



OCCUPATIONAL EXPOSURE TO WOOD DUST – LEGAL ASPECTS AND PREVENTIVE STRATEGIES

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HIGHLIGHTS

- Wood dust is a confirmed carcinogen and major occupational health risk.
- Ultrafine particles pose serious respiratory and systemic health risks.
- Technical controls and medical surveillance are key to effective dust prevention.

ABSTRACT

Occupational exposure to wood dust is a major public health and occupational safety concern, particularly in woodworking, furniture production, and the wood-based materials industry. Its carcinogenic, allergenic, and toxic potential depends on wood species, physicochemical properties, processing methods, and applied chemical treatments. The aim of this review was to analyze occupational exposure to wood dust by synthesizing current evidence on worker health risks, measurement methods, legal regulations, and preventive strategies, in order to evaluate the adequacy of existing solutions and identify areas requiring further improvement. The review is based on 61 literature sources: publications, legal acts, official guidelines from international and national institutions (International Agency for Research on Cancer, National Institute for Occupational Safety and Health, Occupational Safety and Health Administration, American Conference of Governmental Industrial Hygienists, European Agency for Safety and Health at Work, Statistics Poland, Nofer Institute of Occupational Medicine, Polish Ministry of Health). Sources published 2010–2024 were analyzed with particular focus on dust characteristics, exposure limits, measurement methods, preventive measures, and regulatory frameworks. Exposure to wood dust contributes to both acute and chronic respiratory conditions, skin and eye irritation, and a higher incidence of upper respiratory tract cancers. Recent regulatory changes have expanded the classification of wood dust as a carcinogen to include all species. Despite existing occupational exposure limits (OELs), exceedances remain common in woodworking industries. Conventional monitoring methods may underestimate respirable and ultrafine particles (UFP < 100 nm), which pose substantial health risks. Preventive strategies – including technical controls, ventilation, personal protective equipment, and medical surveillance – significantly reduce airborne dust concentrations and worker exposure. Findings indicate a need to update OELs and harmonize regulations with current scientific evidence. Effective prevention requires integrating legal requirements, engineering controls, process automation, and medical and educational interventions. Strengthening national standards within the European Union regulatory framework and improving measurement methods – especially for inhalable and ultrafine fractions – are essential to ensuring adequate worker protection. *Med Pr Work Health Saf.* 2026;77(1)

Key words: occupational exposure, occupational health and safety, legal regulations, wood dust, occupational exposure limits, dust prevention

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Received: July 31, 2025, accepted: February 12, 2026

INTRODUCTION

Occupational exposure to wood dust constitutes a major public health concern, particularly in sectors engaged in wood processing, furniture manufacturing, and the production of paper and wood-based products. The dynamic growth of these industries in Poland – where >40 000 000 m³ of wood are harvested annually, with volumes reaching 41 662 000 m³ in 2023 [1] – contributes to substantial dust emissions. The adverse health effects of wood dust are influenced by its physicochemical characteristics, the species of wood, processing techniques,

particle size distribution, material hardness, chemical composition, and the presence of bioaerosols [2].

Accumulated scientific evidence demonstrates that prolonged occupational exposure to wood dust is associated with a wide range of adverse health outcomes, both acute and chronic. These include respiratory disorders, dermatological conditions, ocular irritation, increased risk of cancers of the upper respiratory tract, occupational asthma, chronic inflammation, and other pulmonary impairments. Wood dust is currently classified among the top 10 occupational carcinogens [3,4].

An evaluation of the regulatory landscape concerning wood dust exposure underscores the critical need for the implementation and enforcement of standardized occupational health procedures. The issues explored in this study are fundamental to understanding the scope of the problem and to formulating evidence-based strategies aimed at minimizing associated health risks.

The aim of this review was to analyze occupational exposure to wood dust by synthesizing current evidence on worker health risks, measurement methods, legal regulations, and preventive strategies, in order to evaluate the adequacy of existing solutions and identify areas requiring further improvement.

METHODS

This article adopts a review-based methodology, drawing upon an extensive analysis of the scientific literature and relevant legal regulations related to occupational exposure to wood dust. The literature review was conducted using both international and national databases, including PubMed, Scopus, ResearchGate, and Google Scholar.

A total of 61 literature sources were included in the final review, comprising peer-reviewed publications, official guidelines, legal acts, documents, reports, and online publications issued by international and national institutions (e.g., International Agency for Research on Cancer [IARC], National Institute for Occupational Safety and Health [NIOSH], Occupational Safety and Health Administration [OSHA], American Conference of Governmental Industrial Hygienists [ACGIH], Statistics Poland [Główny Urząd Statystyczny – GUS], Nofer Institute of Occupational Medicine [NIOM], Polish Ministry of Health, European Agency for Safety and Health at Work [EU-OSHA]) published primarily 2010–2024 in both Polish and English. This number represents the final selection from a broader body of materials identified through database searches. The data were reviewed with a focus on several key dimensions: the classification and physicochemical properties of wood dust, the health effects of exposure, existing occupational exposure limits (OELs), methods for measuring airborne dust concentrations in the workplace, technical and organizational preventive strategies, and legal responsibilities of both employers and employees in safeguarding health.

The findings from the literature and legal review were critically evaluated against current international recommendations for technical and medical prevention.

The analysis further addressed the adequacy and effectiveness of existing measurement methodologies and formulated recommendations for legislative and institutional improvements to strengthen occupational health protections in wood-related industries.

RESULTS

Occupational exposure to wood dust in the workplace

Wood constitutes a fundamental resource within the Polish economy, with its processing predominantly associated with the manufacture of wood-based products, the paper industry, and furniture production [5]. In 2023, 4 154 893 m³ of wood and cork (excluding furniture) were used for manufacturing purposes, while 18 360 219 m³ of wooden furniture were produced [6]. Such a high demand for wood processing results in the generation of substantial amounts of dust during treatment. It is estimated that approx. 3 600 000 workers are exposed to hardwood dust [7].

The physicochemical properties of wood dust vary depending on 3 species: gymnosperms (softwood, e.g., fir, pine) and angiosperms (hardwood, e.g., beech, oak). Hardness, specific gravity, particle size and shape, and chemical characteristics depend on the content of organic substances in wood (e.g., cellulose, hemicellulose, lignin), as well as on the chemicals used during processing (e.g., adhesives, lacquers, paints) [8–10].

Occupational exposure intensity to wood dust is influenced by the type of work performed (e.g., sanding, turning, milling) and machine parameters – such as rotational speed, tool type, and surface area in contact with the wood. The highest dust emissions are observed in sawmills, carpentry workshops, furniture, board, and plywood production plants, as well as in the forestry and agricultural sectors. High dust levels are generated particularly during operations using grinders, circular and panel saws, and lathes. Automated production lines are particularly dust-intensive. Fine solid particles are also released during storage, drying, and the processing of wood materials [11,12].

Dust generated during wood processing can be re-used industrially as an additive in the production of particleboards, fiberboards, and other wood-based construction materials. Both wood and its dust may also serve as fuel, e.g., in energy production. During combustion, wood particles become finer and remain airborne for longer periods, forming the respirable fraction and posing potential health risks to workers [13,14].

Depending on particle diameter, dust is categorized as:

- large ($>50\ \mu\text{m}$) – settling rapidly,
- medium ($5\text{--}50\ \mu\text{m}$) – remaining airborne for several hours,
- fine ($<5\ \mu\text{m}$) – persisting for several days.

The most commonly emitted particles range $10\text{--}30\ \mu\text{m}$; however, sanding processes may generate ultrafine particles (UFP $<5\ \mu\text{m}$) and even nanoparticles (particularly during automated, computer-controlled machining) [10]. Wood dust can also contribute to the formation of the so-called “blue haze” – a mixture of water vapor, bioaerosols, condensed volatile compounds, and dust – which further intensifies worker exposure. Particles $<10\ \mu\text{m}$ are especially hazardous to health and the environment. Diffuse emissions may also occur during mechanical processing or may be wind-borne (e.g., at storage sites), reaching higher concentrations in dry and windy climates [11].

Moisture content in wood is also a major factor affecting dust generation – drier wood (especially $<20\%$ moisture) produces more dust [10]. Depending on the source, raw wood typically contains $20\text{--}140\%$ moisture. Wood hardness significantly affects dust concentration, with hardwoods typically generating a greater proportion of fine particles than softwoods [11].

All these factors that influence the degree of exposure to wood dust require specific procedures established under legislation in order to reduce associated risks.

Legal aspects

Wood dust was originally classified as a Group 1 carcinogenic agent by IARC in vol. 62 of the IARC monographs [8], and this classification was reaffirmed in vol. 100C [9].

In Polish legislation, until 2020, only activities involving exposure to hardwood dust were considered carcinogenic. The Regulation of the Minister of Health of 24 January 2020 [15] amended the 2012 [16] regulation by introducing all types of wood dust into the list of carcinogenic technological processes. This regulation, as amended, was subsequently repealed and replaced by the currently binding Regulation of the Minister of Health of 26 July 2024 on chemical substances, their mixtures, agents, or technological processes with carcinogenic, mutagenic, or reprotoxic effects [17]. It includes all forms of occupational exposure to wood dust, regardless of type, species, or hardness.

Globally, OELs differ and evolve based on the latest scientific findings. The United Kingdom's Health and Safety Executive defines workplace exposure limits based on an 8-hour time-weighted average, which must not be exceeded: $3\ \text{mg}/\text{m}^3$ for hardwood dust, $5\ \text{mg}/\text{m}^3$

for softwood dust, and $3\ \text{mg}/\text{m}^3$ for wood dust mixtures, applying to all wood dust present in the blend [18]. In the United States of America (USA), the OSHA recommends permissible exposure limits for total dust $15\ \text{mg}/\text{m}^3$ and respirable dust $5\ \text{mg}/\text{m}^3$ [19]. Meanwhile, the NIOSH has introduced more stringent limits of $1\ \text{mg}/\text{m}^3$ for all types of wood dust to minimize health risk [19]. The ACGIH guidelines (applied in Canada) specify a time-weighted average (TWA) of $0.5\ \text{mg}/\text{m}^3$ for western red cedar and $1\ \text{mg}/\text{m}^3$ for other wood species [19]. In Australia, the TWA guideline values are set at $1\ \text{mg}/\text{m}^3$ for hardwood and $5\ \text{mg}/\text{m}^3$ for softwood [20].

In Europe, Directive 2017/2398/EU [21] of the European Parliament and of the Council of 12 December 2017 amending Directive 2004/37/EC [22] on the protection of workers from the risks related to exposure to carcinogens or mutagens at work addressed the issue of mixed wood dust exposure and mandated that the exposure limit for hardwood dust be applied to all types of wood dust present in the mixture. According to the binding OEL values, until 17 January 2023, the OEL for hardwood dust was $3\ \text{mg}/\text{m}^3$. Currently, the inhalable fraction limit is reduced to $2\ \text{mg}/\text{m}^3$, with the condition that the limit applies to all wood dust types. In Poland, the OEL for wood dust introduced by Directive 2004/37/EC (as amended) was implemented by the Regulation of the Minister of Family, Labor and Social Policy of 9 January 2020 [23], which amended the Regulation of 12 June 2018 and updated the maximum allowable concentration (MAC) [24]. Moreover, the Polish provisions currently implementing the directive apply to all types of wood dust, not only hardwood, representing a stricter approach than that adopted at the European Union (EU) level. In this context, international experience from countries such as the USA, Canada, and Australia may provide useful reference points for discussions on OELs for wood dust. However, any initiatives aimed at introducing stricter national limits must be considered within the regulatory framework of the EU, since such measures may affect industrial competitiveness and therefore should be coordinated at the EU level.

Impact of wood dust exposure on workers' health

Particle size, density, chemical and mineralogical composition, solubility, and biological activity of dust particles affect their persistence in the air and deposition within the human respiratory system. Particulate matter (PM) is categorized by particle size and enters the body primarily through inhalation [25,26].

A key parameter in occupational risk assessment is the inhalable and respirable fraction. Aerosol particles $<100\ \mu\text{m}$ can be inhaled through the nose and mouth, and their deposition in the respiratory tract defines them as the inhalable fraction. Particles that bypass the nasal barrier reach the throat and larynx ($\text{PM}_{10} <10\ \mu\text{m}$) [27]. The PN-ISO 7708:2001 standard further subdivides the inhalable fraction into pre-tracheal, tracheal, tracheobronchial, and respirable dust fractions [28]. The respirable fraction includes particles with diameters $<4\ \mu\text{m}$ (PM_4) or $\leq 2.5\ \mu\text{m}$ ($\text{PM}_{2.5}$), which can penetrate the lower respiratory tract and deposit in the gas exchange region. According to relevant regulations in Poland, MAC values apply to the inhalable fraction [24].

Occupational exposure to wood dust can affect multiple organ systems, particularly the respiratory tract, skin, and eyes. Naturally occurring substances in dust may also exert toxic or allergenic effects on the human body. Biologically active compounds such as phenols, flavonoids, alkaloids, glycosides, resins, essential oils, latex, rubber, turpentine, preservatives, molds, and bacteria are released during wood processing and may be harmful [29]. Exposure to wood dust and its bio-aerosols significantly increases the occurrence of respiratory symptoms [30]. The presence of bacteria, fungi, and their metabolites in wood dust has been associated with allergies, occupational asthma, and a higher frequency of both acute and chronic respiratory symptoms, as well as declines in certain pulmonary function parameters [31,32].

Wood dust can cause chronic rhinitis, chronic obstructive pulmonary disease, shortness of breath, coughing, conjunctivitis, and can have mutagenic and genotoxic effects [31,33].

In the Workers' Exposure Survey [34] conducted by the EU-OSHA, wood dust ranked 8th among the 24 most frequently assessed occupational cancer risk factors. Workers with the highest probability of exposure to occupational carcinogens were those working with wood dust, respirable crystalline silica and diesel engine exhaust emissions. A total of 3.2% of workers in participating countries were exposed to wood dust at any level, with the highest proportion (7.3%) in Finland. Among the 10 most common occupational cancer risk factors for men, wood dust accounted for 4.5% [34]. Wood dust is most frequently associated with cancers of the nasal cavity and sinuses, the nasopharynx, the lungs, and also with increased risks of laryngeal and gastric cancers [30,35,36]. Studies have shown that carcinogenic risk is associated not only with hardwood dust but also

with softwood, and with the processing of wood-based materials such as plywood, particleboard, fiberboard, and medium-density fiberboard (MDF) [8].

Wood dust can also cause adverse skin reactions, including irritant contact dermatitis, allergic contact dermatitis, phototoxic and photoallergic reactions, contact urticaria, and folliculitis, particularly when handling exotic woods (e.g., Bolivian rosewood) [37].

Occupational diseases

According to the International Classification of Diseases, 10th Revision [38], health effects related to occupational exposure to wood dust are classified in different categories depending on the underlying disease mechanism.

Chronic inhalation of wood dust may lead to pneumoconiosis, classified as:

- J66.0: Woodworker's pneumoconiosis (pneumoconiosis due to wood dust),
- J66.8: Other respiratory diseases caused by inhalation of organic dust.

In contrast, hypersensitivity pneumonitis (allergic alveolitis) represents an immunologically mediated disease entity distinct from pneumoconiosis and is classified separately as:

- J67.8: Hypersensitivity pneumonitis due to organic dust (including wood dust).

Occupational exposure itself is coded as:

- Z57.2: Occupational exposure to dust, including wood dust,
- Z57.8: Other occupational exposures to risk factors.

In the case of allergic reactions, skin and eye irritation, additional classification codes apply, e.g., L23 (Allergic contact dermatitis), H10 (Conjunctivitis), and Z57 (Occupational exposure to risk factors) [38].

The European list of occupational diseases includes acute toxic contact dermatitis, contact urticaria, irritant contact dermatitis, allergic rhinitis, asthma, extrinsic allergic alveolitis, and upper respiratory tract cancers caused by wood dust (nasal cavity and paranasal sinus cancer) [39]. In Poland, 2011–2020, among workers exposed to wood dust, the most commonly recognized occupational diseases were: extrinsic allergic alveolitis (11 cases), asthma (8 cases), allergic rhinitis (5 cases), cancers (4 cases: 2 lung, 1 nasal, 1 laryngeal), and 1 case of skin disease [40].

National data from 2022–2024 presented in Occupational Diseases in Poland 2024 [41] indicate that the largest subgroup within the category of industrial workers and craftsmen comprised workers in food processing, wood processing, and the production of textile

products (183 cases). Unfortunately, the report did not separately identify the subgroup of workers specifically exposed to wood dust [41]. There are no globally accessible statistics on occupational diseases caused by wood dust. Such data are collected independently by individual countries and institutions, making comparisons difficult.

Exceeding occupational exposure limits

According to GUS [42], the number of workers exposed to carcinogenic dusts above the OEL rose 12-fold – from 2372 cases in 2019 to 28 049 in 2023 – following the inclusion of softwood dust and the respirable fraction of crystalline silica on the list of occupational carcinogens. Until 2020, only exposure to hardwood dust had to be reported to the Central Register of Data on Exposure to Carcinogenic or Mutagenic Chemical Substances, Mixtures, Agents or Technological Processes [43]. Between 2013–2019, during which only hardwood dust was still being reported, work involving exposure to wood dust was the most frequently reported process in this registry. However, after the regulatory changes in 2020, a substantial increase in the number of workplaces reporting wood dust exposure was recorded in the following years (2020 and 2021), with year-to-year growth of approx. 120% and 62.5%, respectively [43,44].

A 2022 study by the NIOM [40] in Łódź revealed >8-fold exceedances of the MAC values (and >12-fold according to new guidelines) in woodworking plants, particularly at panel saw operator stations in furniture manufacturing with automatic feed and cutting of particleboard sheets (inhalable fraction: 25.31 mg/m³). Nearly 5-fold exceedance of the MAC (7-fold according to new guidelines) was recorded in a carpentry shop during wooden product manufacturing, puttying, and board sanding (inhalable fraction: 14.11 mg/m³) [40]. Cross-sectional studies in Ethiopia showed that 55% of carpenters were exposed to wood dust concentrations exceeding the workplace threshold limit value (10 mg/m³) [45]. However, given the substantial differences in working conditions, technological development, ventilation efficiency, and regulatory frameworks between Ethiopia and EU countries, such findings should not be directly compared to exposure data from Poland. However, such high levels of worker exposure to dust at the workplace require special attention and appropriate preventive measures to ensure safe working conditions.

Dust prevention in the workplace

Article 207 of the Polish Labor Code obliges employers to ensure a work environment that is safe for workers'

health and life [46]. In work involving exposure to wood dust, appropriate preventive measures must be implemented. Since 2020, all types of wood dust exposure (including softwood) have been classified in Poland as a technological process involving carcinogenic, mutagenic, or reprotoxic substances. Consequently, employers are required to maintain records of such work processes and the employees performing them. Additionally, the Regulation of the Minister of Health of 26 July 2024 on chemical substances, their mixtures, agents, or technological processes with carcinogenic, mutagenic, or reprotoxic effects in the work environment provides additional protection to employees working under such exposures conditions [17]. Such protection extends to preventive health care provided after the termination of exposure, in accordance with the Polish Labor Code [46].

Because wood dust is classified as a carcinogen, work involving exposure to it is prohibited for minors, pregnant women, and breastfeeding mothers [47,48].

In facilities where carcinogenic and/or mutagenic substances are present, the employer is obliged to provide appropriate medical supervision. Medical prophylaxis includes pre-employment and periodic examinations, which encompass a medical check-up, spirometry, and anterior rhinoscopy [49]. Rhinoscopy is a primary non-invasive otolaryngological examination that can aid in detecting early neoplastic changes in the nose, throat, and paranasal sinuses [50], which are the most frequently reported cancers among workers exposed to wood dust.

The latency period between wood dust exposure and the manifestation of nasal cancers is estimated to be ≥20 years. The presence of other chemical and biological substances in the dust complicates diagnosis and the clear attribution of cancer solely to wood dust exposure. This underscores the need for epidemiological studies to determine the strength of such correlations.

Measurement of wood dust concentration in the work environment

An employer whose work involves carcinogenic, mutagenic, or reprotoxic agents is obligated to measure the concentrations of such chemical substances, mixtures, or factors, following the procedures and frequency specified in the regulations issued under the Labor Code. The employer must also apply early detection methods for exposure in the event of accidents or other unforeseen circumstances [17].

Measurements of harmful agents in the workplace are conducted at frequencies outlined in the Regulation

of the Minister of Health of 2 February 2011 on testing and measurement of harmful factors in the work environment [51]. Samples are collected from the workers' breathing zone, in accordance with individual dosimetry principles specified in Polish standards [52,53].

However, the methods used so far do not always account for the measurement of the finest dust particles. According to the regulation [24], inhalable fractions must be considered during wood dust measurements. Gu et al. [54] highlighted the significance of respirable dust fractions composed of particles $<10\ \mu\text{m}$, and especially particles $<100\ \text{nm}$ (UFP), which are often omitted. Routine workplace measurements may fail to capture data essential for assessing the risk of wood dust exposure in the lower respiratory tract. The study revealed that particles measuring $0.3\text{--}10\ \mu\text{m}$ are mainly deposited in the extrathoracic region (upper airways, including nasal cavity, sinuses, pharynx, larynx, and the initial segment of the lower airways – the trachea), whereas particles $5.6\text{--}560\ \text{nm}$ tend to accumulate in the alveolar interstitial region. Even a few minutes of wood processing these particles can be significant, and studies suggest that the current OEL based on particle mass does not reveal high exposure to UFPs and particles $<10\ \mu\text{m}$ [54].

Research indicates that in mixed wood dust generated in furniture manufacturing plants, the respirable fraction constitutes a substantial share of the inhalable dust fraction. As emphasized by Szewczyńska et al. [55], it is therefore important to use total dust meters with quantitative separation of the inhalable wood dust fraction.

A method that combines particle deposition in the lungs and the chemical potential of the particle surface may involve using the lung deposited surface area as a metric for the adverse health effects of aerosol particles [56]. Based on these findings, measurement methods and their interpretation should be adjusted to this new perspective in order to ensure the safety of employees exposed to wood dust.

Technical prevention

Detailed requirements for safe wood processing operations are outlined in the Regulation of the Minister of Economy of 14 April 2000 on health and safety at work while operating woodworking machinery [57]. In summary, legal requirements stipulate that the employer must undertake all measures to reduce wood dust exposure, including the use of appropriate technical solutions (room ventilation, process sealing), air humidification, exposure monitoring and limitation, provision of protective clothing and personal protective

equipment, as well as implementation of hygienic practices to remove dust from skin and clothing surfaces and to protect the skin [37,46,57].

One of the primary elements of technical prevention aimed at limiting worker exposure to carcinogenic and/or mutagenic substances is the automation and sealing of the technological process, or the isolation of workstations [58]. According to general health and safety regulations, employers are obliged to assess and document occupational risk, apply necessary organizational solutions to reduce risk, ensure adequate air exchange in workspaces so that OELs values are not exceeded, and seal dust-generating devices or equip them with local exhaust systems [59].

Efficient ventilation systems are the most effective method of reducing exposure. Ventilation enables the exchange of air, provide treated external air, remove heat, moisture, and contaminants. General ventilation removes air pollutants from the entire room, while local ventilation (e.g., local exhaust hoods) captures them directly at the source of release [58]. General ventilation is less effective because it only mitigates the effects of dust dispersion. The level of airborne dust depends greatly on the configuration of the dust extraction system, and improper setup significantly increases dust levels ($<0.5\ \text{mg}/\text{m}^3$). In studies by Pałubicki et al. [32], an appropriate setup – consisting of upper and lower hoods connected to a common air outlet – resulted in 5-fold lower total dust mass concentrations. In another assessment, stationary measurements indicated that when the local exhaust ventilation (LEV) system was switched off, dust levels ranged $15\text{--}30\ \text{mg}/\text{m}^3$, whereas activating the LEV system lowered these values to $2.3\text{--}4.1\ \text{mg}/\text{m}^3$. Personal exposure monitoring further demonstrated that the use of LEV reduced workers' dust exposure by around 90% [60].

When designing proper ventilation, one must consider not only the dust-generating process itself but also the particle size distribution produced during that process. Research by Cui et al. [61] showed that most dust particles were $<100\ \mu\text{m}$, and significant differences in particle size distribution were observed depending on the machine setup for MDF milling. Less dust was found near the center of the cutting area, while finer dust appeared further away. This knowledge is crucial for optimizing cutting parameters and the placement of dust extraction outlets to reduce exposure [61].

Proper cleaning methods for machinery and surfaces covered in dust should also be considered. Cleaning with compressed air results in high levels of dust due

to further dispersion, while wiping with a damp cloth is associated with significantly lower dust levels. Similarly, vacuuming machines by trained cleaning personnel is recommended. Equipment aging and poor maintenance of ventilation systems can also lead to higher dust levels in the wood processing industry [62].

Workers must use masks or half-masks with appropriate filters when the OELs values is exceeded. In workstations exposed to carcinogenic substances, high-efficiency P3-class filtering equipment is recommended. However, personal protective equipment should not be the primary or sole preventive measure at workplaces, but rather a temporary and supplementary solution [58].

In cases of occupational dermatoses, a 3-stage skin protection program is recommended, involving skin protection (application of protective creams before work), cleansing (hand washing), and skin care (cosmetic creams after work). When exposed to wood and wood dust, barrier creams should be included as part of workplace health and safety protocols [63].

Technological advancements in wood processing also facilitate preventive efforts. The use of modern machinery equipped with integrated ventilation systems, local sawdust and chip extraction, and pneumatic transport systems should improve the standards of safe work in environments with wood dust exposure [64]. In a study by Jacobsen et al. [65], a decrease in wood dust exposure >6-year period was shown to correspond with a reduction in respiratory symptoms, highlighting the importance of dust reduction measures [65]. The best available techniques for minimizing dust emissions in the wood industry are outlined in the Best Available Techniques Reference Document [11]. This document implements Directive 2010/75/EU on industrial emissions (Integrated Pollution Prevention and Control) and provides detailed descriptions of processes, techniques, and procedures at every stage of wood-based product processing.

Worker education

According to Article 237 § 2 of the Polish Labor Code [46], the employer is obliged to train employees in occupational health and safety (OHS) before allowing them to work and to conduct periodic training sessions. Employee training in safe working practices regarding wood dust exposure is a key component of prevention. In a study by Top [66], while workers' awareness of the health risks was relatively high, their knowledge of specific factors determining safe work in dusty environments – such as how

dust forms, OHS rules, OELs values, and exposure-reduction practices – was considerably lower. The significance of wood dust as a health risk factor is often underestimated by workers, underscoring the need for well-prepared, content-rich training materials. Creating accessible educational materials is essential to fostering safe workplace behavior.

CONCLUSIONS

1. Occupational exposure to wood dust is an increasingly recognized public health and workplace safety issue, due to both the intensification of technological processes in the wood industry and a growing number of reported occupational diseases.
2. Wood dust (both hardwood and softwood) should be regarded as a significant occupational risk factor – an assertion supported by recent epidemiological and toxicological data.
3. Adapting measurement methods to assess not only the mass of dust but also its inhalable fractions (including UFP <10 µm, and especially particles <100 nm) allows for more accurate evaluation of workers' health risks.
4. Further epidemiological and clinical research is necessary, particularly in the areas of exposure biomarkers and the impact of UFP fractions on respiratory health.
5. Legal regulations concerning OELs for wood dust in the EU, and also in Poland, should be reviewed and updated to ensure consistency with current scientific evidence and international standards, taking into account that more restrictive national limits must be aligned with the EU regulatory framework.
6. Dust prevention strategies should encompass both technical measures (e.g., enclosure, ventilation, wet cleaning) and personal protective equipment; however, process automation is of primary importance.
7. Regular medical examinations, such as spirometry and rhinoscopy, are essential for the early detection of adverse health effects. Additionally, worker education about the risks of wood dust exposure fosters safer workplace behavior.

AUTHOR CONTRIBUTIONS

Research concept: Alina Mroczek

Research methodology: Alina Mroczek, Janusz Kasperczyk

Collecting material: Alina Mroczek

Interpretation of results: Alina Mroczek, Janusz Kasperczyk

References: Alina Mroczek, Janusz Kasperczyk

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