



BRICK AND TILE PRODUCTION

RESOURCE EFFICIENT AND CLEANER PRODUCTION BRIEFING AND RESOURCE GUIDE FOR MICRO & SMALL ENTERPRISES



PURPOSE

Issue. Certain process, technique, and management deficits are commonly found in micro- and small-scale brick and tile operations. These deficits can have serious adverse effects on short- or long-term business performance---AND, on the local environment and on community health and safety. Among the most significant areas where economic savings can be realized through cleaner production are management actions that address fuel inefficiencies and energy resource depletion, poor clay mining practices, poor process control, and excess dust/chemical pollution.

Response. Addressing these deficits by adopting resource-efficient and cleaner production (RECP) processes, techniques, and management practices can reduce costs and improve business performance and, at the same time, avoid or minimize adverse impacts on the local environment and on community health and safety. RECP approaches generally focus on improving resource and production efficiency which saves physical and energy resources, time, and money needed in production—and results in less waste and pollution. This briefing supports the application of RECP solutions in these four key areas.

Contents. This briefing addresses each deficit area in turn. General business, environmental and health and safety issues are identified first. Then, a question and answer format is used to identify specific deficits and potential RECP solutions. The References and Resources section at the end of this briefing provides more detailed and quantitative information on these solutions.

Audience. This briefing is intended for business development services providers working directly with brick-and-tile MSEs, for those designing MSE strengthening projects, and for USAID staff (and the staff of other funding organizations) charged with overseeing projects in the brick and tile sector.

Scope. This briefing focuses on MSEs that are mining, processing, forming, and firing clay to produce bricks, tiles, and other ceramic products for the construction industry. However, some of the solutions outlined in this briefing could also be applied to MSEs that are mining and/or firing clay for other purposes, such as production of ceramic plates and bowls.

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THE PROVEN BENEFITS OF RESOURCE EFFICIENT AND CLEANER PRODUCTION (RECP)

In 1990, UNEP defined Cleaner Production (CP) as “*The continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment*”. The CP concept is widely accepted and promoted internationally, including by USAID. The strategies used to implement CP can be as simple as following the guidance in this briefing, or more complex and formal Environmental Management Systems (e.g., ISO 14001 standard) utilized by medium and large enterprises. UNEP is now advancing the concept of Resource Efficient and Cleaner Production, updating CP with additional emphasis on efficient utilization of resources in product and service enterprises.

This briefing is specifically concerned with RECP/CP technical and management interventions in production operations. Such interventions focus on (1) increasing the efficiency with which resources are utilized and/or (2) assuring that resources are utilized “cleanly”—without incurring costs and impacts that adversely affect the bottom line of the enterprise, the environment, and worker and community health and safety. Typical RECP interventions include:

- substituting different materials
- modifying processes
- improving process management
- upgrading equipment
- redesigning products

Inefficient use of resources like fuel, water and raw materials incurs both business and environmental costs. Experience shows that by reducing inefficiencies, RECP interventions in many cases substantially improve business performance AND deliver environmental, health and safety benefits—sometimes with little or no investment.

Is this always true? No. Some RECP interventions may not improve business performance. But RECP approaches offer the most cost-effective way to improve environmental or social performance when required by project implementation conditions, local regulations, or simply to preserve community goodwill.

For more information see <http://www.usaidgems.org/sme.htm>.

AREA 1: INCREASE FUEL EFFICIENCY

Business Issues: Traditional brick and tile production requires a great deal of fuel during firing. Inefficient production methods leading to excessive fuel consumption are typical. Excess fuel consumption increases fuel costs, which are often significant operational costs. In addition, a brick and tile enterprise that competes with local communities for fuelwood may find community opinion quickly turning against its operations.

Environmental Issues: Excess fuel consumption increases air pollution. If wood is used as a fuel, excess consumption often contributes to deforestation and associated environmental impacts.

Community & Occupational Health & Safety Issues: Increased air pollution, particularly from incomplete combustion, can cause and worsen respiratory illnesses in workers and the surrounding community. Depletion of fuelwood adversely affects communities, particularly women and girls.

Use the following questions and answers to identify specific causes of poor efficiency and the corresponding RECP methods that address them.

What types of fuel are currently used to fire brick and tile? Are these fuels being used faster than they regrow? Are there other, more abundant sources of fuel available?

Be sensitive to where fuels are originating. Is fuelwood harvesting causing local deforestation, or being trucked from distant locations where forest resources are not sustainable? If the current fuel source is becoming scarcer/more expensive, look for alternative fuel types, such as agricultural waste (crop residue such as corn stover, or processing waste such as sugar bagasse). Consider planting fast-growing local (indigenous) tree species to maintain a source of fuel. Tree planting also helps to prevent soil erosion, reduce siltation of water bodies and maintain soil fertility. If trees are planted, make sure it is clear who owns them to encourage better long-term management.



Brick kiln in Kabul, Afghanistan.
Photo: Wes Fisher, 2003.

Is fuel wood protected from the weather?

A small increase in water content drastically reduces the usable energy that can be extracted from fuel. Make sure to store wood or other fuels in a well-ventilated space that protects it from the rain.

Are there leaks or openings in the kiln structure?

Maintain kiln structure and repair cracks or leaks by replacing the affected section of firebrick or other insulating material. Even small leaks can substantially increase fuel costs over time. Be sure to evaluate leaks when the kiln is running, as some cracks that are visible when the kiln is cool do not leak when the kiln is running (heat makes the firebricks expand and close cracks).

Have alternate firing techniques been tried?

If not, experiment with shorter/hotter firing cycles varying air supply to the fire, etc. Adding combustible material around the bricks or between clamps can increase temperatures and lower traditional fuel needs. Increasing brick drying time before firing can also reduce fuel requirements (less water in the bricks means less fuel used to remove it). As a simple test, leave a brick considered ready for the kiln in a closed plastic bag in the sun. If any condensation forms inside the bag, the brick is not done drying. For more information, see 'Clay Preparation Methods' in the References and Resources section.

If traditional brick-making technology is used (brick clamp or scove kilns, in which a pile of bricks to be fired is simply covered in a sealing layer of mud), ensure adequate insulation of the clamp and orient it at a 90° angle to prevailing wind direction to reduce underfiring or overfiring of bricks.

Is the kiln old enough to replace or not yet built?

If the MSE has the opportunity to choose a design for a new kiln, consider using a kiln structures that require less fuel. Ventilated-shaft brick kilns (VSBKs) or bull trench kilns (BTKs) are effective in reducing smoke and lowering the amount of fuel required for firing.

How much exposure to smoke and ash do workers have?

Allow kilns to ventilate for a few hours after firing. Dangerous gases and fumes accumulate during the firing process and can sicken workers removing bricks or tile.

AREA 2: MINE CLAY SAFELY

Business Issues. Clay mining for brick and tile production usually creates clay pits or borrow areas, which, if improperly managed, can become safety hazards for employees.

Environmental Issues: Clay pits may also accumulate rainwater and become habitat for mosquitoes.

Community & Occupational Health & Safety Issues: Employee injuries can result from improperly managed clay pits. Soil erosion from clay pits may make land unusable for farming.

Use the following questions and answers to identify specific causes of unsafe clay mining conditions and the corresponding RECP methods that address them.

Is clay being mined/ extracted from local pits?

If so, make a plan to return land to a usable state. Set topsoil aside before removing clay and replace it after production ends. As well as preventing erosion and pools of water that attract mosquitoes, this



Clay borrow pit (foreground) for health clinic construction with accumulated medical waste in Sumbe, Angola.

Photo: Wes Fisher, 2003.

makes it more likely that the land will have value after the MSE has removed the clay AND NO LONGER HAS A USE FOR IT.

If there is a local clay pit mine, is the structure stable?

Angle the mine's pit faces to prevent unexpected collapse. This preserves the investment in excavation, guaranteeing a longer life to the working site and less danger for those working inside. It may be necessary to disturb additional land in order to make the angle less steep, but take care to disturb as little land as possible.

AREA 3: IMPROVE PROCESS CONTROL

Business Issues: Improper brick and tile formation and low-quality inputs result in a high number of bricks or tiles that crack or break during firing and must be discarded. This decreases output and increases waste disposal costs. Better use of technology and training will increase productivity and efficiency while reducing costs and waste. For more information, see 'Clay Preparation Methods' in the References and Resources section.

Environmental Issues: A higher fraction of unusable products mean that in order to produce the same amount of useful products, the MSE requires more production (and associated environmental impacts such as deforestation, landscape alteration from clay mining, etc.) per unit of finished, usable product.



Young men making adobe bricks during a youth leadership training camp in Sololá, Guatemala.

Community & Occupational Health & Safety Issues:

Brick or tile wastes require significant amounts of space, leaving less land available for other uses.

Use the following questions and answers to identify specific shortcomings in process control and the corresponding RECP methods that address them.

What kind of machinery is used in the production process?

If little or no machinery is used, consider low-cost technology improvements. Use an extruder or manual presses to condition the clay and remove bubbles (which can cause cracking in the firing process).

What quality control processes are used to evaluate raw materials?

Check incoming clay for organic matter content (easily identified as dark, fibrous

matter that looks similar to finished compost). Bricks that crack during firing may have too much organic material in them due to too much topsoil mixed in with clay.

What uses can be found for production waste?

Broken brick/tile can be ground down and re-used as a grit additive to raw clay (potentially saving costs if grit previously was purchased). Investigate possible uses of broken or burnt brick for construction and other processes. If brick and tile waste is not usable, consolidate it once production ends. This waste may be scattered over a large area and make it hard to farm the land in the future.

AREA 4: CONTROL DUST AND CHEMICAL POLLUTION

Business Issues. Dust, a byproduct of brick and tile production, may cause serious health problems in workers and owners. Dust is most prevalent and most dangerous when clay is extracted and when finished bricks are transported following the firing process. Inhaling rock dust can lead to silicosis, a disease that affects lungs and breathing, and can eventually lead to death. Similarly, the use of lead, cadmium, or barium containing glazes or pigments can lead to poisoning, skin irritations or lung disease. And, even dust from non-toxic glazes can cause silicosis. Unhealthy workers can lower productivity, miss work too often and contribute to costly mistakes.

Environmental Issues: Improperly disposed-of waste from glazes can spread toxic heavy metals into the local ecosystem.

Community & Occupational Health & Safety Issues: Dust can also cause silicosis in people who live close by (including the families of workers and owners). Water contaminated by toxic glazes can make its way into local drinking water supplies, and impair the health of the community.

Use the following questions and answers to identify specific causes of dust/chemical pollution and the corresponding RECP methods that address them.

Where and when is dust most prevalent in the production process?

High-dust operations can often be controlled by spraying the area with a small amount of water. In cases where that is not possible, install ventilating fans, and provide workers with face masks.

What types of glaze are used in production?

If at all possible, avoid using glazes that contain lead, cadmium, barium, or other heavy metals. It may be possible to manufacture glazes locally; see 'Clay and Glazes for the Self-Reliant Potter' for more information.

How are glazes stored and handled?

Improve storage practices. Close containers containing glazing or enameling material to prevent loss of the material through evaporation, spoilage or spills, and to minimize workers' exposure to fumes. Require workers to wash their hands after working with glazes. Many glazes have traces of metal that can cause metal poisoning when ingested. Provide gloves made of rubber, vinyl or other impermeable materials for workers who are handling unfired glazes.

How is glaze waste disposed of?

Prevent water contamination. Apply glazes away from water sources and dispose of chemical wastes properly. Do not clean spilled glazes with water. Sprinkle them with absorbent material such as straw, clay or dirt, and sweep up the spill into a separate container. If glazes contain toxic metals, they should be disposed of safely (for example, in clay- or concrete-lined pits) to prevent leaching into the water supply. Check with an environmental expert to confirm the chosen disposal method is safe for the chemicals used.

REFERENCES AND RESOURCES

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A series of technical briefs dealing with the drying of clay for brick- and tile making, the preparation of clay, and the molding and firing of clay bricks and tiles. The brief describes basic drying processes, different drying methods, surface treatment, drying tests, choice of drying methods, economics and flexibility. A table explains drying faults, their causes, and remedies.

- Energy Efficiency Improvement in the Brick, Tile and Lime Industries on Java (1987). World Bank Energy Sector Management Assistance Program. UNDP, World Bank. http://www-wds.worldbank.org/servert/WDS_IBank_Servlet?pcont=details&eid=0000092653960928074130.

This report discusses improvements in the brick, tile and lime industry in Indonesia. Particular attention is paid to better ways to prepare clay and keep tiles from breaking in the kiln.

- "Energy Saving in Brick Industry: Brick-by-Brick Approach to Sustainable Development." (1999) Terivision No. 18. Tata Energy Research Institute. <http://www.sciencedirect.com/>.

A general discussion of improving energy efficiency in the brick industry. This is not a very technical document, but includes useful starting strategies for dealing with energy issues.

- Glazes for the Self-Reliant Potter (1993). German Appropriate Technology Exchange (GATE). <http://www.gate-international.org/documents/publications/webdocs/pdfs/g17gle.pdf>.

A detailed, step-by-step text on manufacturing glazes from locally available materials.

- Kiln Care Tips. <http://www.marjonceramics.com/pages/Tips/tip2.htm>.

A useful resource on how to repair cracked kilns.

- Status and Development Issues of the Brick Industry in Asia (1993). Field Document No. 35, UN Food and Agriculture Organization (FAO). <http://www.fao.org/docrep/006/AD592E/AD592E00.HTM>.

A comprehensive description of brick production and alternative technologies that improve production. Specific reference to kiln types and different methods of input extraction.

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- "The Environmental Colours of Microfinance Theory" and "Practice Enabling the Link between Microcredit and Environment" in Promoting Environmentally Based Micro-Enterprises (2000). Global Development Research Centre. <http://www.gdrc.org/icm/environ/environ.html>.

This is a larger document on environmental assessment of microenterprises, but includes a case study of brickmakers in Zimbabwe.
- Maithel, Sameer, Heini Mueller and Rajinder Singh (2000). Experiences in the Transfer and Diffusion of Efficient Technologies in the Indian Brick Industry. CTI/Industry Joint Seminar on Technology Diffusion in Asia, 14-15 January 2000. United Nations Framework Convention on Climate Change Secretariat.

This paper discusses the efficiency and environmental soundness of adopting the Vertical Shaft Brick Kiln (VSBK) technology in India.