Current Status of Recycling in Textile Industry in Thailand

Virat Tandaechanurat & Naraporn Rungsimuntakul
Thailand Textile Institute
(THAILAND)

Introduction

Thai Government and industries have concerned about environmental protection and recycling. Ministry of Natural Resources and Environment plays a vital role. The Pollution Control Department and Department of Environmental Quality Promotion issue regulations and promote environmental issues. Department of Industrial Works takes action on the laws and regulations for industrial waste management and waste treatment. For private sector, Thailand Environment Institute (TEI) promotes researches and pursues environmental protection in both industry and household level. TEI has taken action on networking of recycling in the industry, and establishing Material Exchange Center for the industry. The Federation of Thai Industries promotes recycle industry by establishing Environmental Management Club for waste management in 2003. In future, this can be an opportunity for textile industry to use this channel in managing waste other than what they have already implemented.

Recycling in textile industry in Thailand

Thai textile industry is fully integrated industry for it consists of the whole textile manufacturing processes from the beginning to the end of the stream, i.e., fiber, yarn, fabric, dyeing, printing, finishing and garment manufacturing. Textile industry plays important role in the country economy. The gross domestic product (GDP) of textile industry is 145,859 millions bath in 2002 which is 12.29 % of the total industry GDP, and 4.5 % of the country GDP. There are 1,081,540 peoples employed in textile industry in 2003. This is 21.25 % of the total employment in manufacturing. The export value of total textile, apparel, garment, fabric, yarn and other products in 2004 is 14,302 millions US dollars. A huge amount of textile is produced each year. The production of textile is 3,137, 100 tons in 2004. This figure is the sum of 919,100 tons of synthetic fiber; 1,014, 800 tons of yarn; 741,900 tons of fabric and 461,300 tons of garments. It is very interesting to investigate what happens to these materials and manage the full use of them.

Thai textile manufactures have tried their best in utilizing their resources. They practice 3R principle (Reduce, Reuse and Recycle) on-site. They sell the portions that they cannot reuse or recycle in their plants to other small enterprises and merchants who buy waste fibers, yarns and pieces of fabric, stuff-up material and low quality non-woven. Some buyers export these waste fibers. The dyeing and finishing manufacturers reuse and recycle water and process chemicals. Twenty five percent of these plants implement cleaner technology (CT).

Recycling of Fiber

There are four types of synthetic fiber being produced in Thailand,
polyester, nylon, acrylic and rayon. Two types of waste are generated in the manufacturing: process chemicals and fiber wastes. Process chemicals such as glycol and caprolactam are mostly recycled. 77% of other chemicals such as sulfuric acid, zinc sulfate, carbon disulfide and hydrogen sulfide are recycled. Fiber wastes, which are normally less than 5% of the fiber produced, are recycled by two methods. First is the re-polymerization process. This method is done by one polyester plant in Thailand and accounted for 18% of the polyester fiber waste. The re-polymerized polyester has different properties from the virgin polyester; therefore it is used in other applications than regular apparels. For example, they are used as raw materials for automotive seat, non-woven and stuffing materials. Second, other waste fibers are sold and used as non-woven materials and stuffing materials for toys, mattress, pillow and cushion. Some waste fibers are export.

Recycling of Yarn

Waste from yarn processing is recycled in the plant. Comber waste, blow room waste and end of rope are beat and remix in the process. Carding waste and mixer waste are beat, separate and classified. Clean waste is used in open-end yarn spinning or as used as stuffing material. Dirty waste can be used as mushroom planting bed. Winding waste and warping waste are beat, separate and used to make non-woven for furniture pad and automotive trunk liner. It can also re-spinning to make low quality yarn for other applications, such as mopping materials.

Recycling in Bleaching, Dyeing, Printing and Finishing Industry

There are two main activities in this industry: cleaner technology (CT) and reuse of water. The Association of Thai Textile Bleaching, Dyeing, Printing and Finishing Industries (ATDP) has introduced CT to its members since 1992 and actively implemented it. They reduce process chemicals such as salts, wetting agents and dyes, and other process methods, such as automatic dosing and computing matching and control to reduce their waste. They also recycle process chemicals such as sodium hydroxide, PVA sizing agents and printing paste. Some processes and manufacturing methods can be changed or adapted for recycling, e.g., reverse osmosis for recycle PVA, reuse of pad-dye solution, etc. Approximately 100 plants from 414 plants have implemented CT. However, it is implemented at various levels due to understanding and commitment. It should be emphasized that the implementation of CT needs to be continued in order for its effectiveness. The other activity of ATDP is the reuse of water. The New Energy and Industrial Technology Development Organization (NEDO) have funded the project to promote the reuse of water since 2003. Three options of water reuse have been studied at bench scale in textile plants. These options consist of 1) reuse of treated wastewater, 2) membrane technology before wastewater treatment and 3) reuse of process water. The best option is option 2, membrane technology followed by reverse osmosis. It is made into pilot scale in May 2005, with the aim to expand to other dyeing plants.

Recycling of Fabric and Garment

Production waste from the beginning and the end of fabric roll are beat in order to separate the fibers and used in other applications, such as trunk liner, furniture pad and rugs. Cut-off fabrics from garment manufacturing are used in making cover and wiping for sewing machine. Small pieces of the cut-off fabric are donated to charity and jails. They are used as raw materials for rugs, lower grade fabric and stuffing materials. After these materials are handed down and used until they become rags, there
is no activity in recycling these used fibers.

Summary

Current status of recycling in textile industry in Thailand can be summarized below:
1. 18% of polyester waste is re-polymerized. The rest of fiber waste are reprocessed and used in other applications, such as non-woven and stuffing materials.
2. Raw materials, process chemicals, wastewater and used water are reused and recycled.
3. Yarn, fabric and garments are recycled in the plant. The waste that cannot be used in the plants are sold and used in other applications.
4. There is no recycle of the fiber from the used garment or apparels.

For future direction of recycled-based economy in textile, the improvement of production processes must be done. There are needs for developing recycle social system, raising public awareness and supporting from government in recycling.

Acknowledgements

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References

1. Thai Textile Statistics 2004, Textile Industry Division, the Department of Industrial Promotion
2. Information and Communication Technology Center with corporation of the Customs Department
3. The National Economic and Social Development Board, National Statistical Office
4. The Thai Garment Manufacturers Association
5. The Thai Synthetic Fiber Manufacturers’ Association
Current Status of Recycling in Textile Industry in Thailand

Virat Tandaechanurat
Executive Director

Naraporn Rungsimuntakul
Expert, Textile Testing Center

Thailand Textile Institute

June 25, 2005 Thailand Textile Institute
Structure of Textile Industry in Thailand

Up Stream Industry
- Petrochemical
  - Fiber Industry
    - Man-made fiber
    - Natural fiber
  - Spinning Industry
    - Weaving Industry
    - Knitting Industry
    - Dyeing, Printing and Finishing Industry
      - Garment Industry and Textile products
        - Consumer

Mid Stream Industry

Down Stream Industry

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Textile Industry

YARN Spinning

FIBER Melt-spun Wet spinning

FABRIC Weaving Knitting Non-woven

GARMENT Cut&Sew

DYEING Printing Finishing

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# Textile Production in Thailand (2000-2004)

(value: 1000 tons)

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIBER</td>
<td>747.6</td>
<td>754.4</td>
<td>826.3</td>
<td>816.8</td>
<td>919.1</td>
</tr>
<tr>
<td>YARN</td>
<td>838.8</td>
<td>888.2</td>
<td>976.4</td>
<td>977.9</td>
<td>1014.8</td>
</tr>
<tr>
<td>FABRIC</td>
<td>705.0</td>
<td>718.8</td>
<td>765.7</td>
<td>746.3</td>
<td>741.9</td>
</tr>
<tr>
<td>GARMENT</td>
<td>441.4</td>
<td>446.6</td>
<td>457.8</td>
<td>455.2</td>
<td>461.3</td>
</tr>
</tbody>
</table>

Source: Textile Industry Division, Department of Industrial Promotion

June 25, 2005  Thailand Textile Institute

Source: Textile Industry Division, Department of Industrial Promotion
# Thailand’s Textile Exports 2003-2005

(value: US$ million)

<table>
<thead>
<tr>
<th>Items</th>
<th>Export Value</th>
<th>Growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textile &amp; apparel</td>
<td>5,467</td>
<td>6,402</td>
</tr>
<tr>
<td>Garment</td>
<td>2,762</td>
<td>3,092</td>
</tr>
<tr>
<td>Fabric</td>
<td>875</td>
<td>1,035</td>
</tr>
<tr>
<td>Yarn</td>
<td>540</td>
<td>681</td>
</tr>
<tr>
<td>Others</td>
<td>2,762</td>
<td>3,092</td>
</tr>
</tbody>
</table>

Source: Information & Communication Technology Center, Customs Department
## Thailand’s Textile Imports 2003-2005

(value: US$ million)

<table>
<thead>
<tr>
<th>Items</th>
<th>Export Value</th>
<th>Growth rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textile&amp; apparel</td>
<td>2,824</td>
<td>3,136</td>
</tr>
<tr>
<td>Fabric</td>
<td>1,095</td>
<td>1,225</td>
</tr>
<tr>
<td>Yarn</td>
<td>1,100</td>
<td>1,220</td>
</tr>
<tr>
<td>Others</td>
<td>629</td>
<td>691</td>
</tr>
</tbody>
</table>

Source: Information & Communication Technology Center, Customs Department
EMPLOYMENT IN TEXTILE INDUSTRY 2003

Garment  840,460 (16.51%)
Textile   241,080 (4.74%)
Others  4,008,860 (78.75%)

Total Employment in Manufacturing  5,090,400

Source: The Thai Garment Manufacturers Association
### The Role of Textile Subsector in Thai Economy

*(value: million Baht)*

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gross domestic product, GDP (Growth Rate)</td>
<td>3,008,662 (4.8)</td>
<td>3,072,925 (2.1)</td>
<td>3,239,030p (5.4)</td>
<td>3,457,384p1 (6.7)</td>
</tr>
<tr>
<td>2. GDP in manufacturing sector</td>
<td>1,095,968 (6.1)</td>
<td>1,111,047 (1.4)</td>
<td>1,186,998p (6.8)</td>
<td>na. -</td>
</tr>
<tr>
<td>3. GDP in textile sub-sector</td>
<td>146,223 (2.2)</td>
<td>144,641 (-1.1)</td>
<td>145,859p (0.9)</td>
<td>na. -</td>
</tr>
<tr>
<td>4. Total exports</td>
<td>2,768,065 (25.0)</td>
<td>2,884,703 (4.2)</td>
<td>2,952,067 (2.3)</td>
<td>3,333,929 (12.9)</td>
</tr>
<tr>
<td>5. Textile and clothing exports</td>
<td>223,512 (14.4)</td>
<td>235,044 (5.2)</td>
<td>220,962 (-6.0)</td>
<td>226,642 (2.6)</td>
</tr>
</tbody>
</table>

P: Preliminary base on annual figure; P1 : Without annual figure

Source: The National Economic and Social Development Board, National Statistical Office and TESRG
GDP of Textile & Clothing Industry in Thai Economy, 2001

GDP Total (Country) 5,123,418 Million Baht
GDP Total (Industry) 1,638,771 Million Baht
Ratio of GDP (Textile) : GDP (Country) = 5.21%

GDP of Textile & Clothing Industry in Thai Economy, 2001:
266,999 Million Baht (19.46%)

GDP of others industry:
1,371,772 Million Baht

Source: NESDB

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GDP of Textile & Clothing Industry in Thai Economy, 2002

GDP Total (Country) 3,239,030 Million Baht
GDP Total (Industry) 1,186,998 Million Baht

Ratio of GDP (Textile) : GDP (Country) = 4.50%
Ratio of GDP (Textile) : GDP (Industry) = 12.29%

GDP of Textile & Clothing 145,895 Million Baht
GDP of others industry 1,041,103 Million Baht

Source: NESDB
# SYNTHETIC FIBER PRODUCTION CAPACITY IN THAILAND 2004

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Polyester</td>
<td>898,700 tons</td>
</tr>
<tr>
<td>2. Nylon</td>
<td>62,600 tons</td>
</tr>
<tr>
<td>3. Acrylic</td>
<td>77,000 tons</td>
</tr>
<tr>
<td>4. Rayon</td>
<td>65,000 tons</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,103,300 tons</strong></td>
</tr>
</tbody>
</table>

Source: The Thai Synthetic Fiber Manufacturers’ Association

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Recycling in Textile Industry in Thailand

- Process chemicals & raw materials - Recycle
- Production waste - Mostly Recycle
- Consumer - Reuse

First Hand

- Donation
- Second Hand

- Rag

- No recycle of fibers from the used garments
Recycling of Polyester

- Process chemicals such as glycol
- Solid waste (fiber) must be less than 5%
  - 18% of the waste were recycled by re-polymerization process (by one mill)
    - Uses: Non-woven,
      - Fiber-fill /Stuffing
      - Automobile cushion/ floor liner
  - 82% of the waste were recycled by other applications, such as - stuffing for toy, pillow, mattress, etc.
Recycling of Nylon

1. Recycle of process chemicals such as Lactam Direct Recovery (LDR)

2. Recycle of solid waste (fiber, filament)
   - Stuffing
   - Cushion
   - Re-melt as lower grade
   - Export
Recycling of Rayon Fiber

1. Recycle/Reuse of process chemicals, such as sulfuric acid, zinc sulfate, carbon disulfide, hydrogen sulfide
   - 77 % of process chemicals can be recycled.

2. Solid waste (fiber) are recycled by using in other applications:
   - Nonwoven
   - Stuffing for toys, mattress, pillow, etc.
   - Cushion
   - Others
Recycling of Yarn

Production Waste:

- Recycle in the plant
- Recycle (re-spinning & reprocess) and use in other applications
Recycling of Yarn

1. Intermediate products used by spinning mill:

Comber waste – Remix for OE spinning
Blow room waste – Remix at mixing room
End of rope – Beat & mix at mixing room
Recycling of Yarn

2. Waste sold for other applications:

Carding waste and mixer waste:

- Beat, separate fiber and classify
- Clean waste - OE spinning, stuffing
- Dirty waste - Mushroom planting bed.
Recycling of Yarn

2. Waste sold for other applications:

Winding waste and warping waste
Beat and separate fiber

Uses: Other spinning system and applications:
- Mopping materials
- Furniture pad
- Automobile floor liner, trunk liner
Recycling of Fabric

Production waste from the beginning and end of fabric roll:
Beating to separate fiber and use in other application such as:
- Automobile floor liner, trunk liner
- Nonwoven pad, furniture pad
- Low price fabric/garment
- Rug
Recycling of Garment

Cut-off fabrics:

Big pieces – Cover for sewing machine
- Wiping for sewing machine

Small pieces – Donation to charity, jail and use as stuffing, lower grade fabric, rug, etc.
Recycling in Dyeing, Printing & Finishing Industry

2 Main Activities:

1. Water Reuse Promotion Center (WRPC) aided by NEDO

2. Cleaner Technology (CT)
Water Reuse Promotion Center (WRPC)

- Project aided by NEDO for Thailand 2003
- Implement by Department of Industrial Work (DIW) and Department of Industrial Promotion (DIP)
- For waste water reuse in food industry and textile industry
Current Status of Recycling in Textile Industry in Thailand

WRPC for Dyeing, Printing, Finishing Industry

3 Options of Studies:

1. Reuse of Treated Waste Water → Bench Scale Plant (MF+RO)
2. Membrane Technology before waste treatment → Bench Scale Plant (MBR+RO)
3. Reuse of Process Water → Bench Scale Plant (UF+RO)

MF = Micro Filtration
RO = Reverse Osmosis
MBR = Membrane Bio Reactor
UF = Ultra Filtration
Current Status of Recycling in Textile Industry in Thailand

- Option 2 (MBR + RO) yields the best result
- Bench Scale Plant → Pilot Plant  May 2005
  - 10 m³/day → 100 m³/day
- Waste water → MBR → RO → Boiler
- Will be promoted to Dyeing, Printing & Finishing Industry

Source: Textile Industry Division, Department of Industrial Promotion
Recycle in Dyeing, Printing & Finishing Industry

The Association of Thai Textile Bleaching Dyeing Printing and Finishing Industries (ATDP) has introduced Cleaner Technology (CT) to members since 1992 and activity implemented.

<table>
<thead>
<tr>
<th>CT Principles</th>
<th>Water</th>
<th>Energy</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce</td>
<td>♦</td>
<td>♦</td>
<td>●</td>
</tr>
<tr>
<td>Reuse</td>
<td>▲</td>
<td>▲</td>
<td>❌</td>
</tr>
<tr>
<td>Recycle</td>
<td>▲</td>
<td>▲ or X</td>
<td>❌</td>
</tr>
<tr>
<td>Avoid</td>
<td>❌</td>
<td>▲ or X</td>
<td>♦ or ●</td>
</tr>
</tbody>
</table>

◆ = Can implement  ○ = Possible  ▲ = Very difficult
X = Cannot implement

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CT option:

1. Reduce

**Processing Chemicals**
- salts
- wetting agents
- dyes

**Process/Manufacturing Method**
- Automatic dosing
- Computer matching/control

Source: Textile Industry Division, Department of Industrial Promotion
CT option:

2. Recycle/Reuse

Processing Chemicals

- Sodium hydroxide
- PVA (sizing agent)
- Printing paste

Source: Textile Industry Division, Department of Industrial Promotion
CT option:

2. Recycle/Reuse (cont.)

**Process/Manufacturing Method**

- Reverse Osmosis equipment for recycle PVA
- Reuse of pad-dye solution
- Finishing chemical
- Reuse of final rinse water
- Recycle of used water by membrane
- Reuse of cooling water
- Condensate recovery

Source: Textile Industry Division, Department of Industrial Promotion
CT option:

Summary of Status:

- Approx. 100 plants from 414 plants implement CT
- Various levels of implementation due to understanding and commitment
- Need to continue

Source: Textile Industry Division, Department of Industrial Promotion
Summary

Current Status of Recycling in Textile Industry in Thailand

1. Recycle of Fiber Production Waste
   - Repolymerization 18% (polyester only)
   - Reprocess and other applications 82%

2. Recycle of Chemicals
   - Reuse/Recycle of raw materials, such as glycol (polyester), caprolactam (nylon 6)
   - Reuse/Recycle of processing chemicals: salts, wetting agent, dyes, printing paste
Summary

Current Status of Recycling in Textile Industry in Thailand

3. Recycle/Reuse of water (waste, used)

4. Recycle/Reuse of yarn/fabric and garment
   - Recycle in the plant
   - Lower quality fabric, products
   - Other applications: nonwoven, stuffing, liner

5. No recycle of used fiber from garment
THANK YOU
FOR YOUR KIND ATTENTION

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