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Research Article

Evaluation Of Particular Material And Exposure Measurements In Terms of Occupational Health And Safety In A Yarn And Weaving Factory In Denizli Organized Industry Region

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Abstract

Airborne pollutants are associated with pneumoconiosis lung diseases, which are common especially at high exposure levels. When people are exposed to particulate matter, the risk of developing dust-related occupational diseases also arises. In industrialized and industrializing countries, exposure to dust above the limit values can lead to disability and deaths. It is unacceptable for employees to be victimized by diseases caused by the working environment, and occupational diseases create financial burdens on national health and social security systems. All these negativities can be eliminated, managed or controlled.

Particulate matter is an important problem affecting human health and quality of life more in many countries where industrialization is intense. People are in dusty areas in different environments of life. However, workers in industrial establishments where high levels of dust are generated constitute the most affected segment of the dust. Particulate matter causes employees to complain about their work, negatively affect their work performance and consequently cause loss of workforce. Within the scope of this study, which aims to examine the dust exposure of people working in different dusty environments in factories, the dust level of the yarn and weaving parts of the enterprise was determined by making measurements. Dust level values emitted by open end yarn and weaving machines were measured. During the measurement; It was observed that the nominal day conditions determined in the job analysis were not exceeded. The tasks were carried out within the specified periods and all dust sources were studied within the determined periods.

Keywords: Particulate matter, Yarn, Weaving, Dust, Exposure.

Denizli O.S.B. Bir İplik&Dokuma İşletmesinde Partikül Madde ve Maruziyet Ölçümlerinin İş Sağlığı ve Güvenliği Açısından Değerlendirilmesi

Öz

Havadaki kirleticilerin, özellikle yüksek maruziyet düzeyinde sıklıkla görülen pnömokonyoz akciğer hastalıkları ile ilişkileri kurulmaktadır. Kişilerin partikül madde maruziyeti söz konusu olduğunda, toza bağlı mesleki hastalıklara yakalanma riskleri de beraberinde ortaya çıkmaktadır. Sanayileşmiş ve sanayileşmekte olan ülkelerde sınır değerlerin de üzerinde toza maruziyet, iş görmezlikler ve ölümlere yol açabilmektedir. Çalışanların, çalışma ortamından kaynaklanan hastalıklarla mağdur edilmesi kabul edilemeyeceği gibi, mesleki hastalıkların ulusal sağlık ve sosyal güvenlik sistemleri üzerine mali yükler oluşturmaktadır. Tüm bu olumsuzluklar, ortadan kaldırılabilir, yönetilebilir veya kontrol altına alınabilir.

Partikül madde, sanayileşmenin yoğun olarak yaşandığı pek çok ülkede insan sağlığını ve yaşam kalitesini daha fazla etkileyen önemli bir sorun olma özelliği taşımaktadır. İnsanlar, yaşamın değişik ortamlarında tozlu alanlarda bulunmaktadır. Bununla birlikte tozdan en çok etkilenen kesimi, yüksek düzeyde tozun ortaya çıktığı sanayi kuruluşlarında çalışanlar oluşturmaktadır. Partikül maddenin, çalışan kişilerin yaptıkları işten yakınmalarına neden olması, çalışma performanslarını olumsuz yönde etkilemesi ve buna bağlı olarak iş gücü

kaybına neden olması önem arz etmektedir. Fabrikalarda farklı tozlu ortamlarda çalışan kişilerin tozdan etkilenme durumlarını incelemeyi amaçlayan bu çalışma kapsamında, işletmenin iplik ve dokuma bölümlerinin toz düzeyi ölçümleri yapılarak belirlenmiştir. Open end iplik ve dokuma makinalarının ortama yaydıkları toz düzeyi değerleri ölçülmüştür. Ölçüm sırasında; iş analizinde tespit edilen nominal gün şartlarının dışına çıkılmadığı gözlenmiştir. Görevler belirlenen süreler içinde gerçekleştirilmiştir ve tüm toz kaynakları tespit edilen sürelerde çalışılmıştır.

Anahtar Kelimeler: Partikül Madde, İplik, Dokuma, Toz, Maruziyet.

1. Introduction

In general, the term "dust" is used for solid particles of various sizes that can remain suspended in the air for a certain period of time. Dusts are substances that are formed as a result of abrasion, fragmentation, grinding, and combustion from various organic and inorganic substances and whose chemical properties vary between 1 μm and 100 μm and are similar to the structure of the chemical substance that composes them [1].

The textile industry includes processes that turn fiber and yarn into articles of use. It is in the textile sector, surfaces with fiber, yarn, knitted woven fabric, felt and non-woven surfaces for all kinds of needs, home textile products. In the textile industry, machinery and equipment used to produce high quality and optimum speed are important. The textile industry is a labor-intensive industry.

One of the machine effects that occur with mechanization and negatively affect business success is dust. Particulate matter can cause significant inconvenience to the workers using the machines in ambient conditions where more than one machine is operated together. In such environments, high dust levels adversely affect the health and productivity of workers. In order to examine the negative effects of dust generated by yarn and weaving machines on worker health, it is necessary to determine the level of dust emitted by these machines. Particulate matter level measurement was made in the enterprise and its effects on the worker were examined.

As industrialization increases, environmental factors that will adversely affect human health also increase. The working group that is most affected by these environmental factors is the workers. In our country, it is tried to protect the health of our workers with technological advances. The leading sector in our country is the textile sector. Workers in the spinning and weaving industry are exposed to certain environmental harmful factors. The most intense ones are noise, high humidity and dust. In addition to environmental factors, there are factors related to the conduct of the business. These are shift working conditions, like continuous standing work. Workplace dust is the best-known cause of occupational disease. Byssinosis, which is defined especially as a result of cotton dust, has been known since ancient times [2]. Respiratory functions are affected in workers working in yarn production for many years. It is stated that byssinosis develops in individuals exposed to cotton dust for more than 20-25 years [3] and the frequency of byssinosis varies according to the studied departments [4]. In this study, it was aimed to examine the dust exposure level in the yarn and weaving mill and its relationship with the departments and working hours. It is aimed to correlate the changes in the respiratory functions of the workers with the dust concentrations in the workplace by measuring the dust density in different departments.

2. Effects of Particulate Substances On Human Health

Solid particles suspended in the air and can move with the air flow are called particulate matter (dust). The effects of mineral dusts on human health mainly depend on the grain sizes and mineralogical structures of the dusts.

Aerosol condition; It is a multiphase system in which a solid with a diameter of less than 10 microns or a liquid with a diameter of less than 10 microns is in a gaseous environment. The CEN-TR16013-3 standard is used for the measurement of solid and liquid substances in suspension in the environment.

Until recent years, diseases caused by mineral dusts were known only as occupational diseases. Today, researchers have emphasized that mineral powders enter the body through respiration, digestion or skin and cause various diseases. Minerals; They are solid substances that occur naturally, have a certain crystalline internal structure, have a certain chemical composition, and contain unique physical and chemical properties. Particles subject to health are particles with an aerodynamic diameter of less than 10 μm. Particles in this size range can accumulate in the respiratory tract. Particles smaller than 2.5 μm are called “fine particles”. Sources of fine particles include all combustion processes and some industrial processes. Particles in the 2.5-10 μm range are called "coarse particles". The sources of coarse particles are crushing, grinding processes, dust from the roads. Particulate substances are retained in various parts of the respiratory system according to their size[5].

The region where they are held and their particle sizes;

a) 10 micron throat and upper respiratory tract (nasopharyngeal area),

b) They are kept in the lower respiratory tract (tracheobronchial region) of 2.5-10 microns.

c) Dust particles of 2.5 microns and below enter the lungs during respiration.

Therefore, the most important ones in terms of health are the dusts with a size of 2.5 microns and below, which we call "fine particles" or "respirable dust". These dusts reach the alveoli (air sacs) through respiration and cause pulmonary dust diseases, which we call "pneumoconiosis".

In terms of their biological effects, dusts are classified as follows.

2.1. Fibrogenic Powders

Fibrotic changes occur in the lungs when dust particles, which have the fibrogen (fiber) capacity of some substances, are inhaled and accumulate in the lungs. This fibrotic tissue replaces the normal active tissues of the lung over time. By gradually destroying the lungs, it makes it difficult for the worker to work and shortens his life.

The most prominent examples of such dusts are silica, asbestos, talc, aluminum. The above-mentioned dusts cause pneumoconiosis (disease caused by tissue damage caused by the accumulation of dust in the lungs) called silicosis, asbestosis, talcosis, and aliminosis, respectively. Factors such as the concentration of these dusts in the environment, exposure time, body resistance are effective in the illness of the employee. For this reason, those who work in coal mines, especially underground, are taken to rest at certain intervals[5].

2.2. Toxic Dusts

Dusts that cause chronic or acute poisoning effects on various organs (such as nervous system, liver, kidneys, stomach and intestines, respiratory organs, blood-forming organs) when taken into the body fall into this class.

If one or more of the components that make up the dust is a toxic substance, they may cause poisoning depending on the type of the substance, its percentage in the dust, the density of the dust in the air, and the amount of the inhaled dust. Heavy metal powders such as lead, cadmium and manganese are the most prominent examples of this group.

Cadmium has a toxic effect on the kidneys and manganese on the central nervous system. Lead dusts, on the other hand, can have toxic effects on many systems such as the blood system, nervous system, excretory system and digestive system [6].

2.3. Carcinogenic Powders

These are dusts that can cause cancer in humans depending on various internal and external factors. Factors such as nutrition, living conditions, environmental pollution and occupational effects are thought to play a role in cancer formation.

Dusts known to be carcinogenic today include: asbestos, arsenic and its compounds, beryllium, chromates, nickel and their compounds.

2.4. Radioactive Dusts

Ionized rays emitted by radioactive substances in the form of dust in the air damage the cells and tissues of the human organism, cause tumor formation and genetic disorders. These are not many, but the most important are; uranium, thorium, cerium and zirconium compounds are salts of tritium and radium.

2.5. Allergic Powders

They are powders that can cause various allergic reactions such as fever and dermatitis in sensitive people. Various bacteria, yeasts, molds and pollen can also have such an effect. Allergic respiratory system diseases may occur with the inhalation of moldy dusts such as animal feed, straw, grass, grain, pulp, which have been waiting for a long time in humid and warm places such as barns and barns. Bisinosis seen in cotton, flax and hemp workers, weaving factory workers, and bronchial asthma seen in bakers due to flour are allergic reactions. Wood dust is also included in this group .

2.6. Inert Powders

Such dusts are dusts that can accumulate in the body but do not have fibrogenic and toxic effects. Inhaled and settled particles are either excreted through the breathing process and self-cleaning of the respiratory system or, in the worst case, form a permanent accumulation in the lung without major pathological effects. Limestone, marble, gypsum dust and tobacco dust are examples of this group [4].

3. Materials and Method

3.1. Material Model

In experimental studies, noise measurements were made on yarn and weaving looms used in the blanket factory. All exposure limit values were made in the respiratory region on the basis of personal sampling. Location of the measuring device; Sampling pump. It is fixed on the sampled employee. The sampler was placed within 30 cm of the person's mouth and nose. Measurement methodology; TS EN 689 Workplace air – It has been evaluated by comparing the chemical substances exposed by inhalation with the limit values and measuring strategy.

3.1.1. General Principles of Particulate Matter Measurement

Although there are various methods for measuring particulate matter concentration, three main methods are used. In the mass concentration method in the filter system; The air sample is taken at a constant flow rate with the help of a pump, passed through a tared filter system, and then the concentration of suspended particulate matter in the air is calculated by weighing. In this method, depending on the properties of the filter used, particles smaller than a certain size cannot be measured, all particles larger than this size are included in the measurement. Another method is the beta-ray diffraction method with a filter system, which is a radioactive method used to measure the concentration of particulate matter. Finally, the optical method is the most widely used method in measuring the concentration of particulate matter, since particles with a size of 10 microns and less can be detected. The most widely used optical method is the scattering of light. In this method, the air sample taken at a constant flow rate with a pump is passed through a light beam. The light scattered by the particles in the air sample is measured by a photomultiplier tube and electronic devices attached to it. Since the amount of scattered light is proportional to the amount of particles and the air flow rate is constant, the concentration of suspended particulate matter in the air is determined by optical electronic method from the amount of light scattered directly [7,8].

3.1.2. General Principles of Personal Exposure Dust Measurement

It is used to detect particles, steam and gases in the environment that people are exposed to during work. In the mass concentration method in the filter system; The air sample is taken at a constant flow rate with the help of a pump, passed through a tared filter system, and then the concentration of suspended particulate matter in the air is calculated by weighing. It is necessary to pay attention to the fact that the tip of the sampling apparatus is open during measurements.

3.1.3 Method and Device Used

3.1.3.1. Method and Device Used in Aerosol Measurement

While determining the concentrations of particulate matter, for the determination of the amount of substance suspended in the air with the light scattering principle, in accordance with the Workplace Exposure- Guide For The Use of Direct-Reading Instruments For Aerosol Monitoring-Part 3: Evaluation of Airborne Particle Concentrations Using Photometers CEN-TR16013-3 measurement was made.

The "Dustmate Dust Meter", a product of Turnkey company, was used to measure the level of suspended particulate matter in the air.

1) The device can be used for continuous indoor air sampling and monitoring of ambient air.

2) The device measures with the principle of light scattering.

3) There is a built-in diaphragm pump inside the device and the device samples the air with a constant and controlled flow rate with the help of this pump.

4) The measuring range of the device is 0-65.00 mg/m³.

5) The device has an auto-adjustable LCD screen, from which both real-time values and the average of the values during the measurement can be seen.

6) The device can simultaneously measure and save TSP, PM10, PM2,5 and PM1 measurements in its memory.

7) The device has a memory to store 32 KB of data.

3.1.3.2. Methods and Devices Used in Personal Exposure Dust Measurement

Exposure dust measurements at the facility were made according to the General Methods For Sampling and Gravimetric Analysis of Respirable and Inhalable Dust MDHS 14/3 method. Sensidyne brand Gilair Plus model sampling pump, Gilian brand BDX-II Pump Kit model sampling pump, Sensidyne brand Gilian5000 Model devices were used for personal dosimetric dust measurement. Features of the GILIAN 5000 device are given below. High Flow Range: 700–5,000 cc/min Accuracy (Airflow): +/- 5% Constant Flow Control: <+/- 3% of adjusted flow. Features of the GILIAN Gilair Plus device are given below. High Flow Range: 20–5,000 cc/min Accuracy (Airflow): +/- 5% Constant Flow Control: <+/- 5% of adjusted flow. The features of the GILIAN BDX II device are given below. High Flow Range: 500–3,000 cc/min Accuracy (Airflow): +/- 5 % Constant Flow Control: <+/- 5% of adjusted flow

3.2.Particulate (Aerosol) Matter Measurement Values

Table 1. Particle Substance Measurement Values

NO	PM10 (µg/m³)	PM2,5 (µg/ m³)	PM1 (µg/ m³)	MEASUREMENT PLACE
1	390,7	34,20	6,53	GREEN FLAT BLOW ROOM1
2	513,4	55,29	11,49	WHITE FLAT BLOW ROOM
3	520,3	67,38	12,95	WHITE CIRCLE COMB AREA
4	1.218,3	69,13	13,18	WHITE CIRCLE COMB AREA
5	1.297,3	60,23	15,57	WHITE CIRCLE CER AREA
6	1.183,6	59,86	16,12	WHITE CIRCLE CER AREA
7	1.178,3	67,23	15,13	WHITE CIRCLE OPEN END
8	1.258,1	63,57	15,66	WHITE CIRCLE OPEN END
9	1.055,3	65,18	15,27	WHITE CIRCLE OPEN END
10	520,3	67,38	12,95	GREEN CIRCLE COMB
11	1.813,5	77,11	17,71	CERGREEN CIRCLE CAR
12	1.803,7	75,23	17,88	GREEN FLAT OPEN END
13	1.568,9	72,63	16,52	GREEN FLAT OPEN END
14	710,7	34,53	7,88	WARP MACHINES 1

15	723,2	35,13	7,63	WARP MACHINES 2
16	672,3	34,18	7,19	WARP MACHINES 3
17	627,2	31,18	7,62	WARP MACHINES 4
18	629,7	32,49	7,44	WARP MACHINES 5
19	619,7	32,28	7,13	WARP MACHINES 6
20	427,6	32,56	8,62	SIZING MACHINE 1
21	421,3	32,73	9,11	SIZING MACHINE 2
22	438,9	33,25	9,16	SIZING MACHINE 3
23	407,6	29,18	8,56	SIZING MACHINE 4
24	371,2	26,33	7,99	KNITTING SECTION
25	352,2	28,76	8,08	Drawing-in SECTION
26	341,4	28,20	7,73	4. DEPARTMENT
27	347,3	28,92	7,58	1. DEPARTMENT
28	356,2	29,13	7,56	1. - 3. DEPARTMENT
29	375,4	32,69	7,51	5. DEPARTMENT
30	382,2	33,79	7,53	6. DEPARTMENT
31	454,0	35,22	7,63	7. DEPARTMENT
32	457,2	36,13	7,58	8 DEPARTMENT
33	456,3	35,23	7,64	9. DEPARTMENT
34	462,3	36,18	7,23	10. DEPARTMENT
35	238,7	19,13	7,16	CRUDE CLOTH 1
36	221,3	18,56	7,11	CRUDE CLOTH 2
37	218,6	18,13	7,25	CRUDE CLOTH 3
38	817,6	34,28	9,13	WASTE DEPARTMENT

Table 2. Ambient Conditions During Measurement

TEMPERATURE	PRESSURE(mbar)	HUMIDITY (%)	AIR FLOW RATE (m/s)
22,1	1.005,7	64,1	0,1
22,0	1.005,0	64,0	0,1

3.3. Personal Exposure Dust Measurement Results

Within the scope of accreditation under normal working conditions at the facility, long-term personal exposure dust measurements were made on 14 personnel on 30.03.2021. Exposure measurements were made with devices worn on personnel. The values obtained were calculated as eight-hour AOD/TWA and are given in Tables 3 and 4.

Table 3. Exposure Dust Measurements at the Facility Part 1

NUMBER	HISTORICAL TIME	TIME	MEASUREMENT DONE OFFICIAL	DONE EPISODE	PARAMETER	MEASURED VALUE (mg/m³**)	VALUE (mg/m³)
1	30.03.2021 240 Minute	7 Hour	A1	Preparation Section	DUST	0,273	15,0
2	30.03.2021 240 Minute	7 Hour	A2	Weaving	DUST	21,822	15,0
3	30.03.2021 240 Minute	7 Hour	A3	Weaving	DUST	16,232	15,0
4	30.03.2021 240 Minute	7 Hour	A4	Weaving	DUST	1,488	15,0
5	30.03.2021 240 Minute	7 Hour	A5	Weaving	DUST	0,091	15,0
6	30.03.2021 240 Minute	7 Hour	A6	Weaving	DUST	1,984	15,0

Tablo 4. Exposure Dust Measurements at the Facility Part 2

NUMBER	HISTORICAL TIME	TIME	DONE OFFICIAL	DONE EPISODE	PARAMETER	MEASURED VALUE (mg/m³**)	BOUNDARY VALUE (mg/m³)
1	30.03.2021 240 Minute	7 Hour	A7	Raw Cloth	DUST	8,580	15,0
2	30.03.2021 240 Minute	7 Hour	A8	Draw Frame	DUST	9,318	15,0
3	30.03.2021 240 Minute	7 Hour	A9	Comb	DUST	1,163	15,0
4	30.03.2021 240 Minute	7 Hour	A10	Yarn Blowroom	DUST	11,994	15,0

5	30.03.2021 240 Minute	7 Hour	A11	Yarn	DUST	0,748	15,0
6	30.03.2021 240 Minute	7 Hour	A12	Yarn	DUST	4,523	15,0
7	30.03.2021 240 Minute	7 Hour	A13	Open- End Yarn	DUST	0,073	15,0
8	30.03.2021 240 Minute	7 Hour	A14	Comb	DUST	0,493	15,0

Table 5. Ambient Conditions During Measurement

TEMPERATURE	PRESSURE(mbar)	HUMIDITY (%)	AIR FLOW RATE (m/s)
16,5	1000,1	40,0	0,1
16,8	1000,1	40,0	0,1

4. Conclusion and Discussion

The results of the particulate matter (aerosol) measurement made in the Yarn Weaving Plant under normal operating conditions are given above. PM10 values obtained as a result of measurements made at 38 points in the plant are given in Table 1.

The results of personal exposure dust measurement performed in the Yarn Weaving Facility under normal operating conditions are given above. Personal exposure dust measurement results on 14 personnel working at the facility; It has been compared with the limit value specified in the Dust Fighting Regulation and the results are given in Tables 3 and 3. In the exposure dust measurements made at the facility, it was determined that the dust values that the personnel named A2 and A3 were exposed to did not meet the regulation limit value, while all other personnel met the regulation limit value.

There is almost no place where there is no dust. However, with the measures to be taken, this formation can be reduced and its effect can be minimized. The following measures can be taken to prevent dust from spreading into the workplace environment.

1) Dusting operation can be done in a closed system.

2) The dust generated during production can be removed by the "dust suction system" without mixing with the air.

3) If the material will not be damaged, it can be worked by wetting.

4) If the dusty material is suitable in terms of size and properties, it can be transported by compressed air through pipes.

Working at a high dust level in the spinning and weaving mill negatively affects health. In this study, the dust level values emitted by the spinning and weaving machines were determined [7,8]. Workers in the workplaces where dust, which has a direct effect on human health, is produced by workers, such as a mask that reduces the effect of dust. Preservatives were found to be widely used. The best method to prevent the dust generated by spinning and weaving machines from spreading to the environment is protection at the source, that is, measures taken to reduce the dust of the machine. Before personal precautions, reducing the dust levels in the production areas is important for effective protection of workers from dust [9,10,11].

As the dust density decreases, the frequency of deterioration in respiratory functions increases. In this context, it has been revealed that it is necessary to carry out studies to reduce dust density in workplaces. These measures are; appropriate ventilation (Local-General), wet working method, regular dust measurements, periodic control examinations (X-ray and PFT), employment examination (those at risk in terms of lung disease, excessive smokers should be determined and working in jobs with dust exposure should be prevented), education is given [3].

As a result, it was determined that the workers in the factory were not exposed to a significant level of dust, and respiratory functions were not affected as a result of this exposure. It has been understood how important the initiatives to reduce workplace dust concentration are. Periodic inspections of workers are required to anticipate increasing exposure over the years. It is important that these examinations include pulmonary function tests and are functional. Symptoms of heat increase, redness, burning, itching, swelling, blistering can be seen on the skin in contact with dust in workers exposed to dust. Periodic inspection should be carried out

not only according to the risks in the workplace, but also according to the risk groups in the workplace and the special risks of the individuals.

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