Original Article

Personal Exposure to Wood Dust among Workers in Neka Choob Factory (Iran)

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Abstract

Background and Purpose: Inhalation of hardwood dust may produce a range of adverse health effects in the upper and lower respiratory system, including asthma, along with Sino-nasal cancer and nasopharyngeal cancer. This study was carried out to evaluate personal exposure to wood dust among workers in chipboard and furniture production saloons in Neka Choob factory, Iran.

Materials and Methods: Gravimetric method No. 0500 recommended by National Institute for Occupational Safety and Health was used to determine the wood dust concentrations in the workers' breathing zone. The sampling air was drawn through a polyvinyl chloride filter within the breathing zone, using a calibrated personal sampling pump.

Results: The mean workers' personal exposure to wood dust in furniture production saloon (2.87 ± 1.95 mgm^{-3}) was higher than mean exposure of workers whom were working in chipboard saloon (0.93 ± 0.35 mgm^{-3}). The mean workers' exposure to wood dust for both saloons was 1.70 ± 1.53 mgm^{-3}.

Conclusion: The mean workers' personal exposure to wood dust in Neka Choob factory was higher than Occupational Exposure Limit (OEL) recommended by national (Iranian Committee for Review and Collection of OEL) and European Union Scientific Committee on OEL committees. All workers in furniture production saloon and three workers in chipboard saloon have a mean exposure higher than OEL.

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1. Introduction

Wood is processed in many industries including chipboard production factories, Sawmills processing, plywood mills, and furniture factories or smaller workshops such as carpentry that use dry wood only. Approximately, 3.6 million workers in the European Union are exposed to wood dust (1). Inhalation of hardwood dust may produce a range of adverse health effects in the upper and lower respiratory system, including asthma, along with Sino-nasal cancer and nasopharyngeal cancer. The European Union Scientific Committee on Occupational Exposure Limits (SCOEL) recommended that the exposure above 1 mgm^{-3} of inhalation dust was associated with the induction of Sino-nasal cancer and other adverse respiratory effects (2). A number of studies from recent years indicated that the different exposure to wood dust causes different response (3-5). Other studies have studied particle concentrations in wood processing industries and reported that workers are exposed to relatively high levels of dust in their working environment (6-9). Some studies also concluded that there is a significant relationship between lower and upper respiratory tract symptoms and exposure to high level of wood dust in the work environments (5,10). Douwes et al. in a recent study in New Zealand have reported an increased prevalence of asthma and cough symptoms and of eye and nose irritation for sawmill workers (3). Wood dust is a known inducer of cancer in the nasal cavity, and recent reviews have focused on this (11,12). Gustafson et al. studied occupational exposure and severe pulmonary fibrosis (PF) among 181 Swedish patients with severe PF and concluded that Exposure for birch and hardwood dust may contribute to the risk for idiopathic PF in men (13). Wood dust has also been associated with a variety of respiratory symptom and diseases. Jacobsen et al. reviewed 37 papers about adverse health effect of wood dust. The results support an association between dry wood dust exposure and asthma symptoms, coughing, bronchitis, and acute and chronic impairment of lung function (14). The exact number of workers who are working in wood processing factory in Iran is unknown. However, numerous workers are working in the wood processing factories in the north of Iran. Most of them are working in old industries without or low efficient ventilation systems. Neka Choob factory, Iran, is an old mill that produces chipboards and furniture. A walkthrough survey suggested by workers showed that most of the workers were suffering from respiratory symptoms and eye irritation due to exposure to wood dust. Therefore, their exposures to wood dust concentrations are likely to be high. The aim of this study was to evaluate the wood dust concentrations in the breathing zone of workers in both workshops.

2. Materials and Methods

The present study was carried out in Neka Choob wood processing factory in the north of Iran. In total 10 workers were working in chipboard and furniture production saloons when the monitoring was in the process in the factory. Workers were working in different worksites such as milling machine, chipboard cutting, sanding, chipper, glue making, joineries, and cleaning. Wood dust was one of the most important indoor air pollutants in this factory that was emitted to the workspace during the wood processing.

Gravimetric method (Method 0500 recommended by National Institute of Occupational Safety and Health) was used to determine the wood dust concentrations in the workers' breathing zone (15). The collection of coarse particles for health related purposes was based on the use of sampling instruments that collect the so-called "total" aerosol fraction. In the current study, workers' exposure to total wood dust were measured

using a personal sampling pump (MP2N, Sibata, Japan) , 37 mm open-face filter holder (37 mm open faced filter holder, Casella, UK) with 37 mm, 5 µm pore size polyvinyl chloride (PVC) filter (37 mm PVC, SKC, UK) with 2 L/min flow rate. To weigh the filter, a microbalance accurate to 6 decimal places (1 µg sensitivity, Sartorius ME5, Germany) was used. To prevent any grass error during the sampling, a critical orifice calibrated by soap bubble meter for 2 L/min flow rate was used, and sampling process was regularly checked by the operator. All filters were desiccated before and after sampling to remove the absorbed water from the filters. To assess the volume of sampled air, we calculate the correction factor using the ambient temperature and atmospheric pressure. A weighed blank filter was submitted for each group of sample filters and placed in the filter cassette to assess the presence of factors that might interfere with the weight of sample filters. Personal exposure monitoring was carried out in the Chipboard production and Furniture production saloons in the Neka Choob factory. Totally 10 workers were working in both saloons, 6 workers in chipboard saloon and 4 workers in Furniture production saloon. Personal monitors were worn within 30 cm of the breathing zone to ensure that the sampled air presented the air that individual breath. The monitoring started in the morning when the worker started his work and continued during the shift until he finished his work. However, the monitoring times were not exactly 8 h. The SPSS software (version 19, SPSS, Inc., Chicago, IL, USA) was used for analyzing data.

3. Results

Table 1 demonstrates sampling characteristics in chipboard and furniture production saloons. Six monitored workers were working in chipboard production saloon, and four workers were in furniture production saloon. The duration of sampling ranged from 300 to 360 min depending on the work shift. Temperature and atmospheric pressure were measured and used for assessing air volume correction factors.

Descriptive statistics of workers personal exposure to wood dust in Neka Choob factory showed that the mean workers' personal exposure to wood dust in furniture production saloon (2.87 ± 1.95 mgm^{-3}) was higher than mean exposure of workers whom were working in chipboard saloon (0.93 ± 0.35 mgm^{-3}). The lowest personal exposure was found in chipboard saloon (0.42 mgm^{-3}) and one worker in furniture production saloon showed the highest exposure to wood dust (5.66 mgm^{-3}). Mean and standard deviation of workers' exposure to wood dust for both saloons were 1.70 and 1.53 mgm^{-3} respectively (Table 2).

Table 1. Sampling characteristics in different saloons in Neka Choob factory in 2013

Sample	Location	Sampling duration (min)	Temperature (°C)	Pressure (mmHg)
1	Chipboard saloon	300	15	760
2	Chipboard saloon	324	15	760
3	Chipboard saloon	324	15	760
4	Chipboard saloon	360	16	760
5	Chipboard saloon	360	16	760
6	Chipboard saloon	360	16	760
7	Furniture production saloon	360	16	760
8	Furniture production saloon	360	16	760
9	Furniture production saloon	360	18	760
10	Furniture production saloon	360	18	760

Table 2. Descriptive statistics of workers personal exposure to wood dust in Neka Choob factory in 3013

Location	N	Mean (mgm^{-3})	SD (mgm^{-3})	Minimum (mgm^{-3})	Maximum (mgm^{-3})
Chipboard saloon	6	0.93	0.35	0.42	1.29
Furniture production saloon	4	2.87	1.95	1.13	5.66
Total	10	1.70	1.53	0.42	5.66

SD: Standard deviation

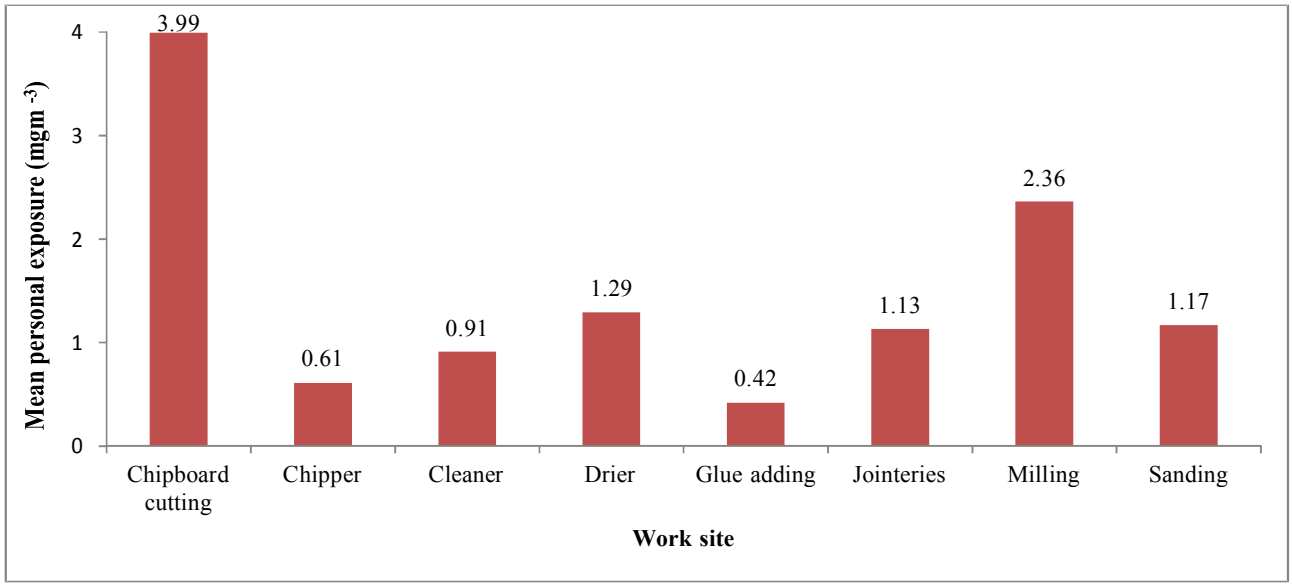

Figure 1. Mean personal exposure of workers in different worksites in Neka Choob factory in 2013

Figure 1 demonstrates the mean personal exposure of workers in different worksites in Neka Choob factory. The highest mean personal exposure to wood dust was related to a couple of workers who were working on chipboard cutting machine (3.99 mgm^{-3}). Workers who were working on milling machine and drier worksite showed a mean exposure of 2.36 mgm^{-3} and 1.29 mgm^{-3} respectively. However, a worker who was working in glue adding worksite showed the lowest exposure to wood dust (0.42 mgm^{-3}).

4. Discussion

Results of the current study showed that mean workers' personal exposure to total wood dust in furniture production saloon was higher than OEL recommended by both the European Union SCOEL and Iranian Committee for Review and Collection of OEL (1,16). All workers in this saloon have a mean exposure higher than recommended OEL. Mean personal exposure to wood dust among workers who were working in chipboard saloon was lower than recommended OEL. However, 3 workers have exposure higher than OEL in this saloon. Workers' exposure in different worksite ranged from 0.42 to 5.66 mgm^{-3}. This study resulted that those workers who are working in chipboard cutting, milling, drier, and sanding and joineries worksites were exposed to wood dust higher than OEL. However, workers who were working in chipper, cleaner, and glue adding worksites had an exposure lower than OEL. In comparison to other studies, a review study was conducted by the European Union Scientific Committee on OELs. The committee analyzed related paper to exposure to wood dust and concluded that workers who were working on sawmill machines in Canada have an exposure from 0.03 mgm^{-3} to

74.0 mgm^{-3}, which in some cases were much higher than those resulted in current study and also recommended OEL (1). A similar study showed that exposure of workers who working in joineries worksite in Australia ranged from 0.21 mgm^{-3} to 51 mgm^{-3} and average exposure of cleaners was 2.9 mgm^{-3}, about 3 times more than that resulted in current study (1). Another study carried out in a furniture factory in the United Kingdom and concluded that wood dust concentrations were 1-4.8 mgm^{-3} in conversion worksite, 0.3-53 mgm^{-3} in component making worksite, and 0.5-27 in assembly worksite that in some cases were much higher than those resulted in current study (1). Schlünssen and co-workers studied wood dust concentrations in a furniture factory in Denmark. They found that wood dust concentrations for manual sanding ranged from 0.85 to 1.4 mgm^{-3}, for cutting machine ranged from 0.46-0.64 mgm^{-3} and for handling assembling ranged from 0.69 to 1.09 mgm^{-3}. Despite the results of dust concentrations for manual sanding and handling assembling were close to our findings (1.17 and 1.13 mgm^{-3} respectively), but mean workers' exposure in chipboard cutting in current study (3.99 mgm^{-3}) was much higher than those reported in Denmark study (17).

Due to the high wood dust concentrations within the breathing zone of the most workers in the studied factory and control of wood dust, it is necessary: To design and install a suitable local exhaust ventilation system considering the factory process and job limitations. To reduce workers' exposure to wood dust in the workplace it is necessary to clean all machines and the workplace's surfaces using an air suction system. To use personal protection device such as suitable respirators when high level of tobacco dust exists.

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