Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA)

Chapter 4.7
Wood Processing and Furniture Making: Cleaner Production Fact Sheet and Resource Guide

Contents

Purpose

This fact sheet offers basic information on important adverse environmental impacts of wood processing and furniture making, as well as associated health and safety impacts. It also discusses opportunities for mitigating those impacts, with an emphasis upon "cleaner production" strategies that may also provide financial benefits to micro- and small enterprises (MSEs). In addition, each fact sheet offers a substantial, annotated list of resources for those organizations seeking more information.[1]

This fact sheet has been prepared for (1) **business development services (BDS) providers,** which offer services such as management training or marketing support to MSEs, and (2) **intermediate credit institutions (ICIs) and direct lenders** that provide financial credit to MSEs. It is intended to be used in concert with other sections in Part III of the *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Development Activities*, which is USAID Africa Bureau's principal source of sector-specific environmental guidance.

[1] USAID cleaner production fact sheets are available for the following subsectors that are likely to have substantial adverse impacts on the environment and/or workers' health: brick and tile production; leather processing; small-scale mining; food processing; wet textile operations; wood processing and furniture making; and metal finishing.

This EGSSAA Chapter was prepared by The Cadmus Group, Inc. for International Resources Group, Ltd. (IRG) under USAID Africa Bureau's Environmental Compliance and Management Support (ENCAP) Program, Contract Number EPP-I-00-03-00013-00, Task Order No. 11. Its contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

Why Focus on Cleaner Production for Mitigation?

Cleaner production (CP) is a preventive business strategy designed to conserve resources, mitigate risks to humans and the environment, and promote greater overall efficiency through improved production techniques and technologies. Cleaner production methods may include:

- substituting different materials
- modifying processes
- upgrading equipment
- redesigning products

In addition to environmental, health and safety benefits, many CP techniques provide opportunities to substantially reduce operating costs and improve product quality. MSEs can profit from cleaner production through more efficient use of inputs and machinery, higher-quality goods that command higher prices, and reduced waste disposal costs. Improved safety measures can also help MSEs avoid costly accidents and worker absences.

Experience has demonstrated that, with assistance, MSEs can frequently identify cleaner production opportunities that produce a positive financial return, sometimes with little or no investment. Many enterprises that change to CP methods may realize substantial financial and environmental benefits, indicating that CP should be the first option considered in addressing MSEs' environmental problems.

Yet, although this approach can offer tremendous advantages, readers should also recognize that cleaner production options showing clear financial benefit will only be available to varying degrees among different enterprises and often may not completely mitigate environmental problems. In some cases, even when pursuing CP approaches, some businesses may need to use solutions that offer no measurable financial return—if such solutions are required by USAID's Regulation 216 or local regulations or desired for other reasons, such as community goodwill.

Important Environmental Issues Addressed by This Fact Sheet

- Air pollution from adhesives
- Air pollution from coating material
- Wastewater
- Hazardous waste
- Wood waste

Adverse Environmental Impacts and Mitigation Opportunities

Several key environmental impacts associated with wood processing and furniture making are listed in the box at left and discussed below. For each environmental impact, the fact sheet provides a list of questions to aid in the assessment of individual MSEs. These questions are followed by a number of mitigation strategies that can be considered, with an emphasis on cleaner production strategies where possible. The strategies presented typically represent a range of available options, from profitable activities that require no investment to other activities that may increase MSE costs.

❑ *Air Pollution from Adhesives*

Adhesives, either synthetic or natural, are used in assembling wooden furniture parts. Adhesive formulations used in this industry contain toxic solvents (for upholstered wood furniture) and hot melts (for non-upholstered wood furniture). Adhesives are also used to apply veneer (a thin piece of wood of uniform thickness) to the piece of furniture. For both assembly and veneer, the use of adhesives releases solvents into the air and damages the environment and health of workers. Alternative approaches to adhesives could reduce both production costs and environmental harm. [2]

Key questions to consider:

- What types of adhesives are used in production? What less toxic alternatives are available?
- How are adhesives usually applied?
- Is waste of adhesives a common occurrence?

Selected mitigation strategies:

- Employ the variable application rate strategy (VARS). The VARS adjusts the glue-spread rate for each individual plywood panel according to its moisture content. The primary benefit of VARS is lower adhesive consumption, which reduces both input costs and emissions.
- Minimize overspray of adhesive. Of the four conventional ways that glue is applied to wood, the most efficient is foam extrusion—a technique in which foamed adhesive is forced under pressure to the extrusion head. The result is less wasted adhesive.
- Replace existing adhesives with less toxic substitutes: e.g., switch to naturally derived adhesives to replace the petroleum-derived chemicals currently used in the manufacture of wood adhesives. Two non-petroleum options that are currently in the experimental phase are furfuryl alcohol resin and lignin adhesives, both of which reduce harmful pollution. The naturally derived adhesives may also be more cost-effective than their petroleum-based counterparts.
- Equip workers with masks or respirators. Masks and respirators may be available to keep workers from inhaling toxic emissions from adhesives and coating material (covered in next section), and can also protect against the inhalation of small airborne particles, such as wood dust, that damage the lungs.

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[2] This fact sheet specifically discusses air pollution from adhesives and coating materials. Readers should also recognize that similar air pollution can be caused by poor handling and inefficiency related to wood preservatives and industrial solvents. Many of the mitigation strategies presented for adhesives and for coating materials are also relevant to wood preservatives and industrial solvents.

❑ *Air Pollution from Coating Material*

Applying coating material (i.e., stains, paints and finishes) in furniture making generates air emissions that can cause potentially serious health problems. The source of these air emissions is the solvents in the coating material, which in turn emit volatile organic chemicals (VOCs). The VOCs escape into the air when the coating is applied or when containers of liquids containing VOCs are left open. There are various options that could reduce VOC emissions and thereby reduce harm to workers' health.

Key questions to consider:

- What technique is being used to apply coating? Is there a more efficient option?
- Are workers adequately trained in the application of coating material?
- Are containers of coating material covered when not in use?

Selected mitigation strategies:

- Use reformulated coating materials that contain fewer VOCs to finish wood furniture. Alternatives include waterborne, ultraviolet-curable, polyurethane, and polyester coatings.[3]
- One method used for spray coating involves a high-volume low-pressure (HVLP) spray system. This uses a high volume of air delivered at low pressure to turn the coating material into a very fine spray. The use of low pressure results in less overspray, and therefore uses less coating material used and emits fewer VOCs.
- Consider investing in a spray booth equipped to recirculate air, to decrease the volume of exhaust emitted to the atmosphere. This process has lower operating costs than other VOC control systems.
- Ensure that containers of coating material are tightly sealed when not in use.

❑ *Wastewater Problems*

Furniture making requires the use of wood preservatives and coating materials, all of which contain solvents. Both preservatives and coating material can contaminate wastewater if they drip from the wood surface, leak from the drums where they are stored, or are discarded after use. In the long run, contaminated wastewater can raise the concentration of toxins in the local water supply to levels that harm people's health and the firm's productivity. This may require wood processing operations to pay for the clean water they need or to clean and recycle their used water on-site.

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[3] These options are described in EPA (1995a), page 58.

Key questions to consider:

- What kinds of chemicals are used?
- Which of these chemicals are the most harmful? Are less toxic alternatives available?
- Where are chemicals stored?
- Are methods in place to control spills and leaks?
- How is wastewater discharged? Is it separated into hazardous and non-hazardous wastewater?

Selected mitigation strategies:

- Increase efforts to dry the wood before finishing. This will lessen the need for surface treatment, because high water content leads to sap stain. In drying wood, try to choose the most energy-efficient option.
- Spray preservatives or coating materials on the wood using a high-velocity spray system. This system results in fewer process residuals and less drippage.
- Install a drainage collection device on rooftops to divert rainwater away from process wastes.
- Store additives, solvents, wood treatment chemicals and fungicides in drums with a spill collection system to reduce the risk of leakage. An effective way to collect spills is to build a berm (e.g., a mound of earth) around the floor of the storage area that could potentially contain more than the stored volume of liquids. If the spill collection system is non-porous (e.g., with a plastic lining on the berm), recaptured spills can most likely be reused.
- Minimize drippage from sprayed-on preservatives or coating materials in two wayas: (1) by mechanically shaking the furniture piece to remove extra preservatives/coating from the wood surface, and/or (2) by allowing enough time for dripping in a catchment area after the preservatives/coating is applied. The drippage should be recaptured so that it does not eventually enter the drainage system. Treated wood should be sent to storage once dripping has stopped.
- Use concrete pads for the wood treatment area and intermediate storage areas to ensure that all drippage is collected.
- Do not store materials in sites that are prone to flooding or that are next to water intake points or groundwater resources.
- Switch to water-based preservatives, which are less toxic and damaging than typical solvent-based preservatives.

❑ *Hazardous Waste*

The waste from wood processing and furniture making is often thrown away like trash—but should not be, because of its hazardous nature. Hazardous

waste cannot be safely disposed of without carefully following procedures for protecting the environment. Unfortunately, proper hazardous waste disposal facilities are typically unavailable in African countries. Therefore, preventing or recycling such waste is most desirable. Two prominent sources of this waste are **paints** and **industrial solvents**.

The spray-painting of furniture objects has a transfer efficiency of approximately 40 to 65 percent (depending on the spraying technique, the shape of the object and whether it is sprayed manually or automatically). The remaining paint—"overspray"—is considered hazardous waste.

In wood-coating and painting operations, industrial solvents (e.g., lacquer thinnier, xylene, or isopropyl acetate) are used to clean application equipment, such as spray guns, spray nozzles, etc. Such equipment must be cleaned often, including each time there is a color change. Contaminated solvents are a by-product of cleanup operations and are considered hazardous. Processing contaminated solvents using recovery units can allow the solvent to be reused, which lowers supply costs and lessens the volume of hazardous waste that must be dealt with.

Key questions to consider:

- How well are workers trained in machine cleaning and maintenance?
- What is the storage procedure for solvents?
- Are solvent containers covered as often as possible?
- How are solvents currently disposed of? Is solvent recycling a viable option?

Selected mitigation strategies:

- Strategies for reducing paint waste:
    - Place a recovery screen behind the object when spray painting. The overspray can be captured onto the screen, scraped off with a special knife and deposited into a container. This recovered paint can be reused without further processing.
    - Save unused or lower-grade paint to be used as undercoat in future jobs.
    - Train spray gun operators in proper spray techniques to minimize waste generation.
- *Strategies for solvents:*
    - Keep solvent containers and equipment containing solvents covered as often as possible to reduce loss of solvent through evaporation. For example, if equipment is soaked in a solvent bath, place an airtight cover over the bath to minimize evaporation. This makes solvent last longer and reduces environmental and health damage from airborne VOCs.
    - Plan the painting process to minimize color changes, if possible, by (1) doing all work related to one color at once, and (2) finishing a color before the shop closes for the day, if possible. The latter

suggestion allows the end-of-day cleaning to also serve as a color-change cleaning. Such strategies will decrease waste, increase productivity by decreasing the time spent cleaning, and decrease the amount of money spent on both paint and solvents.

Use distillation equipment to treat contaminated solvents. Distillation involves heating the contaminated solvent until it boils and then evaporates. The evaporated solvent is cooled and recovered as clean product. The residue should be removed and handled as hazardous waste. (See the chapter on solid waste in the *Guidelines*.) Regular distillation is capable of treating solvents with a boiling point of 40°–200° C. Vacuum distillation can treat those with a boiling point of 140°–250° C. For flammable solvents, the equipment should be explosion-safe. Recycling solvent in this way may be more cost-effective than purchasing new solvent all the time.

❑ *Wood waste*

Wood waste in wood processing and furniture making contributes to the problem of unsustainable timber use. This wood waste includes sawdust and end pieces of various materials, including wood, particleboard, and various types of fiberboard. Wood waste is largely created by inefficient sawing and cutting of wood, as well as improper storage practices. Another cause of wasted wood is inadequate drying of the wood, which causes the boards to split, reducing their usefulness. Improvements in all of these areas can enhance the cost-effectiveness of these operations while reducing environmental problems.

Key questions to consider:

- How does wood become ruined/unusable?
- What contributes most to wood waste?
- How can production processes be changed to reduce waste?

Selected mitigation strategies:

- Train workers in efficient wood-cutting techniques.
- Consider redesigning the product so that wasteful cuts may become unnecessary.
- Order into inventory only wood products that are commonly used or needed for a specific job. Avoid over-ordering. Return unused, damaged or obsolete materials to the supplier for a refund, if possible.
- Store wood so that it is protected from the elements, to avoid spoilage.
- Designate a central cutting area at the work site so reusable wood pieces can easily be collected and stored for future use.
- Find new, productive uses for wood scrap. For instance, dry wood residues can be bonded together with a synthetic resin to form particleboard.

- As a last option, identify and segregate scrap wood available for fuel use by the business or others, if more productive uses cannot be found. However, avoid using laminated materials, as the glue may form toxic emissions when burned. Use sawdust and log ends as fuel for boilers that fire up the drying kiln or oven used to dry raw lumber.

References and Other Resources

References Used in Preparing This Fact Sheet:

- *"Distillation of Spent/Contaminated Solvents"* and *"Recovery of Paint Overspray Using a Recovery Screen."* Green Profit (a not-for-profit initiative of BECO Environmental Management, cleaner production consultants based in the Netherlands and Belgium). http://www.greenprofit.net/cases.html

  The two case studies used from the wood and furniture sector provide concise information on the environmental effects and mitigation measures of specific aspects of the industry. Each case study briefly summarizes one company's experience using a particular mitigation technique.

- *EPA Office of Compliance Sector Notebook Project: Profile of the Lumber and Wood Products Industry* (1995a). U.S. Environmental Protection Agency (EPA). September. http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/lmbrwdsnpt1.pdf

  This sector notebook provides a comprehensive assessment of the lumber and wood products industry. The publication is one of a series of sector publications published by the EPA and posted on the EPA Web site.

- *EPA Office of Compliance Sector Notebook Project: Profile of the Wood Furniture and Fixtures Industry* (1995b). U.S. Environmental Protection Agency (EPA). http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/wdfurnsn.pdf

  This is another of the EPA's series of sector publications.

- *"Improved Wood Processing Saves Money and Forest Resources."* Winrock International http://www.winrock.org/volunteer/reed/ftf/mercury.htm

  This success story was culled from the Winrock Volunteer News and Information section of the Web site. The feature articles provide useful information about Winrock's volunteer projects.

- *"Integrated Life Cycle of Wood: Tree Quality, Processing and Recycling."* U.S. Department of Agriculture, Forest Service. http://www.srs.fs.usda.gov/research/rwud/rwud/rwud_4702.pdf

  This project description is structured as a government report. The scope of the project is national, but the themes addressed could be relevant to other countries that have a substantial wood processing industry.

- *Pollution Prevention and Abatement Handbook: Wood Preserving* (1998). World Bank Group. July. This handbook was prepared to update and replace the 1988 World Bank Environmental Guidelines. http://www.miga.org/documents/WoodPreserving.pdf

  This handbook can be downloaded, section by section, from the above Web site. The Industry Sector Guidelines cover 40 industries, including wood preserving.

Other Resources:

- *Best Practices in Wood Waste Recycling* (1997). Clean Washington Center. http://www.cwc.org/wood_bp.htm

  This note offers detailed and technical information on wood waste recycling as it relates to sourcing, processing and product manufacturing.

- Susilo, Kasru and Achmad Djani. *Cleaner Production Assessment at an Indonesian Plywood Facility: A Case Study* (1997). Forum KMB Indonesia (Indonesian Pollution Prevention Roundtable). http://www.encapafrica.org/documents/Cleaner_Production_Plywood_fac.pdf

  This paper discusses how cleaner production diagnosis and assessment was conducted for one of six plywood facilities, located in East Kalimantan, Indonesia.