Comparative Toxicology of Blasting Abrasives

Evidence summary drawing from IARC, NIOSH, NTP, and peer-reviewed occupational health research

ABRASIVE	STUDIES	EXPOSURE TESTED	LUNG EFFECTS OBSERVED	REGULATORY VERDICT
10X / Mineral wool	10,000+ workers in U.S. and European production cohorts; multiple chronic animal inhalation studies; comprehensive IARC evidence review *(IARC Monograph Vol. 81, 2002)*	Inhalation up to 30 mg/m³, 6 hrs/day, 5 days/week, for 24 months in animals; decades of occupational exposure in workers	No increased lung cancer or mesothelioma in worker cohorts. No carcinogenicity in chronic animal inhalation. Approximately 90% lung clearance within 12 months of exposure ending. *(McConnell et al., 1994; IARC, 2002)*	**IARC Group 3** Not classifiable as carcinogenic to humans; ACGIH A4
Crystalline silica (blasting sand)	Decades of human cohort epidemiology; extensive animal testing; multiple IARC reviews	Decades of occupational exposure; chronic animal inhalation studies including NTP 39-week inhalation *(NTP, 2020)*	Causes silicosis — a progressive, often fatal, occupational lung disease. Causes lung cancer with chronic exposure. NTP confirmed interstitial fibrosis and alveolar proteinosis in 39-week inhalation studies.	**IARC Group 1** Carcinogenic to humans
Coal slag	1 NIOSH instillation study *(Hubbs et al., 2001)* ; 1 NTP 2-week inhalation study *(NTP, 2020)* ; no human cohort studies	Single 10 mg intratracheal instillation, 28 days observation; 2-week inhalation up to 30 mg/m³	Caused greater lung damage than crystalline silica blasting sand in NIOSH testing despite containing no crystalline silica. Elevated hydroxyproline indicating fibrosis. NTP confirmed focal lung inflammation and alveolar proteinosis.	**No IARC Status**
Garnet	1 NIOSH instillation study *(Hubbs et al., 2001)* ; 1 NTP 2-week inhalation study *(NTP, 2020)* ; no human cohort studies	Single 10 mg intratracheal instillation, 28 days observation; 2-week inhalation up to 30 mg/m³	Most toxic alternative abrasive in NTP testing. Lung clearance half-life of ~89–90 days (approximately 3× slower than blasting sand). 100% of exposed rats developed chronic active inflammation at 15 and 30 mg/m³ exposure.	**No IARC Status**
Olivine	1 NIOSH instillation study *(Porter et al., 2002)* ; no human cohort studies; not included in NTP comparative testing	Single 10 mg intratracheal instillation, 28 days observation	Most toxic abrasive tested in either NIOSH study. Higher lung damage than crystalline silica blasting sand on multiple measures. Alveolar lipoproteinosis in 100% of exposed rats (vs. 1 of 6 sand-exposed rats).	**No IARC Status**
Crushed glass	1 NIOSH instillation study *(Porter et al., 2002)* ; 1 NTP 2-week inhalation study *(NTP, 2020)* ; no human cohort studies	Single 10 mg intratracheal instillation, 28 days observation; 2-week inhalation up to 30 mg/m³	Caused pulmonary fibrosis comparable to crystalline silica blasting sand. Significant upper respiratory tract damage including nose goblet cell hypertrophy and larynx squamous metaplasia. Most reactive abrasive tested for upper airway effects.	**No IARC Status**
Copper slag	1 NIOSH instillation study *(Porter et al., 2002)* ; no human cohort studies; not included in NTP comparative testing	Single 10 mg intratracheal instillation, 28 days observation	Caused pulmonary fibrosis comparable to crystalline silica blasting sand. Persistent cytotoxicity (LDH release) and persistent inflammation 28 days after a single exposure.	**No IARC Status**

Nickel slag	1 NIOSH instillation study *(Porter et al., 2002)*; no human cohort studies; not included in NTP comparative testing	Single 10 mg intratracheal instillation, 28 days observation	Caused pulmonary fibrosis comparable to crystalline silica blasting sand. Persistent alveolar inflammation.	No IARC Status
Staurolite	1 NIOSH instillation study *(Hubbs et al., 2001)*; no human cohort studies; not included in NTP comparative testing	Single 10 mg intratracheal instillation, 28 days observation	Caused persistent pulmonary inflammation and histopathologic evidence of fibrosis. Persistent cytotoxicity (LDH release) 28 days after a single exposure.	No IARC Status
Specular hematite (iron oxide)	1 NIOSH instillation study *(Hubbs et al., 2001)*; 1 NTP 39-week inhalation study *(NTP, 2020)*; no human cohort studies	Single 10 mg intratracheal instillation, 28 days observation; 39-week inhalation up to 60 mg/m³	Cleanest in NIOSH instillation screen, but 39-week NTP inhalation showed interstitial fibrosis, chronic active inflammation, alveolar epithelial hyperplasia, and squamous metaplasia of the larynx. NTP could not establish a no-effect level.	No IARC Status
Steel grit	1 NIOSH instillation study *(Porter et al., 2002)*; no human cohort studies; not included in NTP comparative testing	Single 10 mg intratracheal instillation, 28 days observation	Low acute toxicity in instillation testing, but caused alveolar epithelial cell hypertrophy and hyperplasia comparable to blasting sand. Contains measurable arsenic (30 µg/g), nickel (700 µg/g), and chromium (1,200 µg/g). NIOSH recommended chronic studies before declaring safe.	No IARC Status
Aluminum oxide	Not included in NIOSH or NTP comparative studies. Multiple occupational case series and worker studies including *Jederlinic et al. (1990)*.	Decades of occupational exposure documented in aluminum oxide abrasives manufacturing workers; animal studies at varying concentrations	Pulmonary aluminosis (Shaver's disease) — a recognized occupational interstitial pulmonary fibrosis. 1990 study of 9 workers found fibrosis in all 9 after mean 25-year exposure. Slow lung clearance: only ~9% cleared after 20 weeks. Linked to brain aluminum accumulation.	No IARC Status

Source notes: This comparison summarizes published toxicology evidence. IARC classifications: Group 1 = carcinogenic to humans; Group 2A = probably carcinogenic; Group 2B = possibly carcinogenic; Group 3 = not classifiable. NIOSH studies cited: Hubbs et al. (2001) and Porter et al. (2002); both used intratracheal instillation in rats. NTP Technical Report 91 (2020) used whole-body inhalation. McConnell et al. (1994) used nose-only inhalation over 24 months. Following OSHA exposure limits and using appropriate respiratory protection is recommended regardless of which abrasive is in use.

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