Comparing reusable textile and disposable products

by Carl Lehrburger and Jocelyn Mullen

Carl Lehrburger is a waste reduction, recycling and product development consultant living in western Massachusetts. Jocelyn Mullen, an environmental engineer who consults with the resource recovery and reusable textile industries, lives in Colorado Springs, Colorado. Their firm, Lehrburger Mullen, has completed several studies on behalf of trade associations which contrast reusable and disposable products.

The article is based on a study completed by Jocelyn Mullen and Carl Lehrburger under contract to the Textile Rental Services Association of America and the Institute of Industrial Launderers, November 1991.

A recent study found that commercial/industrial laundries offer waste savings for textile use.

Their industry calls them "reusable textile products." To the rest of us, they are the cloth napkins served at nicer restaurants, cotton bar towels or the cabinet roll-towels in the public restroom. In hospitals and health care settings, these products include exam and surgery gowns and washable diapers and bed pads. In factories and printshops, they are used as shop towels and wipers.

Although other industries have received attention for their recycling efforts, the positive conserving nature of rental laundering operations has largely been ignored. Yet in contrast to disposable products that are used once and then discarded immediately in the solid waste stream, reusable textiles are a living, breathing example of reuse.

A recently released study has examined the solid waste impacts of specific disposable paper versus reusable textile products, seeking to quantify the potential for reducing the amount of paper waste from commercial and industrial sources.

The study, A Solid Waste and Laundering Assessment of Selected Reusable and Disposable Products, characterized the amount of solid waste produced by disposable and reusable products, including paper towels, wipers and napkins, adult incontinence products and hospital health care products such as hospital gowns.

Research findings suggest the potential of reusable textiles products to assist in waste stream reduction is significant. In fact, figures show the nation could cut its waste stream by almost 1.5 million tons annually simply by substituting reusables in these product areas for their disposable counterparts. If you add to this figure the 3 million tons of infant disposable diapers tossed each year, the solid waste impacts of the selected disposables increase to 4.5 million tons and equals almost 20 million cubic yards of landfill space annually.

Reusable industry study

The study was commissioned by two trade associations from the reusable textile industry to determine solid waste savings that could be achieved by substituting reusable for disposable products. It also included a laundry comparison of uniforms washed at home and by commercial/industrial launderers.

The study was not a product lifecycle analysis, nor did it compare the water impacts of competing reusables and disposable products. Previous work by the authors includes a lifecycle analysis of disposable, home-washed and commercially laundered infant diapers (1).

Table 1 illustrates the specific products studied.

The study was based on the assumption that all reusable and disposable products are processed by one or both of two different, but interconnected, waste disposal systems: the wastewater treatment system, and the solid waste disposal system. Reusable textiles rely primarily on wastewater treatment for disposal, transferring the waste burden from the solid waste system. Disposable products rely almost exclusively on the solid waste system.

Solid wastes are typically broken down into two main categories for purposes of analysis: process solid waste and post-consumer solid waste. Process solid waste is the waste generated during any and all phases of manufacturing the primary product(s), including wastes generated by fuel production and combustion and acquisition of inputs to the primary manufacturing process(es). Post-consumer solid waste is the waste generated during and after the useful life of the product, including sewage sludge from the treatment of laundering water.

Reusable and disposable products are not used or substituted on a one-to-one basis. Textile products are washed many times during their useful life, and within a single distribution cycle a cloth...
product may be used many times before it is tossed into the hamper for the next cleaning. In contrast, it often takes several single-use products for one job, such as cleaning up a large spill or wiping one’s hands with paper napkins during a meal.

In order to contrast reusable textiles with their disposable counterparts, the concept of a “task” was used to establish comparative use parameters for each product category. For example, disposable towels are used for one task, then discarded. Reusable towels may be used one time, then laundered if the nature of the task (e.g., wiping up grease) makes it impossible to reuse the towel again before cleaning. If the task is wiping up water or dusting, the cloth towel may be used five or 50 times before laundering. Because of the variations in possible use patterns, multiple use scenarios were developed.

Reusable cotton products
Reusable textiles generate solid waste in a variety of ways, including packaging, lint from the laundering process, incidental wastes generated by a laundering facility, and the sludges generated from wastewater treatment. When the total number of uses of each reusable product is divided into the total solid waste generated during its life, solid waste per equivalent use is significantly lower for reusable products than for single-use disposable products. Textiles ultimately enter the solid waste stream after their useful life, and usually after several more uses as rags. A survey of linen supply and industrial laundering services revealed that a large percentage of rental textiles are sold as rags after their useful lives as rental products.

Process solid waste generated by the cotton and synthetic fibers industries during cotton growth, harvest, processing, weaving and cloth manufacture, and synthetic fiber manufacturing and weaving was calculated for each reusable product. By comparing reusable and single-use products on an equivalent task basis, it becomes evident that as the number of tasks per product increases, the process solid waste per

<table>
<thead>
<tr>
<th>Table 1 — Reusable and disposable products studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of study</td>
</tr>
<tr>
<td>Drying/wiping</td>
</tr>
<tr>
<td>Drying hands</td>
</tr>
<tr>
<td>Food service</td>
</tr>
<tr>
<td>Industrial wiping/cleaning</td>
</tr>
<tr>
<td>Health care</td>
</tr>
<tr>
<td>Adult incontinence care</td>
</tr>
<tr>
<td>Industrial uniforms</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Source: Lehrburger Mullen, 1992.
task decreases. The contribution of process solid waste per task is further reduced when reusable products become rags after their useful service life.

Disposal methods for sludge include landfilling, combustion and land application. In industrialized areas, wastewater treatment sludges can contain potentially toxic heavy metals and organics. Land application is suitable only for sludges that do not contain contaminants in concentrations that could pose environmental or public health hazards.

The amount of sludge generated by treatment of water used for laundering was converted to a per-task basis and included in the post-consumer waste calculations. Relatively large numbers of total uses over the life of a reusable product contributes to relatively low post-consumer waste generation figures per 1,000 tasks. Packaging and sludge are the dominant components of post-consumer waste for reusable products.

Linen supply businesses and industrial launderers rely on packaging to protect some clean products during transport and distribution to clients. Because packaging is used after each laundering cycle for napkins, packaging impacts from reusable napkins are on the same order of magnitude as packaging from single-use napkins. However, many reusable textiles, such as industrial uniforms, are not packaged for distribution and may only be bound by twine or placed on hangers, significantly reducing packaging impacts compared with their disposable counterparts.

**Single-use (disposable) products**

Nearly all of the disposable products covered in the study place primary impacts on the solid waste disposal system. Commercial and industrial uses of paper towels, napkins and adult incontinent care products consume 37 percent of the tissue produced by the pulp and paper industry in the United States, and generate 1.4 million tons of municipal solid waste (MSW) each year. Other uses of tissue, such as hospital gowns, represent another 14,000 tons of MSW per year.

The paper, plastics and nonwovens industries have made significant progress in reducing the quantity of process waste requiring disposal. The paper industry burns waste wood for energy production and recovers and recycles process chemicals. Paper wastes generated during the papermaking process are often repulped and incorporated back into new paper. The plastics and nonwovens industries practice similar scrap recycling. This type of recycling, pre-consumer recycling, is distinguished from post-consumer recycling.

Process solid wastes generated by the pulp and paper industry, the plastics industry and the nonwovens industry were calculated for each disposable product. As the number of tasks per product increases, the process solid waste contribution per task decreases. Post-consumer solid waste calculations include the weight of the product as manufactured and the estimated weight of any residuals contained in the product at the time of disposal.

Although both the reusable textile and single-use product industries have made progress in reducing the quantity and volume of packaging waste over the last decade, for most of the products studied, the use of single-use products generates significantly more packaging

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wastes per task than reusables. For example, disposable adult diapers and pads generate 100 times more packaging waste than reusables per 1,000 equivalent tasks.

Comparing products
Commercial towels. Table 2 presents a comparison of solid waste generated by 1,000 equivalent uses of single-use and reusable commercial towels for drying and wiping tasks.

Total waste numbers represent the quantity of solid waste generated by each product per 1,000 equivalent tasks, including the full weight of the product at final disposal, processed solid waste generated during manufacturing and post-consumer packaging. The number of uses of each product as rags (five uses per rag times the number of rags per product based on size) further reduces the quantity of waste generated per equivalent task.

Continuous cloth towels used for drying hands produced one-seventh the amount of solid waste of paper towels per 1,000 equivalent tasks, even when the most favorable use parameter of one paper towel per task is used for comparison. When three paper towels are used per task, disposable paper towels produce 22 times more solid waste per 1,000 tasks.

In the food service sector, trends are similar. Assuming a low-end estimate that cloth towels are used for 10 tasks before laundering, when compared with paper towels at a use rate of one per task, cloth produces two-thirds the solid waste of paper towels. In a more likely
scenario, when the number of paper towels used per task is increased to three, paper towels generate more than four times the quantity of solid waste per 1,000 equivalent tasks.

The data overwhelmingly suggest that, at a minimum, the use of cloth towels produces two-thirds the solid waste of paper towels, using the scenario most favorable to paper disposables. In the scenario most favorable to reusables, paper products produce 20 times more solid waste than cloth. And in the most moderate situation, paper towels still produce almost three times more solid waste than cloth bar towels.

**Industrial wipers and towels.** Table 3 presents data on industrial uses of cloth shop towels compared to paper wipers. For clean tasks where one or two paper wipers would be used instead of a cloth shop towel at five or 10 tasks per wash, paper produces more than 10 times more solid waste than cloth towels. For dirty tasks where two or three paper wipers would be used instead of a cloth shop towel at one or three tasks per wash, paper wipers produce 3.8 times more solid waste than cloth shop towels.

For all scenarios developed, using cloth shop towels produces significantly less solid waste than using paper wipers.

**Table 3 — Solid waste Impacts of Industrial wipers and towels per 1,000 equivalent uses**

<table>
<thead>
<tr>
<th>Industrial wipers and towels</th>
<th>Number used/task</th>
<th>Number of washes per task</th>
<th>Solid waste per 1,000 tasks (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper wipers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>11.47</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>22.94</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>34.41</td>
<td></td>
</tr>
<tr>
<td>Cloth shop towels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 task/wash)</td>
<td>1.00</td>
<td>14.6</td>
<td>8.93</td>
</tr>
<tr>
<td>(2 tasks/wash)</td>
<td>.33</td>
<td>14.6</td>
<td>3.57</td>
</tr>
<tr>
<td>(5 tasks/wash)</td>
<td>.20</td>
<td>14.6</td>
<td>2.32</td>
</tr>
<tr>
<td>(10 tasks/wash)</td>
<td>.10</td>
<td>14.6</td>
<td>1.15</td>
</tr>
</tbody>
</table>

Source: Lehrburger Mullen, 1992.

**Table 4 — Solid waste impacts of napkins per 1,000 equivalent uses**

<table>
<thead>
<tr>
<th>Napkins</th>
<th>Number used/task</th>
<th>Number of washes per task</th>
<th>Solid waste per 1,000 tasks (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper napkins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>15.98</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>32.16</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>47.95</td>
<td></td>
</tr>
<tr>
<td>Cloth napkins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>17.90</td>
<td></td>
</tr>
</tbody>
</table>

Source: Lehrburger Mullen, 1992.
able napkins for drying and wiping tasks in the food service sector.

Cloth napkins at one per task and 33 washes before being discarded produce about one-fifth the solid waste produced by paper napkins at one per task. If three paper napkins are used per task, paper products produce almost 15 times more solid waste per 1,000 equivalent tasks than reusables. At two paper napkins per task, paper produces almost 10 times more solid waste than cloth napkins. However, food service industry sources indicate three paper napkins per cloth equivalent is a more typical replacement figure.

Hospital gowns. Table 5 presents a comparison of solid waste generated by 1,000 equivalent uses of single-use and reusable hospital gowns for examination, isolation and surgical tasks in the medical and health care sector.

Cloth hospital gowns produce less solid waste per 1,000 equivalent uses than paper or nonwoven gowns. Paper examination gowns generate almost four times as much solid waste as cloth exam gowns. Nonwoven isolation gowns produce five times more solid waste than cloth gowns per 1,000 equivalent uses. Nonwoven surgical gowns generate almost six times more solid waste than 1,000 equivalent uses of cloth surgical gowns.

Not only do paper and nonwoven hos-
pital gowns produce more solid waste than cloth gowns, but the waste produced may often be classified as infectious or "red bag" waste, and is thus more costly and more difficult to discard properly. Reliance on cloth hospital gowns represents a simple and cost-effective way to reduce the quantity of potentially infectious hospital waste requiring disposal.

**Adult incontinence care products.**
Table 6 presents a comparison of solid waste generated by 1,000 equivalent uses of single-use and reusable adult incontinent diapers and bed pads in the medical and health care sectors. Infant diapers are not included.

Single-use adult incontinence diapers and pads generate over 75 times more solid waste than 1,000 equivalent uses of reusable cloth diapers and pads.

**Reuse and waste reduction**
There is near universal consensus that waste reduction and material reuse present the best opportunities for reducing the costs and environmental impacts of solid waste. By reducing the amount of wastes generated at the source, the costs of waste collection and transportation are reduced and resources otherwise allocated to production of materials that become waste (e.g., packaging) are conserved. For these and other reasons, reuse and reduction are preferred methods of waste management.

In spite of the failure of public policy to recognize and promote the benefits of waste reduction, many companies today are incorporating waste reduction, reuse and recycling practices into their corporate missions, goals and everyday activities.

For example, Red Lobster restaurants recently stopped using paper napkins, napkin rings and paper placemats, substituting linen napkins instead. Red Lobster estimates that this will eliminate 2,350 tons of paper from the waste stream each year.

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Table 5 — Solid waste impacts of hospital gowns per 1,000 equivalent uses

<table>
<thead>
<tr>
<th>Hospital gowns</th>
<th>Number used/task</th>
<th>Number of washes life</th>
<th>Solid waste per 1,000 task (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam gowns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper gown</td>
<td>1</td>
<td>0</td>
<td>82</td>
</tr>
<tr>
<td>Cloth gown</td>
<td>1</td>
<td>68</td>
<td>23.04</td>
</tr>
<tr>
<td>Isolation gowns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonwoven gown</td>
<td>1</td>
<td>0</td>
<td>128.3</td>
</tr>
<tr>
<td>Cloth gown</td>
<td>1</td>
<td>68</td>
<td>25.49</td>
</tr>
<tr>
<td>Surgical gowns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonwoven gown</td>
<td>1</td>
<td>0</td>
<td>164</td>
</tr>
<tr>
<td>Cloth gown</td>
<td>1</td>
<td>68</td>
<td>27.94</td>
</tr>
</tbody>
</table>

Source: Lehrburger Mullen, 1992.

Table 6 — Solid waste impacts of adult incontinence care products per 1,000 equivalent uses

<table>
<thead>
<tr>
<th>Adult incontinence care products</th>
<th>Number used/task</th>
<th>Number of washes life</th>
<th>Solid waste per 1,000 task (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-use diapers and pads</td>
<td>1</td>
<td>0</td>
<td>977.3</td>
</tr>
<tr>
<td>Reusable diapers and pads</td>
<td>1</td>
<td>76</td>
<td>12.36</td>
</tr>
</tbody>
</table>

Source: Lehrburger Mullen, 1992.

As greater attention focuses on burgeoning solid waste problems, reusable textiles are emerging as one readily available and simple solution. Large U.S. corporations that provide products and services in the hospitality, restaurant and industrial sectors now looking at strategies to curtail excessive waste should investigate greater reliance on reusable textile products as a preferred and effective alternative to wasteful single-use products.

Complete copies of this report may be obtained from Carl Lehrburger for $75 ($55 for nonprofits). For more information, write to Lehrburger Mullen, P.O. Box 998, Great Barrington, MA 01230. The authors can be reached at (413) 528-1325 for Carl Lehrburger and (719) 635-8939 for Jocelyn Mullen.

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