CLEAN by Design

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Best Practices for Textile Mills to Save Money and Reduce Pollution in Bangladesh

Textile and apparel manufacturing have a huge environmental footprint. A single ton of finished fabric can pollute up to 300 tons of water with harmful chemicals and consume vast quantities of energy to create steam and hot water.[1, 2] Since global textile manufacturing has moved to countries with still-evolving environmental regulatory systems, complementary efforts in the private sector are needed to reduce the environmental impact of this industry. Through its Responsible Sourcing Initiative (RSI), the Natural Resources Defense Council (NRDC) has led efforts to leverage the influence of the private sector to reduce the environmental impact of dyeing and finishing textiles. First piloted and tested in China, RSI was expanded to the rapidly growing textile sector in Bangladesh to test and broaden opportunities for improvement.

The accompanying *Best Practice Guide* is available at **www.nrdc.org/cleanbydesign**

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NRDC
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Partnering with pioneering textile retailers and brands, NRDC launched RSI as part of its larger Clean by Design effort to address the environmental impacts of the apparel industry. RSI's purpose is to address the gap that exists between expanding industrial manufacturing in developing countries and their governments' capacities to address its environmental impacts. A cost-effective way to address this gap is to target resource inefficiencies in the manufacturing process, thereby enhancing textile mill profitability, while reducing its environmental footprint.

As part of its RSI efforts, NRDC assessed more than 20 textile mills in China. These assessments led to the development of 10 best practices that Chinese mills should adopt to save money and reduce pollution.[3] The RSI team then evaluated whether these practices were also relevant to mills in Bangladesh. After assessing four different mills in Bangladesh, the team developed seven energy and water savings best practices that overlap with those identified in China. If implemented together, these practices could save as much as 27 percent of water usage while also significantly reducing energy use. For all practices, the initial investment required for implementation can pay back within 15 months or less.

Beyond concerns about environmental impacts or government oversight, these best practices should be adopted because they enhance mill productivity and are good for business. Multinational apparel retailers and brands can reduce the footprint of their global supply chain by encouraging mills to adopt these best practices and rewarding those that do so with more business.

FIRST ORDER OF BUSINESS:

Install Meters to Benchmark Use and Measure Savings

Installing and operating accurate meters and measuring software are fundamental steps in benchmarking performance and initiating efficiency improvements. Metering is the management tool that underpins all the other practices. It allows plants to evaluate the water and energy efficiency of current practices, identify and respond to leaks or unusual spikes in resource use, and evaluate the effectiveness of any process-improvement measures they take.

RSI assessments revealed that many textile mills in Bangladesh *estimate* total water, energy, and chemical consumption based on capacity of pumps and machines; they do not know actual total resource use in practice, or the specific resource consumption of different areas in the factory or of major pieces of equipment.

At a minimum, factories need to meter resource use at the main point of supply. Next, they should prioritize workshop-level metering, and then metering at particular machines that consume the most water or energy in the factory.[4]

Meters and measurement software are relatively inexpensive. For more about metering and costs, please see the full report available at http://docs.nrdc.org/international/int_12122001.asp

The Best Practices for Saving Water, Energy, Chemicals, and Money

RSI focuses on factory infrastructure improvements that would improve the steam production and water heating processes, recycle process water, and recover heat. For each opportunity identified, RSI evaluated the following:

- **Costs**: both upfront investment and ongoing operational
- **Payback period**: the time required to recoup upfront investment through savings in water, materials, and energy costs
- **Resource savings:** water, energy, and chemicals

All cost, return, and impact estimations and calculations are based on the four factories audited in Bangladesh, supplemented with previous RSI work in China. The RSI team selected practices based on greatest impact, lowest cost, and quickest return. (See full report for complete list of practices evaluated and selection criteria, http://docs.nrdc.org/international/int_12122001.asp) These criteria vary somewhat from those used in China because of the differences in circumstances in Bangladesh, such as factories' pumping groundwater at the site rather than purchasing water from utilities and the use of natural gas for fuel rather than coal.

Overall, three out of the seven best practices cost less than Tk 410,400 (US $5,000) each, and two cost almost nothing (see table 1).[5] Costs for two other practices can be lower than Tk 410,400 (US $5,000), depending on the factory. None requires more than 15 months to recoup costs. Each practice delivers savings of:

- One ton or more of water per ton fabric; or
- One percent or more of the factories' total use of steam, gas, or electricity; or
- Ten percent or more of materials or costs for the targeted activity.

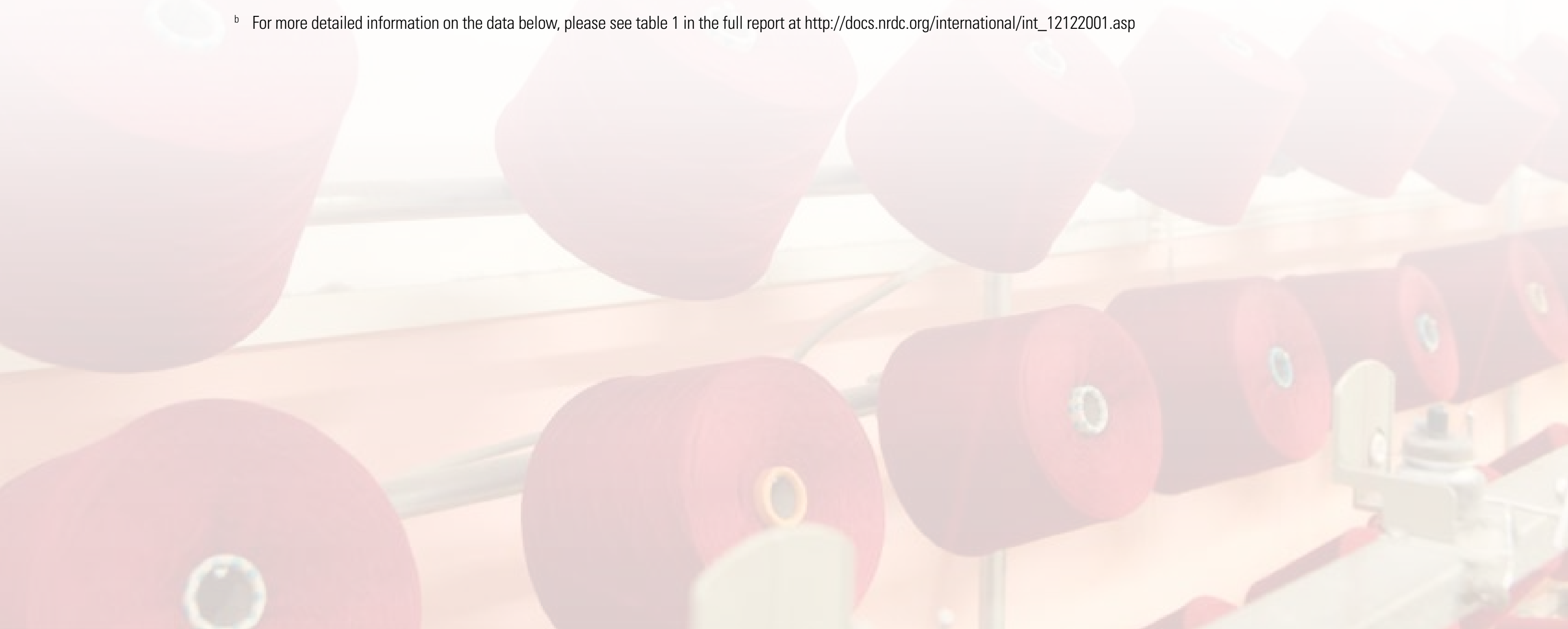
TABLE 1: RECOMMENDED BEST PRACTICES[a]

An Assessment of Four Bangladeshi Factories[b]

PRACTICE	% RESOURCE SAVINGS		SAVINGS (TK/ TON FABRIC)		COST (TK/ TON FABRIC)		INVESTMENT COST (TK) NRDC'S TEN BEST PRACTICES		PAYBACK PERIOD (MONTHS)	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
Meter resource use	N/A	N/A	N/A	N/A	N/A	N/A	20,000 each	500,000 each	N/A	N/A
WATER SAVING PRACTICES										
Eliminate water leaks and reduce hose pipe use	0.3	0.7	6.8	31.3	0.7	1.1	3,000	3,000	0.4	1.4
Reuse cooling water from dyeing machine	8.2	14.8	392	714	75	204	280,000	800,000	2.1	3.3
Reuse process water from rinsing	9.0	11.9	91	426	134	196	380,000	1,000,000	3.9	25.9
ENERGY SAVING PRACTICES										
Steam management	1.1	5.3	81	349	-	-	-	-	Immediate	Immediate
Insulate pipes, valves, flanges	0.4		23		22		60,000		11.2	
Recover heat from drying operations	20.0	20.0	527	1769	267	368	1,000,000	1,500,000	2.5	8.4

[a] Unless otherwise noted, savings and cost figures are based on calculations provided by the technical consultants on this project, the Consortium of Ecopsis+Sofies+HB in their report entitled *Task B: Assessment of Five Medium Performing Facilities* ("Task B Report") (July 29, 2011, as updated October 28, 2011). Descriptions of measures also rely on the Task B Report. The Ecopsis Consortium ("Ecopsis") calculations were updated with the latest information on 2009 production, resource use, and unit costs provided by factories. The "% resource savings," "Savings (Tk/ton fabric)," and "Cost (Tk/ton fabric)" were then carried out by NRDC from the Ecopsis-based calculations. Because Libas did not have reliable 2009 records, we have used 2011 data for Libas; The costs and savings here are in Bangladeshi Taka (Tk). Conversions between Taka and US Dollars throughout the report reflect conversion rates in effect on May 9, 2012, at 82 Tk per 1 USD.

[b] For more detailed information on the data below, please see table 1 in the full report at http://docs.nrdc.org/international/int_12122001.asp



THREE WATER-SAVING BEST PRACTICES

In a country historically bedeviled by too much water, Bangladesh is now facing a crisis due to too little useable water.[6] Hence, reducing water consumption is a crucially important environmental responsibility for textile mills. In Bangladesh, where factories pump and treat their own water prior to use, reductions in water use lead to savings in both energy and chemical costs. NRDC recommends the following water-saving practices that can reduce water consumption between 18 percent and 27 percent, if implemented together:

Eliminate Water Leaks and Improved Hose Pipe Use

Individual leaks may not seem significant in the overall consumption picture. Spread across an entire factory over the course of a year, however, those individual leaks can be responsible for a surprisingly significant loss of resources. RSI estimates conservatively that water leaks account for up to 0.2 to 0.4 percent of water use, or 0.35 to 1.2 tons per ton of fabric at factories using water at levels similar to those we visited. The savings from eliminating water leaks could be higher, judging from the relevant literature.[7]

Significant water can be saved by reducing unnecessary use in cleaning operations. At many of the factories visited by the RSI team, water is wasted when hoses or cooling water streams are left running even after machinery is shut down, after cleaning is completed, and while cleaning is in progress. Rather than relying on workers to reduce water use, low-flow and shut-off valves or trigger guns can be installed on hoses, and thermally controlled shut-off valves can be installed on process units.[8] Combined savings from eliminating water leaks and improved hose pipe use ranged from 0.3 to 0.7 percent of water use. ***How to adopt this best practice: Systematically and routinely check for leaks, replace and repair worn hoses, fittings, etc., and more closely monitor efficiency of water use during normal cleaning operations. Use trigger guns and low-flow and shut-off valves.***

Reuse Cooling Water from Dyeing Machines

In a textile mill, a lot of water is used to cool hot machines without coming into direct contact with the dyes or other chemicals. This "non-contact" cooling water should always be recycled. After its initial use, it is still clean and high in temperature, making it beneficial in processes such as desizing, scouring, washing, or rinsing. Furthermore, discharging so much hot water stresses the wastewater treatment system, lowering its efficiency. Reusing cooling water used to reduce the temperature of dyeing baths before they are drained out is especially promising. RSI found mills were either not reusing this water or using it in cold water processes where the heat is wasted. To use the warmed-up cooling water, factories can use an insulated hot water tank to collect and store water and then recycle this warm water either into the dyeing process or as boiler feed water. Costs are estimated to be modest, and return on investment is less than four months.[9] ***How to adopt this best practice: Install a water reuse system, which includes pipes, valves, pumps, holding tanks, and a control system.***

Reuse Process Water from Rinsing Operations

Dyed fabric must be rinsed with clean water many times to remove unabsorbed dye. While initial rinses are highly colored, later washes are low in both color and chemicals. In current practice, all rinse water is discharged for effluent treatment, but the last few rinses can be reused in processes that do not require high quality water. Investment required to implement this practice is higher than other measures: we estimate between Tk 380,000 (~ US $4,600) to Tk 1,000,000 (~ US $12,100) in upfront costs, plus operating costs of another Tk 200,000 to Tk 500,000 (~ US $2,400 to $6,100), depending on mill size and layout.[10] For two of the four factories, the investment pays itself back within eight months; however, for the two other facilities, this was not as cost-effective a measure, and should be evaluated before implementation. Other process water can also be reused at factories, as our China report outlined. ***How to adopt this best practice: Install pipes, water tanks, a simple sand or carbon filter, and electrical pumps to store and return water to the process.***

THREE ENERGY-SAVING BEST PRACTICES

In China, the RSI team discovered that steam generation is by far the largest energy-consuming activity in a textile dyeing mill. With this in mind, RSI best practices for energy improvements focus on increasing the efficiency of steam use in the production process. In Bangladesh, steam savings are especially important because there is an inconsistent supply of natural gas used to create steam where some factories already face occasional supply shortages.[11]

Steam Management

If a steam distribution system is not managed properly—suffers blocked or broken steam traps and loose fittings and other leaks in the steam distribution system—the result will be losses of steam energy and condensate. Steam quality is then affected and extra condensate is introduced into the steam system. The extra condensate must be discharged or it can have a "water hammer" effect, which can cause energy inefficiencies and losses of up to 5 percent.

Steam traps prevent unneeded condensation. In steam systems that have not been adequately maintained, between 15 percent and 30 percent of the traps may have failed.[12] By implementing a quality steam management regime with monthly testing, a factory can save between 1 percent and 5 percent of steam consumption. This measure does not require capital investment for implementation, but rather management time and attention. *How to adopt this best practice: Regularly inspect leaks in the system, loose fittings, and steam traps (monthly testing is recommended) and repair or replace leaks, faulty fittings, and broken steam traps as soon as they are out of order.*

Recover Heat from Drying Operations

The drying and stenter operations generate heat that is vented to the atmosphere at a temperature of 120º C to 150º C.[13] The heat can be captured and used to warm up incoming process water.[14] In some circumstances, the hot air itself can be beneficially reused in the dryer or elsewhere; in this case the air stream would require filtration prior to use.[15] Savings are estimated to be at least 20 percent of drying costs based on experience.[16] Textile mills also have other valuable sources of heated air, whose heat could also be captured, such as stack gases. For three of the four mills assessed, the estimated payback period is less than eight and a half months. *How to adopt this best practice: Install an air to water heat exchanger and pipes and filers to connect to heating needs.*

Insulate Pipes, Valves, and Flanges

Steam is transported to many locations and equipment across a factory, and heat loss can be considerable. A well-insulated steam system has about a 90 percent reduction in heat loss compared to a factory with uninsulated pipes, valves, and fittings.[17] Most of the visited factories in Bangladesh had insulated the majority of their steam pipes. For the one factory where the pipes had not yet been insulated, insulation was estimated to cost about Tk 60,000 (around $730). None of the factories visited had insulated their valves and flanges, and that is a savings opportunity across the board. *How to adopt this best practice: Routinely inspect and insulate all pipes, valves, and flanges in the mill with good quality insulation material.*

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OTHER POTENTIALLY LOW-COST MEASURES[18]

In addition to the measures described, the assessments in Bangladesh uncovered several other attractive opportunities to reduce resource use and save money. RSI research did not provide sufficient data to include these in the list of best practices, or they do not meet all our criteria for inclusion in the list, but may still be beneficial to certain mills. More details and practices are highlighted in the full report.

Optimizing the compressed air system could yield significant savings as the technical team estimated that every factory visited is producing more compressed air than necessary.

Reusing condensate could provide a great source of hot clean water. Savings were estimated at 5 percent to 15 percent of condensate at the two factories that had not yet implemented the practice. Costs vary depending on mill layout and infrastructure.

Improving boiler blow-down to prevent either too frequent blow-downs or insufficient blow-down, which can lead to increased energy consumption. Automatic boiler blow-downs or the use of a manual total dissolved solids meter to determine appropriate blow-down times could save energy and money.

Recovering heat from hot process discharged water to heat other water in the factory. While we had limited data to assess this practice, rough calculations indicate potential payback periods between three and a half and 13 months.

Eliminating inefficient lighting and increasing use of natural light can save energy at very low costs, although it may take some time for payback.

Reducing the incidence of chemical losses by minimizing spillage could lead to savings. Bulk chemicals are best prepared in a solution that is pumped to dyeing machines as needed. In addition, only required amounts of chemicals and prepared solutions should be taken to production areas.

HOW RETAILERS AND DESIGNERS CAN HELP

Designers, brands, and retailers should promote these best practices with their suppliers to protect the environment and help the bottom line. Designers in particular can make better selections of fibers and dyes to reduce environmental impact at the drawing board. Finally, these important stakeholders can join with NRDC and its RSI Initiative to craft solutions on the ground, reinforcing and expanding the capacity of environmental governance in developing countries for long-term results that could extend well beyond the impact of a single supply chain.

1 All units are in metric tons
2 Personal communication with Naureen Chowdhury, International Finance Corporation (IFC), based on factory assessments carried out by IFC.
3 "Best practice" refers to the best opportunities to reduce pollution at low or no cost and with a quick payback period as identified by our analysis, based on specific criteria defined further in our full report, available at: http://docs.nrdc.org/international/int_12122001.asp
4 RESET Energy, NRDC Clean by Design Assessment Report of Denim Factory G Redacted Edition, July 2011 (Reset Denim Factory G Report), at 13.
5 The costs and savings here are in Bangladeshi Taka (Tk). Conversions between Taka and US Dollars throughout the report reflect conversion rates in effect on May 9, 2012, at 82 Tk per 1 USD.
6 Around Dhaka, a city of 12 million, intense water pollution has left much of the watershed extremely polluted, and water-borne disease now affects nearly 80 percent of the population. World Bank, *Bangladesh Country Environmental Analysis: Bangladesh Development Series Paper No: 12* ("World Bank Bangladesh Analysis"), September 2006.
7 S. Barclay and C. Buckley. 1993. Waste Minimization Guide for the Textile Industry – A Step Towards Cleaner Production,Volume III. In: UNEP/IEO ICPIC International Cleaner Production Information Clearing House.
8 Linda Greer, Susan Egan Keane, Zixin Lin, *NRDC's Ten Best Practices for Textile Mills to Save Money and Reduce Pollution*, p.6, February 2010.
9 Consortium of Ecopsis+Sofies+HB,*Task B: Assessment of Five Medium Performing Facilities,* July 29, 2011, at p. 4 of Chapters 2, 3, 4, and 5.
10 Ibid.
11 Conversations with factories. Also see AFP. Bangladesh signs deal for first nuclear power plant. Nov. 2, 2011, http://news.yahoo.com/bangladesh-signs-deal-first-nuclear-plant-175455575.html (last visited Nov. 9, 2011).
12 Linda Greer, Susan Egan Keane, Zixin Lin, *NRDC's Ten Best Practices for Textile Mills to Save Money and Reduce Pollution,* February 2010, at 8.
13 Consortium of Ecopsis+Sofies+HB,*Task B: Assessment of Five Medium Performing Facilities,* July 29, 2011, at p. 8 of Chapters 2, 3, 4, and 5.
14 Personal communication with Cyrus Lam, RESET Energy.
15 Consortium of Ecopsis+Sofies+HB,*Task B: Assessment of Five Medium Performing Facilities,* July 29, 2011, at p. 8 of Chapters 2, 3, 4, and 5.
16 Ibid.
17 Linda Greer, Susan Egan Keane, Zixin Lin, *NRDC's Ten Best Practices for Textile Mills to Save Money and Reduce Pollution,* February 2010, at 9.
18 The RSI team learned during its factory visits that some factories are using a magnetic technology for controlling scale in boilers. The effectiveness of this technology is disputed. NRDC recommends that factories carefully evaluate this technology before use.