AM [2000]. Refractory ceramic fiber: toxicology, epidemiology, and risk analyses—a review. *Inhal Toxicol* 12(5):359–399.
- Maxim LD, Kelly WP, Walters T, Waugh R [1994]. A multiyear workplace-monitoring program for refractory ceramic fibers. *Regul Toxicol Pharmacol* 20(3):S200–S215.
- Maxim LD, Allshouse JN, Kelly WP, Walters T, Waugh R [1997]. A multiyear workplace-monitoring program for refractory ceramic

- fibers: findings and conclusions. *Regul Toxicol Pharmacol* 26:156–171.
- Maxim LD, Allshouse JN, Chen SH, Treadway J, Venturin D [1998]. The development and use of respirator response functions as part of a workplace exposure monitoring program for control of potential respiratory hazards. *Regul Toxicol Pharmacol* 27:131–149.
- Maxim LD, Venturin D, Allshouse JN [1999a]. Respirable crystalline silica exposure associated with the installation and removal of RCF and conventional silica-containing refractories in industrial furnaces. *Regul Toxicol Pharmacol* 29(1): 44–63.
- Maxim LD, Mast RW, Utell MJ, Yu CP, Boymel PM, Zoitos BK, Cason JE [1999b]. Hazard assessment and risk analysis of two new synthetic vitreous fibers. *Regul Toxicol Pharmacol* 30:54–74.
- Maxim LD, Allshouse JN, Chen SH, Treadway JC, Venturin DN [2000a]. Workplace monitoring for refractory ceramic fiber (RCF) in the United States. *Regul Toxicol Pharmacol* 32:293–309.
- Maxim LD, Allshouse JN, Venturin DE [2000b]. The random-effects model applied to refractory ceramic fiber data. *Regul Toxicol Pharmacol* 32:190–199.
- Maxim LD, McConnell EE [2001]. Interspecies comparisons of the toxicity of asbestos and synthetic vitreous fibers: a weight-of-evidence approach. *Regul Toxicol Pharmacol* 33:319–342.
- Maxim LD, Yu CP, Oberdörster G, Utell MJ [2003]. Quantitative risk analyses for RCF: survey and synthesis. *Regul Toxicol Pharmacol* 38:400–416.
- McConnell EE, Mast RW, Hesterberg TW, Chevalier J, Kotin P, Bernstein DM, Thevenaz P, Glass LR, Anderson R [1995]. Chronic inhalation toxicity of a kaolin-based refractory ceramic fiber in Syrian golden hamsters. *Inhal Toxicol* 7:503–532.
- McConnell EE, Axten C, Hesterberg TW, Chevalier J, Müller WC, Everitt J, Oberdörster G, Chase GR, Thevenaz P, Kotin P [1999]. Studies on the inhalation toxicology of two fiberglasses and amosite asbestos in the Syrian golden hamster. Part II: Results of chronic exposure. *Inhal Toxicol* 11:785–835.
- Middleton AP [1982]. Visibility of fine fibres of asbestos during routine electron microscopical analysis. *Ann Occup Hyg* 25(1):53–62.
- Moolgavkar SH, Luebeck EG, Turim J, Hanna L [1999]. Quantitative assessment of the risk of lung cancer associated with occupational exposure to refractory ceramic fibers. *Risk Anal* 19(4):599–611.
- Moore MA, Brown RC, Pigott G [2001]. Material properties of MMVFs and their time-dependent failure in lung environments. *Inhal Toxicol* 13:1117–1149.
- Morgan A, Holmes A, Davison W [1982]. Clearance of sized glass fibers from the rat lung and their solubility in vivo. *Ann Occup Hyg* 25(3):317–331.
- Morgan WKC [1994]. Bronchitis, airways' obstruction and occupation. In: Parkes WR, ed. *Occupational lung disorders*, 3rd ed. Boston, MA: Butterworth-Heinemann Ltd.
- Morgan WKC [1995]. Epidemiology and occupational lung disease. In: Morgan WKC, Seaton A, eds. *Occupational lung diseases*, 3rd ed. Philadelphia, PA: W.B. Saunders Company, pp. 82–110.
- Morimoto Y, Kido M, Tanaka I, Fujino A, Higashi T, Yokosaki Y [1993]. Synergistic effects of mineral fibres and cigarette smoke on the production of tumour necrosis factor by alveolar macrophage of rats. *Br J Ind Med* 50:955–960.

- Morrow PE [1986]. The setting of particulate exposure levels for chronic inhalation toxicity studies. *J Am Coll Toxicol* 5(6):533–544.
- Muhle H, Bellmann B [1996]. Interim report: study of the in vivo solubility of vitreous silicate fiber dusts. Hanover, Germany: Fraunhofer Institute for Toxicology and Aerosol Research.
- NIOSH [1974]. Criteria for a recommended standard: occupational exposure to crystalline silica. Washington, DC: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 75–120, pp. 54–55, 60–61.
- NIOSH [1977a]. Occupational exposure sampling strategy manual. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77–173.
- NIOSH [1977b]. NIOSH criteria for a recommended standard: occupational exposure to fibrous glass. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77–152.
- NIOSH [1993]. NIOSH occupational fiber exposures and lung disease: research strategy. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Version 7.4.
- NIOSH [1995a]. NIOSH criteria for a recommended standard: occupational exposure to respirable coal mine dust. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 95–106.
- NIOSH [1995b]. Report to Congress on workers' home contamination study conducted under the Workers' Family Protection Act (29 U.S.C. 671a). Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 95–123.
- NIOSH [1996]. NIOSH guide to the selection and use of particulate respirators certified under 42 CFR 84. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 96–101.
- NIOSH [1998]. NIOSH manual of analytical methods, 4th ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98–119.
- NIOSH [2002]. NIOSH certified equipment list as of November, 2004. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002–144. [http://www2a.cdc.gov/drds/cel/cel_form_code.asp]
- NIOSH [2004]. NIOSH respirator selection logic. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005–100.

- <http://www.cdc.gov/niosh/docs/2005-100/default.html>
- Nyberg K, Johansson A, Camner P [1989]. Intraphagolysosomal pH in alveolar macrophages studied with fluorescein-labelled amorphous silica particles. *Exp Lung Res* 15:49–62.
- Oberdörster G [1994]. Macrophage-associated responses to chrysotile. *Ann Occup Hyg* 38:601–615.
- Oberdörster G, Morrow PE, Spurny K [1988]. Size dependent lymphatic short term clearance of amosite fibres in the lung. *Ann Occup Hyg* 32(Suppl 1):149–156.
- O'Brien DM, Froehlich PA, Gressel MG, Hall RM, Valiante D, Bost P, Clark NJ [1990]. Sentinel event notification system for occupational risks (SENSOR): recommendations for control of silica exposure at Ingersoll-Rand Company, Phillipsburg, NJ. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. ECTB 171–17b.
- Okayasu R, Wu L, Hei TK [1999]. Biological effects of naturally occurring and man-made fibres: *in vitro* cytotoxicity and mutagenesis in mammalian cells. *Br J Cancer* 79(9–10):1319–1324.
- OSHA [2002]. OSHA supports program designed to protect workers exposed to refractory ceramic fibers. U.S. Department of Labor, Occupational Safety and Health Administration, Office of Communications, OSHA trade news release, February 14.
- Perkins RC, Scheule RK, Hamilton R, Gomes G, Freidman G, Holian A [1993]. Human alveolar macrophage cytokine release in response to *in vitro* and *in vivo* asbestos exposure. *Exp Lung Res* 19:55–65.
- Perrault G, Dion C, Cloutier Y [1992]. Sampling and analysis of mineral fibers on construction sites. *Appl Occup Environ Hyg J* 7(5):323–326.
- Peters GA, Peters BJ [1980]. Sourcebook on asbestos diseases: medical, legal, and engineering aspects. Chapter 1. Products. New York: Garland STPM Press, pp. A1–A7.
- Peto R, Lopez AD, Boreham J, Thun M, Heath C Jr. [1992]. Mortality from tobacco in developed countries: indirect estimation from national vital statistics. *The Lancet* 339:1268–1278.
- Piguet PF, Collart MA, Grau GE, Sappino A-P, Vassalli P [1990]. Requirement of tumour necrosis factor for development of silica-induced pulmonary fibrosis. *Nature* 344:245–247.
- Pott F [1997]. Fibrous dusts. In: Greim H, ed. Occupational toxicants: critical data evaluation for MAK values and classification of carcinogens. Vol. 8. Weinheim, Germany: Verlagsgesellschaft mbH (VCH).
- Pott F, Ziem U, Reiffer FJ, Huth F, Ernst H, Mohr U [1987]. Carcinogenicity studies of fibres, metal compounds, and some other dusts in rats. *Exp Pathol* 32:129–152.
- Pott F, Roller M, Kamino K, Bellman B [1994]. Significance of durability of mineral fibers for their toxicity and carcinogenic potency in the abdominal cavity of rats in comparison with the low sensitivity of inhalation studies. *Environ Health Perspec* 102(Suppl 5):145–150.
- RCFC [1993]. Refractory ceramic fiber (RCF) monitoring project: quality assurance project plan. Washington, DC: Refractory Ceramic Fibers Coalition.
- RCFC [1996]. Refractory ceramic fibers: a substitute study. A report prepared by Everest Consulting Associates, submitted to the U.S. Environmental Protection Agency, Washington, DC, for the Refractory Ceramic Fibers Coalition.

- RCFC [1998]. Refractory ceramic fiber. Report presented to the ACGIH Committee on Threshold Limit Values for Chemical Substances and Physical Agents, July 13.
- RCFC [2001]. PSP 2000 product stewardship strategic plan for refractory ceramic fibers. [<http://www.rcfc.net/psp2000.htm>].
- RCFC [2004]. RCFC Member companies. [<http://www.rcfc.net/about.htm>].
- Rice C, Lockey J, Lemasters G, Dimos J, Gartside P [1994]. Assessment of current fibre and silica exposure in the U.S. refractory ceramic fibre manufacturing industry. *Ann Occup Hyg* 38(Suppl 1):739–744.
- Rice C, Lockey J, Lemasters G, Levin L, Gartside P [1996]. Identification of changes in airborne fiber concentrations in refractory ceramic fibre manufacture related to process or ventilation modifications. *Occup Hyg* 3:85–90.
- Rice C, Lockey J, Lemasters G, Levin L, Staley P, Hansen K [1997]. Estimation of historical and current employee exposure to refractory ceramic fibers during manufacturing and related operations. *Appl Occup Environ Hyg* 12(1):54–61.
- Rice CH, Levin LS, Borton EK, Lockey JE, Hilbert TJ, LeMasters GK [2005]. Exposures to refractory ceramic fibers in manufacturing and related operations: A 10-year update. *J Occup Environ Hyg* 2:462–473.
- Rödelsperger K, Weitowitz HJ [1995]. Airborne fibre concentrations and lung burden compared to the tumour response in rats and humans exposed to asbestos. *Ann Occup Hyg* 39(5):715–725.
- Rogers A, Yeung P, Berry G, Conaty G, Apthorpe L [1997]. Exposure and respiratory health of workers in the Australian refractory ceramic fibre production industry. *Ann Occup Hyg* 41(Suppl 1):261–266.
- Rood AP [1988]. Size distribution of airborne ceramic fibres as determined by transmission electron microscopy. *Ann Occup Hyg* 32(2):237–240.
- Rossiter CE, Gilson JC, Sheers G, Thomas HF, Trethowan WN, Cherrie JW, Harrington JM [1994]. Refractory ceramic fibre production workers. Analysis of radiograph readings. *Ann Occup Hyg* 38(Suppl 1):731–738.
- Scholze H, Conradt R [1987]. An in vitro study of the chemical durability of siliceous fibres. *Ann Occup Hyg* 31(4B):683–692.
- Selikoff IJ, Hammond EC, Churg J [1968]. Asbestos exposure, smoking, and neoplasia. *J Am Med Assoc* 204(2):104–110.
- Smith DM, Ortiz LW, Archuleta RF, Johnson NF [1987]. Long-term health effects in hamsters and rats exposed chronically to man-made vitreous fibres. *Ann Occup Hyg* 31(4B):731–754.
- Solomon E, Borrow J, Goddard AD [1991]. Chromosome aberrations and cancer. *Science* 254:1153–1160.
- Stacey MH [1988]. Production and characterisation of fibers for metal matrix composites. *Mater Sci Technol* 4(3):227–230.
- Stanton MF, Layard M, Tegeris A, Miller E, May M, Kent E [1977]. Carcinogenicity of fibrous glass: pleural response in the rat in relation to fiber dimension. *J Natl Cancer Inst* 58(3):587–603.
- Stanton MF, Layard M, Tegeris A, Miller E, May M, Morgan E, Smith A [1981]. Relation of particle dimension of carcinogenicity in amphibole asbestos and other fibrous minerals. *J Natl Cancer Inst* 67:965–975.
- Sweeney J, Gilgrist D [1998]. Exposures to respirable silica during relining of furnaces for molten metals. *Appl Occup Environ Hyg* 13(7):508–510.

- Thornton CC, Lehman CB, Wood EW [1984]. Flexible blanket noise control insulation field test results and evaluation. In: Maling GC, ed. *Inter noise 84, Proceedings of the International Conference on Noise Control Engineering*. Honolulu, HI: Noise Control Foundation, pp. 405–408.
- TIMA [1993]. *Man-made vitreous fibers: nomenclature, chemical and physical properties*. Nomenclature Committee of Thermal Insulation Manufacturers Association, Inc., 2nd rev., March 1.
- Timbrell V [1965]. Human exposure to asbestos: dust controls and standards. The inhalation of fibrous dusts. *Ann NY Acad Sci* 132(1):255–273.
- Timbrell V [1982]. Deposition and retention of fibres in the human lung. *Ann Occup Hyg* 26(1–4):347–369.
- Timbrell V [1989]. Review of the significance of fibre size in fibre-related lung disease: a centrifuge cell for preparing accurate microscope-evaluation specimens from slurries used in inoculation studies. *Ann Occup Hyg* 33(4):483–505.
- Tran CL, Jones AD, Cullen RT, Donaldson K [1997]. Overloading of clearance of particles and fibres. *Ann Occup Hyg* 41(Suppl 1):237–243.
- Treadwell MD, Mossman BT, Barchowsky A [1996]. Increased neutrophil adherence to endothelial cells exposed to asbestos. *Toxicol Appl Pharmacol* 139:62–70.
- Trethowan WN, Burge PS, Rossiter CE, Harrington JM, Calvert IA [1995]. Study of the respiratory health of employees in seven European plants that manufacture ceramic fibres. *Occup Environ Med* 52(2):97–104.
- Turim J, Brown RC [2003]. A dose-response model for refractory ceramic fibers. *Inhal Toxicol* 15:1103–1118.
- Vallyathan V, Shi X, Castranova V [1998]. Reactive oxygen species: their relation to pneumoconiosis and carcinogenesis. *Environ Health Perspect* 106(Suppl 5):1151–1155.
- van den Bergen EA, Rocchi PSJ, Boogaard PJ [1994]. Ceramic fibers and other respiratory hazards during the renewal of the refractory lining in a large industrial furnace. *Appl Occup Environ Hyg* 9(1):32–35.
- Venturin DE [1998]. *Unit operational code of practice and engineering controls guidebook: band saws*. Amherst, NY: Unifax Inc. prepared for Refractory Ceramic Fibers Coalition.
- Vincent JH [1985]. On the practical significance of electrostatic lung deposition of isometric and fibrous aerosols. *J Aerosol Sci* 16(6):511–519.
- Volkwein JC, Page SJ, Thimons ED [1982]. *Canopy-air curtain dust reductions on a gathering-arm loader*. Pittsburgh, PA: U.S. Department of the Interior, Bureau of Mines, Report of Investigations 8603.
- Volkwein JC, Engle MR, Raether TD [1988]. *Dust control with clean air from and overhead air supply island (OASIS)*. *Appl Ind Hyg* 3(8):236–239.
- Vu VT [1988]. *Health hazard assessment of nonasbestos fibers*. Washington, DC: U.S. Environmental Protection Agency, final draft.
- Vu V, Barrett JC, Roycroft J, Schuman L, Dankovic D, Baron P, Martonen T, Pepelko W, Lai D [1996]. *Workshop report: chronic inhalation toxicity and carcinogenicity testing of respirable fibrous particles*. *Reg Toxicol Pharm* 24:202–212.
- Wagner GR [1996]. *Screening and surveillance of workers exposed to mineral dust*. Geneva, Switzerland: World Health Organization.

- Wagner JC, Berry G, Timbrell V [1973]. Mesotheliomata in rats after inoculation with asbestos and other minerals. *Br J Cancer* 28:173–185.
- Walker AM, Maxim LD, Utell M [2002]. Risk analysis for mortality from respiratory tumors in a cohort of refractory ceramic fiber workers. *Regul Toxicol Pharmacol* 35: 95–104.
- Wang Q, Han C, Wu W, Wang H, Liu S, Kohyama N [1999]. Biological effects of man-made mineral fibers (I): reactive oxygen species production and calcium homeostasis in alveolar macrophages. *Ind Health* 37:62–67.
- Warheit DB [1994]. A review of some biophysical factors and their potential roles in the development of fiber toxicity. *Regul Toxicol Pharmacol* 20: S113–S120.
- WHO/EURO Technical Committee for Monitoring and Evaluating Airborne MMMF [1985]. The WHO/EURO man-made mineral fiber reference scheme. *Scand J Work Environ Health* 11:123–129.
- Wright A, Cowie H, Gormley IP, Davis JMG [1986]. The *in vitro* cytotoxicity of asbestos fibers: I. P388D₁ cells. *Am J Ind Med* 9:371–384.
- Yamato H, Hori H, Tanaka I, Higashi T, Morimoto Y, Kido M [1994]. Retention and clearance of inhaled ceramic fibres in rat lungs and development of a dissolution model. *Occup Environ Med* 51:275–280.
- Ye J, Shi X, Jones W, Rojanasakul Y, Cheng N, Schwegler-Berry D, Baron P, Deye GJ, Li C, Castranova V [1999]. Critical role of glass fiber length in TNF- α production and transcription factor activation in macrophages. *Am J Physiol* 276: L426–434.
- Yegles J, Janson X, Dong HY, Renier A, Jaurand M-C [1995]. Role of fibre characteristics on cytotoxicity and induction of anaphas/telophase aberrations in rat pleural mesothelial cells *in vitro*: correlations with *in vivo* animal findings. *Carcinogenesis* 16(11):2751–2758.
- Yu CP, Oberdörster G [2000]. Dose response and human cancer and non-cancer risk assessment of inhaled refractory ceramic fibers (RCF).
- Yu CP, Asgharian B, Yen BM [1986]. Impaction and sedimentation deposition of fibers in airways. *Am Ind Hyg Assoc J* 47(2):72–77.
- Yu CP, Zhang L, Oberdörster G, Mast RW, Glass LR, Utell MJ [1994]. Clearance of refractory ceramic fibers (RCF) from the rat lung: development of a model. *Environ Res* 65:243–253.
- Yu CP, Ding YJ, Zhang L, Oberdörster G, Mast RW, Maxim LD, Utell MJ [1996]. A clearance model of refractory ceramic fibers (RCF) in the rat lung including fiber dissolution and breakage. *J Aerosol Sci* 27(1):151–160.
- Yu CP, Ding YJ, Zhang L, Oberdörster G, Mast RW, Maxim LD, Utell MJ [1997]. Retention modeling of refractory ceramic fibers (RCF) in humans. *Regul Toxicol Pharmacol* 25:18–25.