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BRIEF ORIGINALS · KURZORIGINALIA

Particle Size Distribution of Wood Dust in Rubberwood (*Hevea Brasiliensis*) Furniture Manufacturing

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Subject The study evaluated the concentration and particle size distribution of air-borne wood dust in the Rubberwood furniture manufacturing industry. Air quality samples were measured at routing and hand-sanding work stations in furniture factories using the micro-orifice uniform deposit impactor (MOUDI) air-quality measuring instrument. It was found that less than 25% of the air-borne wood dust particles at the two work stations were less than 10 μm in size, which in turn did not pose major respiratory health hazards. However, the high wood dust concentrations at the two work stations is a matter of concern, and efforts must be taken to minimize the air-borne wood dust exposure levels workers are subjected to in the Rubberwood furniture manufacturing industry.

1 Introduction

Wood dust is one of the most common organic dusts workers' are exposed to in the furniture manufacturing industry. Studies have found that exposure to wood dust can cause health effects like nasal mucosa damage, irritation and sino-nasal cancer, while deep lung deposition leads to lung cancer and impaired respiratory function (Shamssain 1992, Mikkelsen et al. 2002). Wood machining processes, such as shaping, routing and sanding produce particularly high levels of dust emission. Nevertheless, the wood dust exposure levels are influenced by the airflow field in the working area, the worker inhalation rate and the ventilation system, while the level of its toxicity varies with the characteristics of the wood dust, such as the wood species and size of dust particles (Mikkelsen et al. 2002). In this context, reports on Rubberwood (*Hevea brasiliensis*) dust particles and their potential health effects on the workers are sparse (Ratnasingam 2008). Therefore, a study was undertaken to evaluate air-borne wood dust concentration and its particle size distribution in the Malaysian Rubberwood furniture industry. The results of the study have far-reaching industrial implications, as the Rubberwood furniture manufacturing industry is one of the largest wood industry sectors in South East Asia.

2 Methods

The air-borne dust concentration and particle size distribution of Rubberwood dust was evaluated at 25 large furniture factories in Malaysia. Sampling periods of 8 hours were undertaken at the routing and hand-sanding work stations in each of the factories to determine the time-weighted average value of wood dust concentration. The conditions at the work stations in the factories were reflective of the current industrial practices. Air quality samples at the two work stations were measured using the micro-orifice uniform deposit impactor (MOUDI), which had a ten-stage rotating impactor with filters to separate the particles into different sizes. By operating the instrument at selected flow rate and pressure drop across the stages, particle sizes of 18, 15, 12, 10, 8, 5, 3.2, 1.8, 1, and 0.56 μm were measured. By weighing

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Table 1 Wood dust concentration and particle size distribution
Tabelle 1 Holzstaubkonzentration und Spangrößenverteilung

Machining Process	Average Dust Concentration (mg/m^3)	Particle Size (μm) in %									
		18	15	12	10	8	5	3.2	1.8	1	0.56
Routing	63	61.0	10.3	8.0	5.0	4.0	3.5	2.5	2.5	1.7	1.5
Sanding	89	43.0	12.0	20.2	6.3	4.5	3.5	3.1	2.8	2.3	2.3

Note: Average dust concentration based on 8 hours sampling period

the impaction stage before and after sampling, the particle size distribution of the air-borne dust was constructed as described (Marple et al. 1991).

3 Results

The average dust concentration and dust particle size distribution of the two processes are presented in Table 1. The average air-borne dust concentration at the routing work station (63 mg m^{-3}) was lower than that recorded in the sanding work station (89 mg m^{-3}). The values recorded in this study were higher than the standard 8h TWA MEL for wood dust of 5 mg m^{-3} (FMR 1989, HSE 1999), and therefore the high air-borne wood dust concentration in the Rubberwood furniture factories poses respiratory-related health hazards, as reported previously by Ratnasingam et al. (2009).

In terms of particle size distribution, this study revealed that less than 25% of the air-borne dust by weight at the two work stations were less than 10 µm. Hence, the results indicate that only a small portion of the air-borne wood dust particles is capable of penetrating into the lower parts of the respiratory system to cause serious health problems. However, the dust particles from the routing process were coarser than the particles from the sanding process due to different machining process (Ratnasingam and Scholz 2008). The results from this study also affirm the fact that the wood sanding process resulted in two distinct particle size distributions due to the abrading and ripping actions on the material, as suggested previously by Chung et al. (2000). This study indicates that the wood dust characteristics from wood machining processes differ, and it is the air-borne wood dust concentration, and not its particle size distribution, that poses serious threats to the respiratory system of workers in the Rubberwood furniture manufacturing factories. In this context, improving the exhaust and ventilation system at the workplace and the use of dust protection gadgets by the workers are highly recommended to minimize air-borne wood dust exposure levels.

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