SMALL PLANTS AND THEIR MEDICAL PROBLEMS— THE FURNITURE INDUSTRY

Industrial Hygiene Aspects of the Furniture Manufacturing Industry

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The furniture industry covers a wide variety of processes and types of products, including household, office and institutional furniture, and partitions and various fixtures. Household furnishings account for about 66% of the sales, numbers of establishments, employment, etc. The household furniture portion can very appropriately be called a small industry. In 1978, there were about 5,370 of these establishments, most companies with only one location. These establishments employed about 320,000 workers, the average plant having around 60 employees and the largest companies with fewer than 7,500 in the furniture portion. Except where furniture manufacturing is a subsidiary or a division of a larger company, there are no full-time industrial physicians or industrial hygienists employed, though a few of the larger plants have safety engineers or safety managers and nurses.

Two broad categories of household furniture are produced--case goods and upholstered goods. The manufacture of case goods involves three basic operations: mill work, assembly and finishing; whereas, upholstered goods manufacturing involves cutting, sewing, spring-up and upholstering. Preparatory to mill work, the lumber is air- and kiln-dried to a moisture content of 6-8% then cut and planed to rough dimensions. Large panels and turnings are cut, glued and planed. Individual parts are cut, mitered, molded, turned, routed and shaped in the finish mill area, then taken to the assembly area where they are sanded, polished and glued together. Parts are stacked everywhere around the plant; it is not surprising then that low back pain--from pushing these parts around on rough wooden floors—is prevalent. After assembly, there is further hand sanding and the addition of ancillary components, such as drawers, mirrors and hardware. Stains, fillers, sealers and finishes are applied in a finishing area after which the pieces are packaged for shipping.

Potential health hazards are present at every step in the process. The primary industrial hygiene concerns are noise, solvent vapor and inadequate ventilation. Other potential hazards are wood dust and formaldehyde.

Not all lumber is pre-treated, but white pine is attacked by a fungus during warm weather storage. The resulting blue stain can be prevented by dipping the lumber in a mixture of sodium pentachlorophenate and sodium azide. In addition to its toxicity, sodium azide reacts with certain metals to form explosive and shock-sensitive metal azides. Sodium pentachlorophenate, on the other hand, penetrates even the intact skin and also causes dermatitis.

Fiber board and particle board, used very extensively in furniture manufacturing, are made primarily with urea-formaldehyde glue. And as pointed out by Mr. Breysse, these

boards continue to release formaldehyde long after their manufacture at a rate that depends on the ambient temperature. Thus, storage warehouses for such material must be well-ventilated, especially during summer months. Many large panels are made in the same way as plywood room paneling, by gluing veneer to each side of a rigid core in a veneer press using urea-formaldehyde glue. As the panels are heated in the press, formaldehyde is released. Thus, press operators very often experience eye, nose and throat irritation. Freshly veneered cores continue to release formaldehyde until they are cool. Experience indicates that local exhaust ventilation is the only feasible way to reduce employee exposure. Local exhaust systems must be provided for both the veneer press and the stacks of panels off-loaded by the operator.

As previously mentioned, a major health hazard in the furniture industry is noise. Hearing conservation programs are a requisite for employees in the mill work area, where noise levels exceed 90 dB(A). Engineering controls for the saws, planers, molders, shapers, tenoners and other pieces of wood working equipment are evolving slowly. Successful noise reduction is achieved with enclosures on the planers, molders and tenoners, but changes in geometry of the saw blade also effectively reduce noise generation; likewise, saw guards can be lined with acoustic foam. Special attention has also been given to the re-design of air nozzles used to blow off dust particles. Meanwhile, it is still necessary that employees use personal protective equipment.

Wood dust is created in abundance and in most areas of the plant. Much of the dust that is very fine and respirable is generated by operations such as sanding; elsewhere, the particles tend to be large. Little attention has been given to the industrial hygiene of wood dust, inasmuch as domestic woods are largely used in the US. Attention is now being given with the recent implication of wood dust to nasal cancer in furniture workers. Lung deposition characteristics cannot be predicted nor can representative air sampling methods be established for the dust because little is known about the particle size distribution in the manufacture of furniture. Preliminarily, the smallest wood particles are produced by sanding and these are 10 micrometers in aerodynamic diameter. If confirmed, the primary site of deposition after inhalation will be the nose and the throat, and the air sampling method of choice will be a total dust sample. If wood dust is determined to be a significant health hazard, local exhaust ventilation will be required at the source. Dust collection systems are presently used; however, the primary concern is for machine maintenance and housekeeping, not to maintain low levels of atmospheric dust. Oftentimes, these systems are starved for makeup-air and the inside of the building is at a negative pressure. Attention should be focused on the location of the exhaust intakes and provision for makeup-air.

Finishing wooden furniture often requires fifteen or more steps, the majority of which involve spraying various finishing materials—stain, filler, sealer and lacquer—onto the furniture. The remaining steps include wiping and sanding between spray applications. Spraying is usually done inside a spray booth with handheld spray guns. The employee's primary exposure is the inhalation of volatile solvents from the finishing materials. Wiping and sanding is done outside the spray booths; these workers also breathe solvent vapors, but their biggest risk is dermatitis—the dry, fissured type—from contact with the finishing materials.

Finishing materials contain a variety of chemicals. Non-volatile components consist primarily of nitrocellulose lacquer, amino resins and pigments. Numerous volatile solvents are used; most, if inhaled, have similar physiologic effects—ie, slight respiratory irritation, central nervous system depression and possible liver or kidney damage from continued overexposure. Benzene and methyl n-butyl ketone are no longer used.

To determine a worker's exposure to these solvents is an analyst's nightmare. EPA's air quality standards for photochemically reactive hydrocarbons require that no individual solvent may constitute more than 20% of the total volatile portion of a given product. Thus, a typical formulation will have at least five different solvents and oftentimes many more. And though air samples are easy to collect (over activated charcoal), their quantitative determination is time-consuming and difficult because of the complexity of the mixture. The concentration of each solvent must be known in order to judge an overexposure, since effects are additive.

Finishing rooms are generally maintained at a positive pressure with respect to other plant areas to prevent dust contamination. This measure also assures adequate make-up air for the spray booths. Well-designed booths provide make-up air from behind the worker and through perforated panels for good distribution; such booths appear to provide adequate protection. Overexposures otherwise result from poor work practices, such as spraying outside the booth or standing between the exhaust intake and the piece being sprayed.

Personal protection against solvent dermatitis, especially for those persons who wipe the finish, consists of chemical-resistant gloves, aprons and clothing. Barrier creams and good personal hygiene are also helpful, but silicone creams must be avoided because of their damaging effect on the finish.

Microwave and infrared radiation hazards attend the ovens that are used to cure the adhesives; however, these ovens are generally quite well shielded and there is little employee exposure.

Another minor operation that poses a hazard is the manufacture and repair of saw blades. Carbide tips are soldered to the blades with silver solder, which poses two potential problems: Cadmium can be eliminated with a solder that is free of cadmium, while silver fumes are controlled by local exhaust ventilation.

There are few additional problems in the manufacture of upholstered furniture, except for the dust from cotton batting. Upholsterers are given pulmonary function tests and respiratory questionnaires. We have seen an occasional case of dermatitis, which was attributable to the fabric; in one case the fire retardant was responsible. Such incidents are rare because the upholsterer contacts only a small area of fabric and potent dermatological agents are not normally used.

Some furniture contains plastic hardware, carvings, etc. Employees who make these plastic parts—generally of polystyrene and rigid polyurethane—are exposed to diphenylmethane diisocyanate (MDI), styrene, diatomateous earth, silica and methylethylketone peroxide. Styrene and MEK peroxide irritate the skin and respiratory tract; MDI, like TDI, is a respiratory sensitizer at low concentrations. It is customary to use the pre-polymerized MDI, which has a lower vapor pressure and is less likely to become airborne.

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