Green Chemistry progression towards sustainable textiles: A Historical Perspective

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Textiles and Chemicals

• The Textile Industry and Chemical Industry have been linked together since the beginning of the Industrial Revolution

**Indigo**
1878

**Mauveine**
1856
US Chemical Industry

- $720 billion: Chemicals are one of America’s largest industries, a $720 billion enterprise.
- 784,000: The business of chemistry employs 784,000 people nationwide.
- Vital: The chemical products manufactured are an essential part of every facet of our nation’s economy. Over 96% of all manufactured goods are directly touched by the business of chemistry.
- 10% of all USA exports are from the Chemical Industry
- Without the chemical industry, there could be no modern textile industry
Impacts of a Global Textile Industry

• Textiles and Apparel sector of the global economy represents 3% of all merchandise trade.
• 10% of Global Carbon Output is textile related
• 20% of global water pollution is textile related
• 68 lbs of clothing per person is discarded to landfill in USA each year
• This represents 5% of US landfill capacity
It is estimated that over 5,000 unique compounds are used in the production of textile and apparel products.
"LIMITS TO SUCCESS" AND THE SUSTAINABILITY CHALLENGE

Developed Economy
Revenues, Economic Growth
Industrial Productivity
Waste Generation
Human Health and Prosperity
Despair, Death, Disease
Toxicity of Air, Soil, Water
Dispersion of Waste
Human Tolerance for Toxicity

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In the Global North

• Policy drives regulations enforcing water quality criteria. Example is the USA Clean Water Act (1972)
  – First actions were building effective Wastewater treatment facilities.
  – Second actions were pollution prevention and toxics reduction via process redesign.
  – Third actions are using LCA data to redesign materials and products.
  – Fourth actions may be the redesign of commerce.
Regulation Path & Societal Response

- NPDES
- Clean Air Act
- Clean Water Act
- TSCA
- APEO
- German Ban On Azo dyes
- Whole Effluent Toxicity
- EU Detergent Law
- Responsible Care
- DfE Green Chemistry
- Green Seal
- Life Cycle Integration
- CPSIA
- Elimination of Toxics


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Substances which may be harmful to health:

- Polycyclic aromatic hydrocarbons (PAH)
- Tin-organic compounds (TBT, DBT, TPhT, DOT)
- Allergy-inducing dispersion dyes
- Pesticides
- Chlorinated benzenes and toluenes
- Low emission of volatile components

Legally banned and controlled substances:

- Azo-dyes
- Carcinogenic dyes
- Pentachlorophenol
- Formaldehyde
- Phthalates
- PFOS and PFOA
- Heavy metals (Nickel, Chrome)
- Cadmium or lead total contents
- Banned flame retardant products

Biologically active and flame-retardant substances:

- Chlorinated phenols – TeCP

Product quality:

- Acceptable pH-value
- Good colourfastness
The textile world speaks OEKO-TEX®
Chemicals Management Framework

• Textile Life Cycle Scope
Oeko-Tex Standard 1000

• A Comprehensive Textile Standard - Social, Ecological and Product/Process Stewardship
• The only environmental certification system that is especially tailored to the textile and clothing industry
Oeko-Tex Standard 1000

• Allows for a comprehensive assessment of an operation's environmental and social performance
  – as compared to other environmental management systems which only partially cover the relevant areas

• Full recognition of other management systems, including ISO 9000, ISO 14000, EMAS
Index Prototype Approach

- **Employs lifecycle-based approach**
  - Accounts for product impacts up and down the supply chain
  - Useful and educational organizational structure within the Prototype

### Materials
- Packaging
- Manufacturing
- Transportation
- Use & Service
- End of Life

1. **Brand**
   - Complete once per brand
   - Contains brand-level (e.g., “product policy”) applicable to all apparel products for that brand

2. **Product**
   - Complete once per product/garment
   - Contains product-level decisions and practices specific to a garment

3. **Supplier Facility**
   - Complete once per facility
   - Contains facility-level practices not specific to a product/garment
   - Completed by supplier

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