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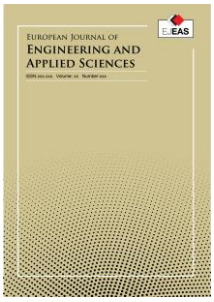

Research Article

Evaluation of Major Occupational Hazards Encountered in the Furniture Production Process on Employee Health

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Abstract: Occupational Health and Safety (OHS) practices in Turkey focus on sectors with high accident frequency and certain occupational diseases. According to the 2012 year data of the Ministry of Labor and Social Security, which divides the workplaces into 88 activity groups, it has determined the furniture sector as 18th in terms of the number of workplaces, 26th in terms of the number of employees, 19th in terms of occupational accidents and 25th in terms of occupational diseases, shows the necessity of investigating the working conditions of the furniture industry in Turkey in detail. In this study; in order to define the occupational hazards on employee health arising from the furniture production processes, of a chosen facility producing wooden furniture in Tekirdag were examined for 4 months. The data obtained as a result of defining and measuring the main workplace hazards and periodic health surveillance data, including the health reports of the employees, were evaluated together with the help of the Occupational Physician of the facility and the impact of the main workplace impacts of the investigated production process on employee health was defined. As a result of the study; it has been understood that the change in workplace air quality may have significant effects on employee health. It has been clearly seen that among these effects, especially the noise factor, is a main factor that occurs frequently on the furniture industry workers and causes different levels of influence. In addition, although workplace dust factor, which can occur at different intensities in different steps of the production processes due to the raw material, remains at a low level with preventive measures such as the use of dust collection systems in the facility, the dermatitis-type effects caused by these dusts on the skin can be visibly noticed, however, it was understood that adequate controls and necessary health screenings for diagnosis could not be made within the facility. On the other hand, no serious health problems have been identified due to exposure to chemicals used in the facility. In the future, detailed scientific studies on the reduction and elimination of noise and dust factors , which are determined to be the most important workplace environment effects in this enterprise , and the definition of good practices will also guide the facilities that produce similar products.

Keywords: *Furniture industry, environmental impact, employee health, occupational disease, personal exposure*

Mobilya Üretim Sürecinde Karşılaşılan Başlıca Mesleki Tehlikelerin Çalışan Sağlığı Üzerinde Değerlendirilmesi

Özet: Türkiye'de İş Sağlığı ve Güvenliği (İSG) uygulamaları, kaza sıklığı yüksek sektörlerde ve belirli meslek hastalıkları üzerinde yoğunlaşmaktadır. İşyerlerini, 88 faaliyet grubuna ayıran Çalışma ve Sosyal Güvenlik Bakanlığı 2012 yılı verilerine göre mobilya sektörünü işyeri sayısı bakımından 18., çalışan sayısı bakımından 26., iş kazası bakımından 19. ve meslek hastalığı bakımından da 25.sırada belirlemiş olması(, Türkiye'deki mobilya sektörünün çalışma koşullarının ayrıntılı incelenmesinin zaruriyetini göstermektedir. Bu çalışmada; mobilya üretim süreçlerinden ortaya çıkan çevresel ve sağlık etkilerinin tanımlanması amacıyla, Tekirdağ'da ahşap mobilya üretimi yapan örnek bir tesisin üretim süreçlerinden oluşan çalışma ortamı etkileri ile sağlık problemleri 4 ay süreyle incelenmiş, başlıca önemli çalışma ortamı etkileri tanımlanıp ölçülmesi sonucunda elde edilen veriler ile çalışanların sağlık raporları da dahil olmak üzere, periyodik sağlık kontrol bulguları, tesisin işyeri hekiminin de yardımıyla değerlendirilmiş ve

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incelenen üretim sürecinin başlıca önemli çalışma ortamı etkilerinin çalışan sağlığı üzerine etkisi ortaya konulmuştur. Bu çalışma sonucunda, özellikle çevresel iç ortam kalitesindeki değişimin çalışan sağlığı üzerinde önemli etkilerinin olabileceği anlaşılmıştır. Bu etkilerden özellikle gürültü faktörünün mobilya sektörü çalışanları üzerinde sıklıkla ortaya çıkan ve farklı düzeylerde etkilenmeye sebep olan bir etken olduğu açıkça görülmüştür. Ayrıca hammaddeden kaynaklı olarak üretim süreçlerinin farklı adımlarında farklı yoğunlukta ortaya çıkabilen toz faktörünün, tesis içerisinde toz toplama sistemleri kullanımı gibi önleyici tedbirler ile maruziyetin düşük düzeyde kalmasına karşın bu tozların özellikle ciltte yol açtığı dermatit türü etkilerin gözle görülebilir şekilde farkedilebildiği, ancak teşhisi için yeterli kontrollerin ve gerekli sağlık taramalarının tesis içinde yapılamadığını anlaşılmıştır. Diğer yandan, tesiste kullanılan kimyasal madde maruziyetinden kaynaklanan ciddi boyutta bir sağlık sorunu tespit edilmemiştir. Gelecekte bu işletmede başlıca önemli çevresel etki olarak tespit edilen gürültü ve toz etmenlerinin azaltılması ve ortadan kaldırılmasına yönelik detaylı bilimsel çalışmalar yapılarak iyi uygulamaların tanımlanması, benzer üretim yapan tesisler için de yol gösterici nitelik taşıyacaktır.

Anahtar Kelimeler: *Mobilya sektörü, çevresel etki, çalışan sağlığı, meslek hastalığı, kişisel maruziyet.*

1. Introduction

The wooden furniture manufacturer, taking the precautions related to occupational health and safety and the environment, within the framework of quality systems, using computer technology to system the structural system of all kinds of wooden furniture used indoors and outdoors for living, resting, eating, sleeping, storage, working and exhibition purposes. It is the person who analyzes and projects, analyzes and costs the materials, keeps the whole production process under control and intervenes in the problems, and carries out and supervises the process within the prescribed plan.

One third of the world's furniture exports are carried out by China. Again, EU countries realize about one third of the world's furniture exports. Furniture manufacturing is a core industry in many EU countries and has a competitive position in the world. Because Germany, Poland and Italy are the 3 largest exporters after China. France, Denmark, Belgium, Sweden, Denmark, Austria, England and the Netherlands are other important furniture exporting countries. The EU furniture industry is highly specialized and consists of many sub-sectors. Furnished/upholstered furniture and kitchen furniture are the two largest production groups. EU countries also have an important position in the wooden furniture transit trade. Germany, France, the Netherlands and Spain are the EU's largest furniture consumers. Turkey's share in world furniture exports is 1.6 % as of 2019 [1].

The furniture industry in Turkey is concentrated in certain regions where the market is concentrated and/or forest products are concentrated. According to their share in the total production of important furniture production regions; they are listed as İstanbul, Ankara, Bursa (İnegöl), Kayseri, İzmir and Adana [2].

The furniture and wood industry in Turkey consists of a large number of small-scale family businesses with high production costs as they generally work inefficiently with a low capacity utilization rate. However, as a result of the transformation of the furniture industry by entering the rapid globalization process in recent years, it is on the way to become a much more information and capital-intensive fashion sector compared to the past. In the Turkish furniture industry, especially in the last 15-20 years, the number of medium and large-scale enterprises, as well as small-scale enterprises, has started to increase [3].

Furniture Manufacturing sector in Turkey employs 196 thousand 695 people. In this sector, the number of workplaces

increased by 13% and total employment increased by 47% between 2009 and 2012. 96% of workplaces are small businesses with less than 20 employees. 52% of the people employed in the sector also work in these enterprises employing less than 20 employees (Table 1). Total employment in the sector was approximately increased to12% in 2012. This rate is 3-4% of the total employment growth rate recorded in all sectors in the same year in Turkey. With the employment increase rate above Turkey's average, the sector is one of the rising sectors in terms of share [4].

Table 1 Development of employment in furniture manufacturing sector by number of employees at work (2009-2012) [4]

	2009	**2010**	**2011**	**2012**
Number of Employees Working in the Sector	133.464	151.904	175.127	196.695
In workplaces employing 1-19 workers	78.150	79.784	90.320	102.447
In workplaces employing 20-49 workers	13.991	22.870	27.111	30.122
In workplaces employing 50-99 workers	9.744	13.027	15.449	17.691
In workplaces employing 100-249 workers	12.698	14.287	18.262	18.851
In workplaces employing 250-499 workers	-	5.263	7.027	9.198
In workplaces employing 500-999 workers	-	9.536	9.569	8.853
In workplaces employing 1000-4999 workers	-	7.137	7.389	9.533
Sector Employment Previous in				
Change by Period (%)	-5,58	13,82	15,29	12,32
Total Employment in All Sectors				
(Thousand People)	21.277	22.594	24.110	24.821
Change in Total Employment (%)	0,39	6,19	6,71	2,95

Informal employment in the sector between 2009 and 2013 and the trend of the unregistered employment rate, which was 31% in 2009, decreased by 8 points to 23% in 2013 [4]. Moreover, until the May 2012, the distribution of the number

of furniture manufacturing and the number of employees in these plants according to the size of the them is given in Table 2.

The furniture industry in Turkey generally has a structure dominated by small-scale workshops working with traditional methods. However, in the last thirty years, the number of medium and large-scale enterprises has started to increase. Furniture industry, which is the locomotive of the forest industry, creates a domino effect in the raw material supply chain. Therefore, it has a strategic importance for Turkey with

Table 2 The distribution of the number of furniture manufacturing plants and the number of employees[4]

Workplace Size by Number of Employees (People)	Number of Workplace (Number)	Number of Employees (Person)
1-9	12.750	40.884
1-49	1728	45.574
50-249	192	25.405
250-499	15	6.095
500-749	5	1.862
750- 999	1	1.676
1000-….	1	3.710
TOTAL	14.692	125.206

the added value it creates. Increasing the international competitiveness of the sector, which has also shown a positive image in terms of foreign trade recently, and the OHS law, which has been on the country's agenda for the last three years, require important studies in the field of health and safety in this sector. It is understood from the data in Table 1 that furniture plants operate mainly in small and medium-sized enterprises. According to these data, 132569 of 196695 plants consist of companies with less than 50 employees in 2012.

In the Occupational Health and Safety Law No. 6331, which entered into force in 2012 in Turkey[5], it has been implemented on different dates as of the date of publication with a triple grouping. Transition groups to implementation vary depending on the number of employees, hazard class and whether they are a public institution or not. The law entered into force one year after the publication of the law, especially in furniture businesses with less than 50 employees, which are in the "dangerous" business class, and six months later in businesses with more than 50 employees. According to the list (NACE Rev 2) in the annex of the "Workplace Hazard Classes Communiqué", businesses related to the furniture industry are in the "hazardous" class. It's just that the furniture is painted, varnished, etc. doing complementary works is included in the “very dangerous” class General Directorate of Occupational Health and Safety (GDOHS) [6].

The law, which consists of five parts, has brought important obligations and responsibilities to employers/employer representatives of approximately 20,000 enterprises within the furniture industry and to more than 100,000 employees, among other industries [7;8]. But as shown in Table 2, where the number of furniture manufacturing workplaces and the distribution of the number of employees in these workplaces are given according to the SSI 2012 statistics, 99% of the total number of furniture manufacturing plants with more than 50 employees, which constitutes 70% of the total number of employees. The fact that furniture factories with few employees operate outside of their OHS obligations, with an optimistic estimate, means that occupational safety practices depend on the efforts of the employer and the employee . Furniture manufacturing, which is generally in the dangerous class, contains many risks in terms of occupational health and safety in terms of the processes and working conditions. In the literature, it has been determined that various risk factors such as injuries, electric shocks, noise, vibration, musculoskeletal disorders, wood dust exposure, exposure to chemicals, fire and explosion can be seen in joinery, painting and flooring workshops due to machines and hand tools. [9,10,11]. Machinery and equipment, compressors, ventilation systems used in furniture paint shops are the main sources of noise and vibration. Similarly, the health effects of noise and vibration may result in increased blood pressure, metabolism disorders, behavioral disorders, circulatory disorders, sleep disorders, headaches and fatigue, while noise may result in hearing loss and vibration may result in tissue deformations (15).

Another risk affecting the health of employee in furniture paint plants is wood dust. A high percentage of fine dust is generated during the processing and especially sanding of wood material. Released dust can cause skin diseases such as dermatitis, nasal congestion, respiratory problems such as asthma and bronchitis, and nasal sinus cancer [9,10,12].

During the activities carried out in furniture paint plants, there is an intense use of chemicals.The materials used in paint plants are materials such as paint (primer paint, top coat paint, lacquer paint), varnish, varnish, thinner; similarly, they are organic chemical compounds formed by the combination of different substances added in a binder.They contain different ratios of resin/binder and various solvents [9,13]. Most of the paints, thinners and varnishes used in the furniture industry are irritating.The binders/resins in these substances cause damage when they come into contact with the skin for a long time, and the solvents contained in these substances create negative health effects when exposed both through the skin and through inhalation because they are volatile.These chemicals also cause health risks such as allergic reactions, eye irritations, respiratory disorders, digestive disorders, skin diseases, and brain and nervous system disorders [14,15]. The most commonly used solvents in the production of paints and similar chemicals are benzene, toluene, ethylbenzene and xylene compounds, which are preferred because they are inexpensive and dissolve oil, varnish and other resins well [15,16].

Besides, the wooden materials such as boards may contain biological contaminants as a biological risk factors, Mold and fungus growing on tree bark can cause allergic reactions. Inhaling fungal spores found in the bark of maple, alder and cork trees causes lung diseases (suberosis, sequosis).

Parallel to the growth of the furniture industry in our country, the number of work accidents has been increasing in general

in the last six years [17], and it has been observed that there has been a significant increase in the reporting of work accidents in the industry since 2012, together with the obligations brought by the Occupational Health and Safety Law No. 6331 in Turkey. However, the number of occupational diseases detected in the sector is below the forecast due to reasons such as inadequacies in the diagnosis and diagnosis of occupational diseases, and the slow progression of occupational diseases related to the furniture sector. A total of 5,068 employees, 4,829 men and 239 women, in the furniture manufacturing sector in Turkey, had occupational accidents and 2 male employees were affected by occupational disease in 2015 [4].

According to Social Safety Institute (SSI) 2012 data, the sector, which mostly consists of small and medium-sized enterprises, ranks 19th in terms of occupational accidents and 25th in terms of detected occupational diseases among 88 sectors in Turkey, despite the possibility that the data is far below the real situation [2]. It shows the necessity of examining the working conditions of the sector in detail and eliminating the necessary cause or factors of work accidents and occupational diseases immediately.

In this context, the aim of this study is to define the effects of workplace / occupational hazards on employee health caused by workplace / occupational hazards factors in a sample facility that produces furniture from wooden materials. For this purpose, workplace environment and personal exposure factors such as chemicals, noise, wood dust, vibration were measured and evaluated in terms of their effects on employee health.

2. Materials and Methods

2.1. Investigation Plant

Each of the processes in the furniture production stages in the furniture industry, manufacturing industry, can vary according to the type of furniture to be produced or its usage characteristics. In the literature, the main process types in furniture production; office processes, shaping processes, assembly processes, surface treatment processes and transportation processes [18].

In this study; the occupational hazards and health problems of choosen facility in Tekirdağ province, which produces two shifts with 430 employees on an area of 74,943 m2 and gained a corporate identity in the field of furniture production in Turkey, were examined for 4 months. In the facility investigated in this study, the process is defined by the production processes that take place in 3 basic groups: wood production, metal production and upholstered production

Panel workshop defined as the area where box-type furniture is produced, solid workshop where frame type furniture is produced, metal workshop where metal material is prepared, polish workshop where top surface treatments such as paint and varnishing are applied, upholstery workshop where textile coating products are prepared, and assembly where necessary parts are attached according to the feature of the furniture produced. In the wooden furniture production processes, which consist of 5 basic production stages, including the workshop, the measurements made on-site and the periodic health control findings, including the health reports of the employees, were evaluated with the help of the on-site physician of the facility, and the impact of the main environmental effects of the examined production process on employee health was defined.

2.2. Method

In the investigated enterprise; TS2607 ISO1997:2005 [19] methods were used for noise measurements, which is one of the sector-specific occupational/workplace hazards that may affect employee health, TS ISO 16200-1 for the determination of the amount of volatile organic compounds in the indoor air [20], and NIOSH 0600 for the wood dust factor that occurs during the cutting and drilling processes of the raw material [21].

TS EN ISO5349-1/TS ISO2631-2 methods [22] have been used for vibration, which occurs during the application of processes such as sanding and has an effect at the level of the hand-arm to which the workers are exposed for 8 hours.

In the workplace hazard, personal noise exposure measurements were made with the TES1354 device with a measurement range of 0-9999% within a working period of 420 minutes. Gillian BDX Air Sampling Pump device was used for the determination of the volatile organic compounds in the indoor environment and the amount of wood dust emerging during the cutting and drilling processes of the raw material, and the personal exposure measurement results were calculated using the gas chromatography method with the Agilent (HP) 6890 type device. The results obtained in the measurements made by using the Svantek 958 brand device for vibration, which occurs during the application of processes such as sanding and affects the level of the hand-arm to which the employees are exposed for 8 hours, were evaluated by comparing them with the legal limits.

In addition, by taking the opinions of the workplace physician, the audiometry, respiratory function and blood and urine tests of the employees, and lung charts of the employees were examined from the health files kept for each employee, and it was evaluated whether each effect had a potential harm to the health of the employee.

All the occupational hazards, which may occur during work flow processes, examined in the study have been tried to be defined that have the potential to harmfull effect on employee health within the scope of OHS legislation. Moreover, the appropriateness of the methods of protection from these dangers were questioned.

Thus, the situation of the furniture industry, which is one of the sectors on which studies are very limited, in terms of the major important occupational hazards has been tried to be revealed. Furthermore, it has been aimed to be a reference source that can be used in defining the health and safety system for small businesses.

3.Results and Discussion

3.1. Furniture Production Processes' Major Occupational Hazards on Employee Health

Main process types in furniture production; office processes, shaping processes, assembly processes, surface treatment

processes and transportation processes[18]. In the incvestigated plant; production is carried out in 3 basic groups as wood production, metal production and upholstered production, and production processes are processed in the panel workshop, sizing machine, massive workshop and polish workshop in accordance with customer demands.

The polishing workshop, which is also defined as the surface treatments in furniture production, is classified as the sections where the upper surface treatments of the furniture in the batch production system and the parts that make up the furniture in continuous production are made (Table 3).According to this classification; Top surface treatments are handled in 4 sections as Natural varnishing, Coloring and varnishing, Covering protective layer preparation and Artificial tree image preparation [18].

In the investigated facility; The parts coming from the massive and panel workshop are separated according to their types and the order of operation is determined. The varnish or paint applied to the products coming from the massive workshop with a spray gun is applied to the floor by hand. After the paint-soaked floor is smoothed with sandpaper, it is polished or painted for the second time. Wax process is applied to the laminate type product coming from the panel.If it is made of MDF or paintable chipboard, filling, edge painting, sanding, top coat spray processes are applied and dried with UV rays. In case the incoming piece is coated, if it is necessary to color, the coloring process will be done, then the filler pen would go through the surface painting, sandpaper and final coat process and then baked.

The parts that come out of the polish shop move to the assembly line. In the metal workshop, cutting, bending, hole, pressing, dovetailing, deburring, grinding and welding of solid profile and empty profile metals are carried out, and if the parts are upholstered, the seat frame of the upholstered production is lathed and painted.

Table 3 Sequence of assembly and surface treatment in batch production system and continuous production system [18]

Batch Production Panel Line	Continuous Production Panel Line
Piece cut	Panel cut
Veneer bonding	Veneer bonding
Dimensioning	Dimensioning
Edge bonding	Edge bonding
Hole drilling	Hole drilling
Assembly	Surface treatments
Surface treatments	Assembly

If it is not a part of the upholstered product, it is sent to the semi-finished product line or to an external company for chrome plating. The water curtain used in the painting process is cleaned periodically and the resulting water is sent to the chemical pre-treatment pool. After the priorities of the files coming to the Sheet Metal workshop are determined according to the delivery date, the processes such as giotin scissors cutting, twisting, hole, spot welding rivet, grinding, corner cutting, profile cutting are passed according to the characteristics of the desired part.

In the epoxy workshop, if necessary, deburring or grinding is performed on the parts to which epoxy powder paint will be applied, and then spray degreasing is performed. Generally, paint booth and baking oven are used for the parts that are few in number, and the paint line and powder paint baking oven are used for the parts that are high in number. The paint booth has a closed system structure that prevents the powder paint from reaching the environment. Since the paint line is a closed machine, the parts moving in the closed area are painted by the operators standing on both sides of the machine, and the parts move towards the baking oven here, and the pieces coming out of the baking oven are ready for use.

In the upholstery workshop, all upholstered products are prepared and assembled. According to the incoming production file, leather and fabric cuttings and sewing are carried out simultaneously on the one hand, while the elastic girth of the armchair and sofa skeletons is drawn, whitened and lowered to the dressing station. The covers coming from the sewing lines are combined from the skeleton dressing lines coming from the bleaching and hand dressing processes are carried out. If the parts from other workshops are not installed in the final assembly stations, the wooden materials are cleaned, the accessory fastenings are assembled and checked, and the product is delivered to the shipping unit from the tooling line.

The general work flow processes of these workshops and their effects on the environment are given in Figure 1.

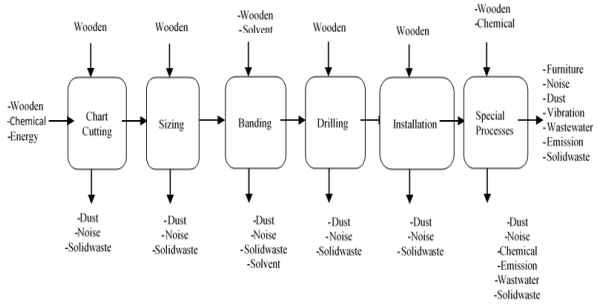

Figure 1. Production processes steps applied in the panel workshop of the investigated facility

3.2. Noise Measurement Results and the noise effect on workers' health of the Investigated Facility

Noise is one of the hazards defined under the title of "Physical Effects" in many sources on OHS, which can be encountered not only in industrial areas but also in all areas of life, causing both work accidents and occupational diseases. Although the noise intensity changes depending on the machine features used, the cutting and hole line in solid and panel workshops, and metal cutting and CNC machines in the metal workshop are the points where the noise occurs the most. Workplace noise measurement results, which were determined by on-site measurements in different workshops and machines of the facility, are given in Table 4, and personal noise exposure measurement results are given in Table 5.

Table 4 Workplace noise measurement results of the investigated facility

Measurement Location	Equivalent Noise Leq (dBA)
Massive Cutting Line	99,5
Massive Sizing Line	87,5
Massive-Panel Walkway	81.4
Panel Chipboard Cutting Line	85,5
Panel Chipboard Sizing Line	88.6
Panel Chipboard Special Process	91.0
Panel Chipboard Hole Line	86.8
Panel Coated Calibration Line	95.4
Panel Coated Sizing Line	83.7
Panel Coated Press Line	80,4
Panel Coated Drilling Line	93.1
Panel Coated Special Process Line	91.0
Polishing Workshop Sanding Machine	87.7
Polishing Workshop Sanding Machine	80.6
Lacquer Workshop Paint Booth	82.1
Metal Drill Line	86.7
Metal Cutting	88.0
Metal Cutting	96.8
Metal Twisting	82.7
Polishing Machine	89.7
Metal CNC Cutting	88.1
Metal Stock Area	80.5
File Line Front	82.7
File Line	98.7
Epoxy Oven Front	87.0
Uphoalstery Workplace Sponge Cutting Machine	72.8

Table 5 Personal exposure noise measurement results of the investigated facility

Department of the Employee Workplace	Measurement Result dB(A)	Exposure Limit Value dB(A)
Cut	90	87
Sizing	89.7	87
Drilling	84	87
Installation Line	86.6	87
Metal cutting and twisting	113	87
Upholstery Dressing (Special Processes)	87.6	87
Thickness Machine (Special Processes)	100.6	87

When the results of the pulmonary function test and chest X-ray, which provide the preliminary evaluation of respiratory tract and lung diseases other than the audiometric test, which are among the periodic health screenings of the employees of the facility, are evaluated, no diseases developed from the effects of the workplace are observed in the investigated facility employees.

3.3. Chemicals' effect on employees' health of the Investigated Facility

Cengiz (2002) reports that chemical substances, which are used for a better standard of living, the amount of consumption increases in parallel with population growth, and there are millions of types, pose serious dangers to human, plant and animal health [23]. Aksakal et al. (2005) state that the materials and chemicals used in the sector have changed in parallel with the developing furniture sector [24]. Podniece (2012) states that the chemicals in question may have effects such as toxic effects, respiratory diseases, occupational cancers, mutagenic effects, and skin diseases [25]. Wood is generally treated with adhesives, solvents, varnishes, insecticides, water and moisture protectors, paints, pigments and varnishes, which are almost all volatile and can be released in the environment when the wood is heat treated.

The workplace measurement results for the determination of the amount of volatile organic compounds that pass into the indoor air from the chemicals used in the polishing, coloring or surface cleaning stages, especially solvents, are given in Table 6 and the personal exposure measurement results are given in Table 7 in the facility under investigation.

Again, according to the results of blood analysis and urine culture tests, which detect the presence of cancer or substances that have entered the bloodstream, no effect was observed, especially from volatile organic compounds.

Table 6 Workplace measurement results of volatile organic compounds passing into the indoor air in the investigated facility

Parameter Concentration (mg/m^3)	Measurement Location	Measured Value (mg/m^3)	NIOSH Limit Value (mg/m^3)	OSHA Limit Value (mg/m^3)
1,1dikloropropan	Coloring bench	663.89	-	-
Toluen	Coloring bench	1.54	560	750
Toluen	Upholstery workshop	0.18	560	750
2-butanon	Upholstery workshop	1.47	885	-
Metilen chloride	Epoxy	11.34	-	433
Ksilen	Epoxy	1.8	655	-

Table 7 Personal exposure measurement results of volatile organic compounds that pass into the indoor air in the investigated facility

Parameter Concentration (mg/m^3)	Measurement Location	Measured Value (mg/m^3)	NIOSH Limit Value (mg/m^3)	OSHA Limit Value (mg/m^3)
Toluen	Paint cabinet	0.01*	375	750
Ksilen	Paint cabinet	0.01*	350	2350
Aceton	Paint cabinet	0.24	590	2400
Etil benzen	Paint cabinet	13.01	435	435
Ksilen	Paint cabinet	45.47	435	435
Toluen	Paint cabinet	15.20	375	750

*The lower determination limit for the volatile organic compound parameter is 0.1 mg/m3 and no volatile organic compounds were detected within the determination limit.

Tomak et al. (2010), wood preservation methods gain importance due to the increasing environmental pressure to obtain natural durable and high quality tropical tree species from unsustainable forests and to increase the strength of wood with various chemicals [26]. In addition, due to the importance of dimensional stability, biological resistance against insects and fungi, hardness and mechanical resistance, fire resistance, appearance, paintability and adhesiveness depending on the end use of wood materials, chemical properties of wood materials gain importance. Its modification based on impregnation with substances is mandatory [27]. The positive results of the studies carried out

to obtain water-based wood coloring agents obtained from various tree and plant extracts instead of chemicals that have harmful effects on the environment and human beings, by using "natural products" instead of chemicals used as dyes in furniture, reducing environmental pollution and providing a more livable environment for future generations. environments have the advantage.

3.4. Wood Dust Imitation effect on workers' health of the Investigated Facility

The control of the risks of fine wood particles formed during the processing of wood material has been legalized since 1974. Processes that cause high dust formation in the furniture industry; cutting, chamfering and drilling, machine or hand sanding, using compressed air to remove dust collected on furniture or other surfaces, special surface and assembly made by hand, using low density raw materials, contacting bagged dust from dust extraction systems [2] . Lungs are an important organ affected by exposure to environmental harmful substances, due to their large surface area, high blood flow and thin alveolar epithelium structure [28]. Occupational lung diseases; it occurs in different clinical pictures depending on various factors such as the chemical properties of the exposed agent, the physical characteristics of the exposed agent, the mode of exposure and the resistance of the individual to this agent. During the cutting and shaping of wood, sufficiently small particles of wood dust dispersed in the form of wood dust and sawmill dust can enter the depths of the lungs through respiration. Workers who come into contact with dust pose risks such as asthma, chronic bronchitis, nasal inflammation, and lung dysfunction [29]. It is also known that wood dust has an allergic effect and sawdust has a cancer effect.

Dust that emerges as a result of processes such as sizing, drilling and sanding in the solid and panel workshops, which form the two main parts of the facility where wood material is processed, and in the polishing unit after painting, spreads to the working environment and causes negative effects on employee health. The dust concentration and limit values to which the plant workers are exposed during the 8-hour working time are given in Table 8.

Table 8 Dust concentrations and limit values to which the employees in the investigated facility are exposed

Measured Worker/Department	Measured value (mg/m^3)	PARPAT* Limit Value (mg/m^3)	OSHA Limit Value (mg/m^3)
Worker-1 / Cut	0.5	10	5
Worker-2 / Sander	0.88	10	5
Worker-3 / File Line	0.67	10	5
Worker-4 / Sander	0.58	10	5
Worker-5/ Special Transaction Line	0.32	10	5

*PARPAT: Regulation on Measures to be Taken at Workplaces and Work with Flammable, Explosive, Dangerous and Harmful Substances ın Turkey published in the Official Gazette dated, 17th July 2014 and numbered:29063.

According to the results of the pulmonary function test used in the general definition of respiratory tract damage caused by wood dust, there is no development of respiratory function insufficiency in facility workers. Again, according to the results of blood analysis and urine culture tests, which detect the presence of cancer or substances that have entered the bloodstream, no effect was observed, especially from volatile organic compounds. As can be seen in Table 8, one of the main reasons for low dust exposure in a high dust working environment is the use of dust extraction systems in all machines and areas where dust generating operations are carried out in the factory.

3.5. Vibration effect on workers' health of the Investigated Facility

The most common sources that cause the vibration factor, which is defined as the transmission of a mechanical energy to the body, are stone crushing machines, pneumatic hammers, portable saws, polishing and planing machines that cause local vibration [30] . Vibration that affects the working efficiency of the exposed person is classified as Hand-Arm Vibration, which is formed by the transfer of the current vibration to the hand-arm system, and Whole Body Vibration, where the current vibration is transferred to the whole body [31]. Among the types of work done in the examined facility, the sections where the works that produce hand-arm vibration are performed are defined as the sanding and file lines. In furniture production, which is generally done with machines, a work flow process that causes whole body vibration has not been observed due to the machine mounting depths and good grounding properties.

The measurement results of the amount of vibration at the hand-arm level that the workers are exposed to for 8 hours are given in Table 9.

Table 9 Hand-arm vibration exposure measurement results in the investigated facility

Vibration Measurement Location	1. Measurement	2. Measurement	3. Measurement
File Line	0.213 m/s^2	0.159 m/s^2	0.151 m/s^2
Sanding Line	0.671 m/s^2	0.239 m/s^2	0.124 m/s^2

Considering the measurement results, the measurement value exceeding the 5 m/s2 value specified as the daily working exposure limit value for 8 hours in the Regulatıon On The Protectıon Of Employees From Vıbratıon-Related Rısks published in the Official Gazette dated 22.08.2013 and numbered 28743 is not encountered [32].

4. Conclusion

In this study, which includes the evaluation of furniture production processes from wood material in terms of OHS, it has been observed that health problems that may develop in employees due to the effect of production conditions are defined similarly in all countries. The main problem related to the furniture production process in our country is the fact that the occupational disease and work accident data do not reflect the truth, especially since the medium and small scaled workshops have not entered the OHS implementation process, as well as the high number of people who continue to work in the sector unprotected without being aware of the danger, and the emergence of occupational diseases. The fact that the exit process takes a long time gives symptoms that prevent positive thinking about the health status of the

employees in the furniture production sector.

As a result of the study, it has been understood that there may be significant effects on employee health from occupational hazard factors, apart from raw material supply routes, which cause environmental effects to be experienced more globally.

It has been clearly seen that among these factors, especially the noise factor, is a factor that occurs frequently on furniture sector workers and causes different levels of influence. According to the workplace and personal exposure noise measurement results of the investigated facility, maksimum noise were measured as 99,5 dB(A) at Massive Cutting Line and 113 dB(A) at metal cutting and twisting workplaces respectively. On the other hand minumum noise were measured as 72,8 dB(A) at Uphoalstery Workshop Sponge Cutting Machine while personal exposure measured as 84 dB(A) at drilling line. So, the fact that the noise emission from the machines, which is the main factor for the high level of exposure to noise, could not be prevented, and the protection against noise is limited to the effectiveness of personal protective equipment and the preference of personal protective use can be defined as the reason for the health damage caused by the effect. In addition, despite the fact that adequate controls and necessary health screenings cannot be performed to diagnose the effects of dust factor, which can occur at different intensities at different stages of production processes due to raw materials, especially on the skin, the absence of an employee whose respiratory tract is seriously damaged shows that with the preventive precautions such as the use of dust collection systems in the factory, it can be achieved to keep the exposure at a low level.

Similarly, no serious health problem has been identified due to exposure to the chemicals used. The application of the chemicals used in the paint and polishing processes in the factory environment to the material is done in the cabinets that prevent the spread of chemicals in the general working environment. By using the aqueous system in these paint cabinets, the spread of chemicals and dust particles to the indoor air and environment is prevented, thus minimizing their negative impact on the environment and workers.

Vibration effect, on the other hand, is at a level that can be defined as the least likely source of danger to have an effect on employee health due to short-term exposure.

As a result; it is necessary to take more effective measures against the internal factors that occur in the furniture production processes, especially against noise, and to conduct a more comprehensive health screening in order to better interpret the exposure to dust.

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