

TRIESKOVÉ A BEZTRIESKOVÉ OBRÁBANIE DREVA 2024

CHIP AND CHIPLESS WOODWORKING PROCESSES 2024

Vedecký časopis // Scientific journal



TECHNICKÁ UNIVERZITA VO ZVOLENE // TECHNICAL UNIVERSITY IN ZVOLEN
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EXAMPLES OF SAFETY AND HEALTH RISK FACTORS IN WOODWORKING INDUSTRY IN SLOVAK REPUBLIC

Alena Očkajová¹ – Adrián Banskí² – Martin Kučerka¹ – Zuzana Vyhnáliková²

Abstract

In the article, we want to point out the still existing safety and health risks in woodworking operations, the essence of which lies in processing of non-homogeneous materials such as wood, with anisotropic properties and the occurrence of natural wood defects, manual feed of the workpiece into the cut, tools with a large number of cutting edges and high cutting speeds, manual handling of loads, but also in many cases in the irresponsible approach of the employees or employers themselves to the OHS. Failure to address or avoid these risks leads not only to injuries, but long-term work in this environment to occupational diseases, especially hearing loss, diseases of the musculoskeletal system, etc. Although the legislation covers all areas in terms of OSH, its implementation in practice is lengthy and not always adequate. The basis for characterizing the existing safety and health risks was the manual "Risk Assessment Basics - Good for You, Good for Your Company", Check list for Woodworking. Based on the description, it is obvious that the safety risks in woodworking are known, but in many operations they tolerate, and due to health risks, minimal attention is paid to manual handling of loads and ergonomics, the neglect of which contributes significantly to diseases of the musculoskeletal system.

Key words: woodworking, safety and health risks, OHS

INTRODUCTION

The woodworking industry is one of the high-risk industries and although our legislation covers all areas in terms of occupational health and safety (Acts of OHS), we often come across reports of workplace accidents (usually severe) as a result of non-compliance with, or a breach of, OSH regulations from the perspective of the affected employee, or even inadequate workplace security on the part of the employer. The problem in question is more frequent in small and medium-sized companies, which include woodworking operations. This situation is mainly caused by:

- the disintegration of large state-owned companies into small, private, or family-owned companies, where OSH issues are not given much attention,
- equipment with outdated technology, which in many cases does not meet safety criteria,
- the low professionalism of the owners, who are not always specialists in their field, let alone in the area of possible risks at work, because in many cases they do not know about them or do not want to know, in other cases they consider the area of

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occupational safety and health more as a burden and unnecessarily invested money, which does not bring the effect immediately,

- low awareness of employees themselves, who approach the issue only through the prism of OSH training but do not implement in practice the acquired knowledge of occupational safety and health, which implies an obligation for each individual to comply with all safety regulations, to protect their own health as well as the health of their co-workers,
- the use of machinery and equipment characterized by high speeds, high noise levels, dangerous tools with many cutting edges,
- strenuous physical work carried out mainly in hazardous environments,
- the phenomenon that many people and experts think of wood as a healthy, natural material, a renewable resource, without taking into account certain negative characteristics that arise from the various technological processes involved in its processing (e.g. wood dust during sanding, free formaldehyde in the production of particleboard and fibreboard, medium density fibreboard (MDF), fungi and moulds in landfills, etc.).

A suitable solution was found to eliminate the risk in the first place, if this is not possible, it must at least be reduced to an acceptable level by complying with the relevant limit values [1]. This is difficult and there is not always the will to do so in smaller and family-run companies. As the situation in various woodworking operations is not only problematic in Slovakia, international health and safety institutions (e.g. the European Agency for Safety and Health at Work) try to help employers with a number of brochures with specific instructions and examples on how to deal with selected situations directly in practice. Although many of the procedures may seem tedious at first sight, if the right system is set up and the issue is approached in a targeted and regular manner, the desired objective will certainly be achieved.

The aim of the presented paper is to highlight examples of safety and health risk factors in woodworking operations (woodworking) that can very quickly become hazardous if they are not controlled or the limit values specified in the legislative regulations are not respected, as there is a high probability not only of a cumulative effect of risk factors in long-term exposure but also of a synergistic effect of several simultaneously acting factors in the working environment, which is common in woodworking operations.

MATERIAL AND METHODOLOGY

From a range of risk assessment materials, we have selected the handbook „Risk Assessment Basics - Good for You, Good for Your Company, part Woodworking“ [2,3] which will be used to characterize selected risk factors for the woodworking industry, with specific examples, to give an idea of their multitude and diversity. It is by characterizing these hazards that we want to emphasize that the risk here cannot be said to be small, perhaps medium, but in most cases large, and that this is then matched by the likelihood and severity of damage to health, whether it is a severe accident or a gradually emerging occupational disease. In addition to the general checklist of hazards or dangers given in this manual, there are also lists of hazards or dangers for selected operations, and for woodworking, the manual gives the following checklist of hazards or dangers:

Work tools, equipment

- Are all machines fitted with covers?

- Are instructions available regarding hazardous work practices?
- Are employees trained to operate the machinery?
- Are regular inspections and tests of work tools provided?
- Do employees use suitable means to guide short or narrow pieces of material through the saw?
- Can employees' clothing be drawn between moving parts of machinery and cause damage to their health?

Electrical hazards

- Are electrical machines earthed?
- Are electrical cables and wiring harnesses maintained in a safe condition?
- Are outlets, connections, switches, and fittings covered?
- Is the environment in the area specified in terms of enclosure?

Air quality

- Do woodworking machines have an automatically activated exhaustion system when in use?
- Do you check the exhaust equipment regularly?
- Do you clean and wipe the dust from ceilings, wall partitions, and cable ducts?
- Do you assess the air quality in your workshop?
- Do employees use respirators if they work in paint booths?

Chemicals

- Are employees who come into contact with hazardous chemicals adequately trained?
- Do employees use personal protective equipment (gloves, goggles, face shields, respirators) when working with chemicals?
- Are chemicals kept well away from sources of fire?

Noise and vibration

- Do you assess the noise level in the workplace?
- Do employees exposed to high noise levels use hearing protection?
- Do you avoid vibrations that can be transmitted from machinery through work pieces to employees' hands?

Health risk

- Do you organize health checks for employees?
- Are employees exposed to high noise levels regularly sent for audiometric examinations?
- Are employees appropriately trained on working with loads?
- Do you try to meet the special needs of employees when designing the workplace (ergonomics)?

On the basis of our own practical experience and numerous visits to woodworking enterprises, as well as experimental measurements we have carried out in them and in the framework of our own research, we present selected examples, in particular for the following areas: Work tools, Equipment; Air quality; Noise and vibration; Health risk.

RESULTS AND DISCUSSION

Safety risks

Work tools, equipment

➤ **Are all machines fitted with covers?**

The woodworking industry is characterized by the presence of tools with a large number of cutting edges that operate at high speeds, e.g. circular sawblades (approx. 7000 min⁻¹), bottom spindle moulder (approx. 8300 min⁻¹), top spindle moulder (up to 30000 min⁻¹), and it is therefore very important to provide them with covers, [4]. Modern woodworking machines are equipped with perfect protection for all moving and rotating parts and tool guards that uncover themselves during the working operation. When changing tools or carrying out maintenance work, the tool cover is only opened when the power supply is switched off.

Of course, all machines are fitted with covers from the manufacturer, but we often encounter unprotected rotating spindles in joint-carpentry and furniture workshops, e.g. (in bottom spindle moulder) in individual production, it is sometimes necessary to change the tool many times per change due to production requirements (customer needs) and this seems to be very tedious for the operator if he should always fix the tool and the cover, which is also part of the exhaust, together with the protective grid, for finger stop. In this case, the danger or hazard is multiplied by the manual feed of the workpiece into the cut. If the work is carried out without a cover, e.g. with a bottom spindle moulder that also includes a finger protection unit, the operator can very quickly come into contact with dangerous moving parts of the tool.

The danger of working on woodworking machines when manually feeding material into the cut is also increased by the very characteristics of the material being machined, such as its anisotropy, the occurrence of knots, and other growth defects. A very dangerous situation can arise especially during planing (thickness and surface planer), and sawing. The knots distort the structure of the wood, have a higher density (2 to 3 times higher than the surrounding wood, [5]), and are often the cause of material kickback, and the operator does not always react promptly to the situation, which can result in the hand slipping off the workpiece being moved. The knots are also dangerous if they are not perfectly bonded to the surrounding wood (unsound knots) – loose knots, knots affected by rot, and they come loose on contact with the cutting edge of the tool and can strike the operator.

➤ **Can employees' clothing be caught between the moving parts of the machinery and cause damage to their health?**

It is the perfectly designed machine covering that should prevent clothing from being drawn between the moving parts of the machinery and thus damage the health of the employees. As mentioned above, if the cover is out of action for any reason and the machine is being worked on, then there is a high probability of employees' clothing being pulled between moving and rotating machine parts, or undressed hair or hanging items - bracelets, chains, etc. being pulled in.

Risk factor – working without a cover and the manual feed of material (wood) into the cut. This activity (manual feed) should certainly be included in the checklist of hazards or dangers for woodworking, the hazards of which are determined by the species, the anisotropy itself (the difference in physical and mechanical properties in three mutually

perpendicular directions) and the occurrence of natural defects in the wood, such as knots, ruptures, defects in the structure of the wood, etc., which essentially distinguish the machining of this material from other materials with a homogeneous texture.

- **Do employees use appropriate means to guide short or narrow pieces of material through the saw?**

In most cases, yes, because employees are aware of the dangers of this action, especially when sawing and milling. Rather, a problem can arise when larger chips or dropped knots are on the saw table or bottom spindle moulder and the operator tries to remove them by this means and can very quickly stumble against the moving tool.

- **Are there instructions available on dangerous working practices?**

Operating manuals for all machinery and equipment, as well as instructions on hazardous work practices, are available at woodworking facilities.

- **Are employees trained to operate the machinery?**

Of course, employees in most operations are trained to operate machinery and certainly warned about unsafe working practices, but the human factor does not always act in accordance with the regulations and instructions. Two risk groups of employees in terms of age need to be highlighted and drawn attention to. While young employees may not yet appreciate the potential risk of not following all the rules for working on woodworking machines, older employees are also aware of the risks involved, but their routine in operating the machines means that they try to 'improve and speed up' certain activities, which often results in the use of unsafe working practices, [6].

Risk factor – age of the employee

Air quality

- **Do woodworking machines have an automatically activated exhaust system when they are in use?**
- **Do you check the exhaust equipment regularly?**
- **Do you clean and wipe the dust from ceilings, wall partitions, and cable ducts?**

The answer to these three questions is yes, every machine in operation is always equipped with an exhaust system, very typical in the case of little-used stands are mobile exhaust units, with high efficiency. It is also ensured that pipelines are checked, as this is the first prerequisite for the spread of dust into the working environment. The problem arises when the employees themselves disable the suction from the machine, as in the case of the bottom milling machines, and thus cause a permanent load on the environment, especially with fine dust, which floats in the environment, does not settle or settles very slowly, and is stirred up again by any movement.

Wood dust dispersed in the working environment are airborne dust particles, with a diameter of less than 100 µm [7,8,9], which pose a health risk to operating personnel because they cause respiratory problems in addition, beech and oak hardwood dust are classified as Category 1 carcinogens, which means a proven chemical carcinogen [10]. In woodworking operations, where dried wood is already handled, that a large number of dust particles with a particle size diameter of fewer than 100 µm are produced and about 80 % of such dust particles are produced during the sanding operation [11,12,13].

Fine coating of dust can often be seen on various structures, walls, sloping surfaces, power lines, and on the exhaust pipeline itself, which is less regularly cleaned (vacuumed) and is swirling again by any activity. Our experiments have confirmed that the smaller the dust particles are, the higher their cohesion and adhesion to the surface and they are able to stick even on "steep surfaces" [14]. The floors are cleaned of dust regularly, but sometimes with compressed air "because it's faster". Another problem in terms of settled dust is the stacked material near the machines (in smaller operations) that will be processed, and it is not possible to clean this area well on a regular basis. It should be in the interest of the employer but also of the employees themselves, in the wood processing industry, to protect their respiratory system and to wear suitable PPE [15].

Risk factor – inadequate cleaning of settled dust

➤ Do employees wear respirators if they work in paint booths?

It certainly is, and it should be pointed out that paint manufacturers are now trying to develop eco-friendly coatings, where harmful chemicals are replaced by less harmful ones or new systems without harmful additives, [1]. But certainly, the use of respirators is important, and this also depends on the type of coating equipment. The dispersion of these substances into the air is different when spraying (the largest), and it would be different when dipping, roller coating, or painting. As spraying is the predominant coating method in smaller operations, the use of respiratory protective PPE should be a matter of course.

➤ Are you assessing the air quality in your workshop?

To ensure the air quality in the workshop, the limit values of hazardous factors in the working environment set by the standards should be respected and employers should take care to professionally monitor and measure these hazardous factors in the workplace, (whether it is dust, free formaldehyde, noise).

Noise and vibration

➤ Are you assessing noise levels in the workplace?

➤ Do employees exposed to high noise levels use hearing protection?

The noise level of the woodworking machines exceeds the limit value of 87 dB [16], (conveyors, main sawing machines – frame saws, trunk band saws, circular saws, sorting lines, planers, moulders etc.), which greatly reduces the quality of the environment in which the operating personnel moves throughout the working shift. The prolonged exposure to noise causes gradual hearing loss but also other health problems – stress, headaches, insomnia, increased blood pressure, lack of appetite, etc.

Employees have hearing protectors, but if we have worked with them ourselves, we can see that they greatly interfere with our comfort at work, weaken communication between colleagues, make us less aware of our immediate surroundings, and can also reduce our alertness and attentiveness. Very important in such cases to invest in personal protective work equipment that will only eliminate high noise levels, not human speech. It must be stressed that noise increases if tools are blunted, or poorly balanced if the wrong size tool is used (e.g. a larger diameter saw blade than is sufficient to perform the operation), again the material, its anisotropy and the occurrence of natural defects, especially knots, etc. must be emphasized [17]. Employees are very unlikely to rotate if they are trained to work on these machines, because if they work in the same hall it does not matter which machine they operate, as the noise in the working environment is equally high in any location.

Risk factors – noise and using PPE, not of the highest quality**➤ Do you avoid vibrations that can be transmitted from the machines through workpieces to the employees' hands?**

There are a number of woodworking operations where vibration cannot be avoided, e.g. the operation of hand-held electrical machinery and tools, where employees are mainly exposed to vibration transmitted to their hands, which can be reduced by the use of appropriate PPE – anti-vibration gloves, although they do not always meet the stated reduction in vibration values in practice, [18].

Risk factor – vibrations and using PPE, not of the highest quality***Health risks*****➤ Are employees adequately trained to work with loads?**

There is still a great deal of strenuous physical work involved in woodworking, which includes working with loads (e.g. when assembling parts, and packing, but often also when loading and unloading parts into and out of the machine). In this work, aids aren't used a lot to reduce or eliminate this factor. This is heavy physical work, whether dynamic or static. I do not know if employers train their employees on the basic rules of handling loads (horizontal plane rule, vertical plane rule – the center of the gravity of the object as close as possible to the center of the gravity of the operator), the principles of lifting, lowering loads, pulling and pushing (e.g., material handlers – proper use of their own weight), etc. Particularly for the younger age group, training is essential to learn the correct procedures and rules (to learn them), as these activities gradually lead to health problems, especially with the sacral spine [19, 20].

Risk factor – aids aren't used a lot to reduce or eliminate working with loads, working without training (accent on young people)**➤ Do you try to meet the special needs of employees in workplace design (ergonomics)?**

I don't know if it is correct in this case to talk about the special needs of employees when designing a workplace. Here, we should not define it as the special needs of employees, but as the employer's obligation to create the best possible workplace, also from the point of view of ergonomics, the aim of which is to preserve the health of employees at maximum performance. In our operations, the aim is primarily maximum performance, and not enough attention is paid to the health and well-being of employees. However, it is in woodworking that we encounter a great deal of physical strain, whether dynamic or static, and it is precisely by the ergonomic design of the workplace that this strain could be eliminated, at least in part.

Static load, which is a long-term, unilateral, and excessive load on the musculoskeletal system, is encountered in woodworking (especially furniture production, construction, and joinery production, upholstery production) when using any tools, especially hand machines, pneumatic nailers, staplers, drills, etc. when the basic ergonomic principle of a straight wrist is not observed - e.g. when pistol tools are used instead of hanging tools for working horizontal surfaces. By having to twist or bend the wrist, more strain is placed on it, resulting in less force being exerted and progressive health problems [21]. This problem is compounded by the sheer weight of hand tools and implements. And it is up to employers

how they tackle the design of their workplaces so that individual operations can be carried out in the context of basic ergonomic principles.

In most positions when operating conveyors (e.g. checking center slats in large composites, assembling parts) the operator has to be bent over (again the basic ergonomic principle of a straight back is not followed), and the height of the handling plane - i.e. the height of the conveyor is uniform for all employees operating it and we can then observe that tall people have to have their back very bent over the conveyor and short people may have a problem with the operator and have to bend over to pick up individual parts. Rarely are these positions equipped with at least simple swivel chairs for a short rest, perhaps adjustable in height, which would go some way to eliminating the uniform height of the handling plane and at least partly eliminate physiologically unacceptable working positions (bending over, stooping...), [22].

Risk factor – not observed the basic ergonomic principles, physiologically unacceptable working positions

CONCLUSION

Based on the description of possible safety and health risks in wood processing operations, it can be concluded that work in this sector is physically demanding. Among the items that receive minimal attention based on our analysis are:

- work is carried out without a tool covers,
- inadequate cleaning of settled dust,
- absent material handling training,
- PPE not of the highest quality or in line with scientific advances,
- minimal ergonomic design of workplaces (static and dynamic loads, physiologically unacceptable working positions, straight wrists, etc.),
- risks age categories of employees with accent to young workers.

There is an absent item in the list of hazards or risks for wood processing:

- processing of non-homogeneous material such as wood, with anisotropic properties and the occurrence of natural wood defects and
- manual feed of the workpiece into the cut.

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