3.4F Wood Processing and Furniture Making: Cleaner Production Fact Sheet and Resource Guide

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 Section 3.4 of the *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities,* USAID Africa Bureau's principal source of sector-specific environmental guidance.

Why Focus on Cleaner Production for Mitigation?

Cleaner production 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 cleaner production 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, 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

[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 worker health: brick and tile production; leather processing; small-scale mining; food processing; wet textile operations; wood processing & furniture making; and metalworking.

return, sometimes with little or no investment. Many enterprises that change to cleaner production methods may realize substantial financial and environmental benefits, indicating that cleaner production 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 cleaner production techniques, 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 right and discussed below. For each key 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 key 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 and adhesive formulations used in this industry contain solvents (for upholstered wood furniture) and hot melts (for non-upholstered wood furniture). Another use of adhesives is in the application of veneer (a thin piece of wood of uniform thickness) to the piece of furniture. The use of adhesives for assembly and veneer releases solvents into the air and damages the environment and health of workers. Alternative approaches to adhesives could result in lower production costs and less adverse environmental impacts. [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:

[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 relevant to wood preservatives and industrial solvents.

- 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 reduced adhesive consumption, and thereby, reduced input costs and reduced emissions.
- Minimize over-spray of adhesive. A more efficient way of applying adhesive to wood is by foam extrusion – a technique in which foamed adhesive is forced under pressure to the extrusion head. This is one of the four conventional ways that glue is applied to wood. The result is less wasted adhesive.
- Replace existing adhesives with less toxic substitutes: e.g., switch to naturally-derived adhesives to replace 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 (a low-VOC binder) and lignin adhesives. The naturally derived adhesives are more cost-effective than their petroleum-based counterparts.

❑ *Air pollution from Coating Material*

The air emissions generated from applying coating material (i.e. stains, paints, and finishes) in furniture making 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 compounds (VOCs). The VOCs release into the air when the coating is applied or when containers of liquids containing VOCs are left open. There are options that could reduce VOC emissions and thereby reduce negative health impacts on the workers.

Key questions to consider:

- What coating application technique is being applied? 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 for wood furniture finishing operations. Alternative coating materials include: waterborne coating materials, ultraviolet curable coating, polyurethane coatings, and polyester coatings. These options are described on page 58 of the *EPA Office of Compliance Sector Notebook Project – Profile of the Wood Furniture and Fixtures Industry* http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/wood.html
- One method used to spray coating includes a high-volume low-pressure (HVLP) spray system. This involves the use of 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 less coating material used and less VOC emissions.
- Consider investing in a spray booth equipped to recirculate air. Coating material is often sprayed in booths that are generally not equipped with filters of any sort. One method that helps to decrease the exhaust flow

volume emitted to the atmosphere is "recirculation" – this allows equal portions of fresh air and recirculated air to be pumped back into the booth. This process has lower operating costs compared to other VOC control systems.
- Ensure that containers of coating material are tightly sealed when not in use.

❑ *Wastewater*

Furniture making requires the use of wood preservatives and coating materials all of which contain solvents. Both preservatives and coating material can generate contaminated wastewater as a result of: the drippage from the wood surface; leakage from the drums that store these chemicals; and the discard of used formulations. In the long run, contaminated wastewater can increase the concentration of toxics in the water supply to levels that are harmful to health and the productivity of operations. This may require wood processing operations to pay for procuring clean water or clean and recycle the water on-site.

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 to reduce water content would decrease 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 less 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 greater than 100% of the stored volume of liquids. If the spill collection system is non-porous, recaptured spills can most likely be reused.
- Minimize drippage from sprayed on preservatives or coating materials by effective removal of extra preservative from the wood surface by mechanical shaking until no drippage remains. The drippage should be recaptured so that it does not eventually enter the drainage system. Allow for sufficient holding time after preservative is applied to minimize free liquid. Treated wood should be sent to storage once drippage has stopped.

- Use concrete pads for wood treatment area and intermediate storage areas to ensure collection of drippage.
- Do not store materials in sites that are prone to flooding or that are adjacent 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*

Wood processing and furniture making produce waste that is often thrown away like trash, but should not be because of its hazardous nature. Hazardous waste cannot be safely disposed without taking into account procedures for protecting the environment. Proper hazardous waste disposal facilities are typically unavailable in African countries. As such, 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% (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 for cleaning application equipment, such as spray-guns, spray-nozzles, etc. Cleaning application equipment is frequent and takes place each time there is a color change. Contaminated solvents are a by-product of cleanup operations, and are considered hazardous. Recycling spent solvents with recovery units can lead to the solvent being reused, which lowers supply costs.

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 discharged? 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 coating and painting waste generation.

Strategies for solvents:

- Keep solvent containers and equipment containing solvents covered as often as possible to reduce solvent loss through evaporation,

maintaining solvent life and reducing environmental and health impacts related to the release of VOCs. For example, if equipment is soaked in a solvent bath, place an airtight cover over the bath to minimize solvent loss through evaporation.

- Plan the painting process to minimize color changes, if possible, by doing all work related to one color at once, and by finishing a color before the shop closes for the day, if possible. This 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 boiling point and subsequently evaporation. The evaporated solvent is cooled and recovered as clean product. The residue should be removed as hazardous waste. Regular distillation is capable of treating solvents with a boiling point between 40 – 200^{o} C. Vacuum distillation can treat 140-250 ^{o} 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 wood, particle board, 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 impacts of concern.

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 those 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 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 segregated 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. 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:

- "Improved Wood Processing Saves Money and Forest Resources." Winrock International

  http://www.winrock.org/reed/ftf/mercury.htm This success story was culled from the Winrock Volunteer News and Information section of the website. The feature articles provide useful information about Winrock's volunteer projects.

- "Sub-sectoral Environmental Guidelines – Wood Processing." European Bank for Reconstruction and Development (EBRD).

  http://www.ebrd.com/about/policies/enviro/sectoral/timber/wood.pdf This section of the EBRD website offers general information about environmental risks and issues within various sub-sectors. There is little information on preventive or mitigation measures.

- "Integrated Life Cycle of Wood: Tree Quality, Processing and Recycling." USDA – Forest Service

  http://www.srs.fs.fed.us/units/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.

- *EPA Office of Compliance Sector Notebook Project – Profile of the Lumber and Wood Products Industry.* U.S. Environmental Protection Agency (EPA). September 1995.

  http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/lumber.html This sector notebook provides 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 website.

- *EPA Office of Compliance Sector Notebook Project – Profile of the Wood Furniture and Fixtures Industry.* U.S. Environmental Protection Agency (EPA). September 1995.

  http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/wood.html This sector notebook provides comprehensive assessment of the wood furniture and fixtures industry. The publication is one of a series of sector publications published by the EPA and posted on the website.

- *"Distillation of Spent/Contaminated Solvents" and "Recovery of Paint Overspray Using a Recovery Screen."* Green Profit is a not-for-profit initiative of BECO Environmental Management, a cleaner production consultancy company based in the Netherlands and Belgium.

  http://www.greenprofit.net/cases.html The two case studies used from the wood and furniture sector provided concise information on the environmental effect and mitigation measures of specific aspects of the industry. The case study is a brief overview of the experience of one company's application of the measure.

- *Pollution Prevention and Abatement Handbook – Wood Preserving.* World Bank Group. July 1998. This handbook has been prepared to update and replace the 1988 World Bank *Environmental Guidelines.*

  http://wbln0018.worldbank.org/essd/essd.nsf/Docs/TOC?OpenDocument This handbook can be downloaded, section by section, from the above website. The Industry Sector Guidelines cover 40 industries, including wood preserving.

Other Resources:

- *Waste Minimization Fact Sheets: Lumber, Wood Products, and Furniture.* The Green Land, Environment Canada. August 2002.

  http://www.ns.ec.gc.ca/epb/pollprev/wm_factsheets/wood.html This fact sheet is an overview of the key waste minimization issues in the lumber, wood products, and furniture industry. The note includes contact information for the School for Resource and Environmental Studies, Dalhousie University, in Canada.

- Kasru Susilo and Achmad Djani. *Cleaner Production Assessment at an Indonesian Plywood Facility: A Case Study*. Forum KMB Indonesia (Indonesian Pollution Prevention Roundtable). 1997.

  http://www.acpa.org.au/docs/General%20Industry/Susilo.PDF This paper discusses how cleaner production diagnosis and assessment was conducted for one of the six plywood facilities, plywood mill A, located in East Kalimantan, Indonesia.

- *Best Practices in Wood Waste Recycling*. Clean Washington Center. 1997.

  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.

- *Integrated Pollution Prevention and Control, BAT Guidance Note: Wood and Furniture.* Prepared by IPPC project, Estonia. 1999.

  http://www.envir.ee/ippc/docs/wood_and_furniture_bat.pdf This note provides an overview of best available techniques regarding the wood and furniture industry in Estonia.

- *Investment projects in Wood Works and Furniture in Tanzania. United Nations Industrial Development Organization (UNIDO).*

  http://www.envir.ee/ippc/docs/wood_and_furniture_bat.pdf A database of specific projects related to wood processing and furniture manufacturing in Tanzania. Includes links to information on individual companies and proposed projects.

- *Environmental Management Center.*

  http://www.emcentre.com/unepweb/tec_case/furnitur_36/house/casename.shtml Lists twelve case studies related to cleaner production and furniture manufacturing.