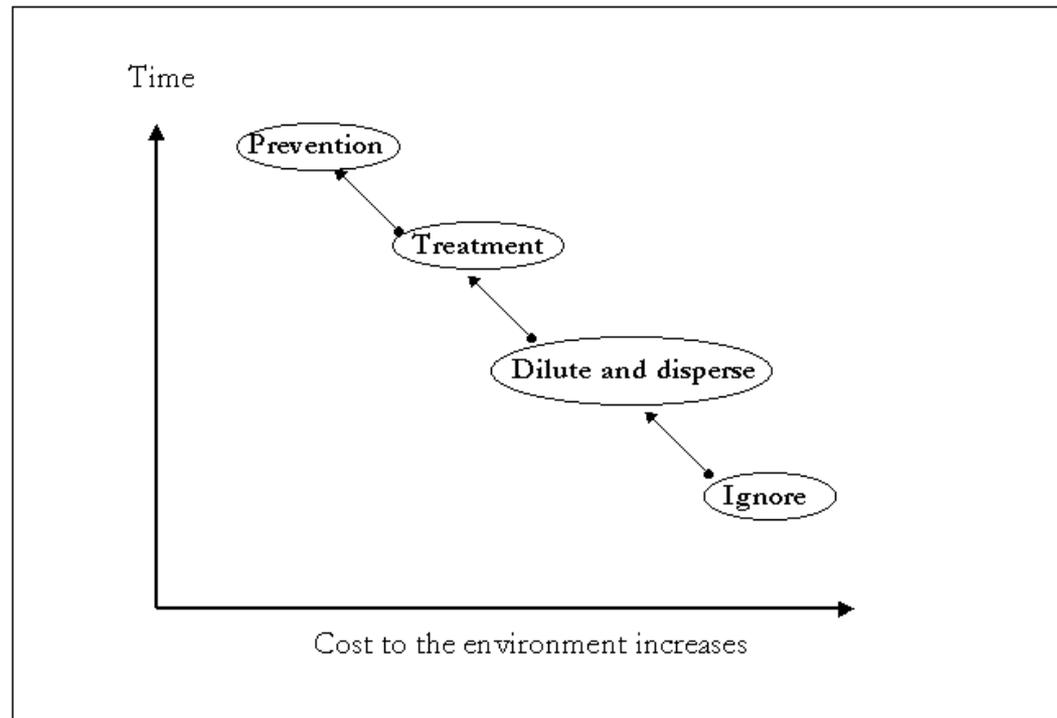


Potential of 3R in Industrial Wastes

Ijaz Hossain
BUET

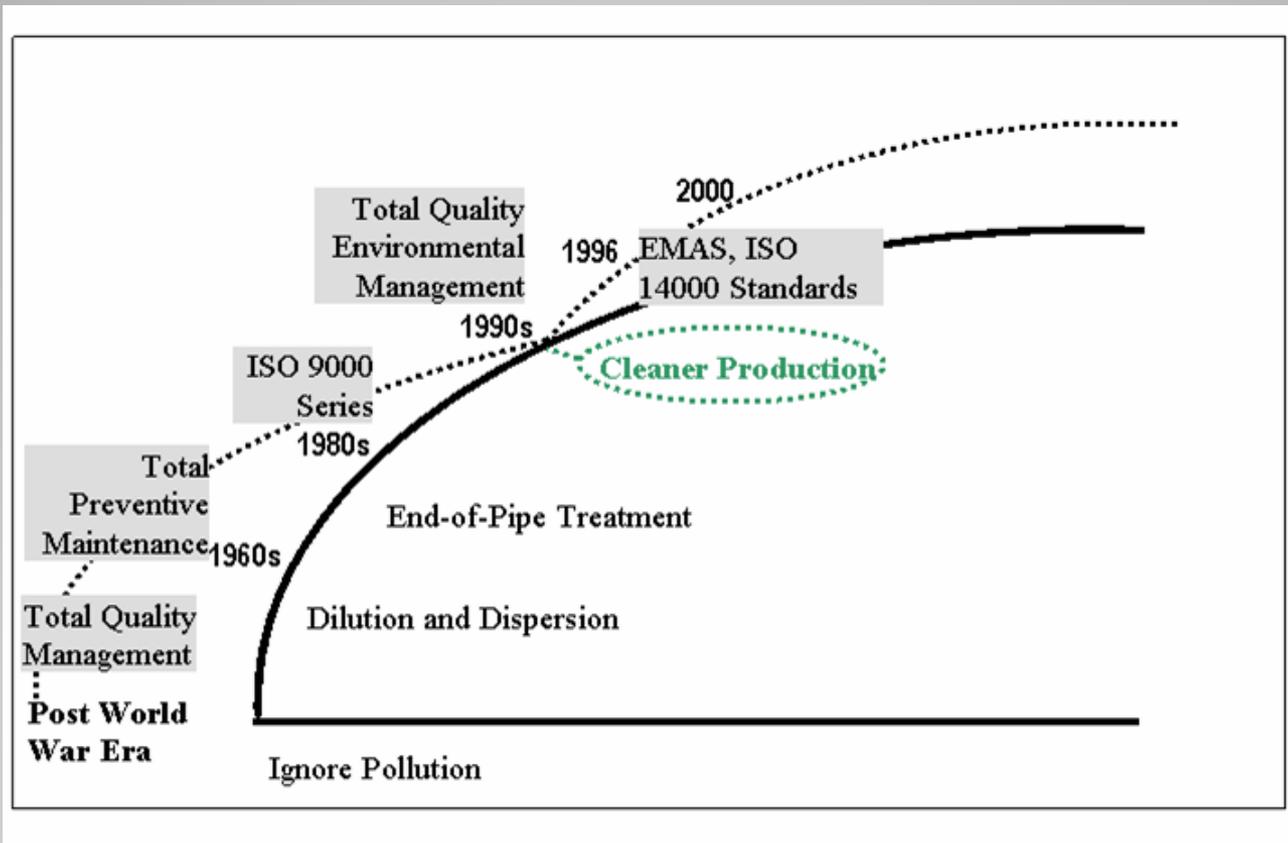
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Response of Industries to Environmental Pollution



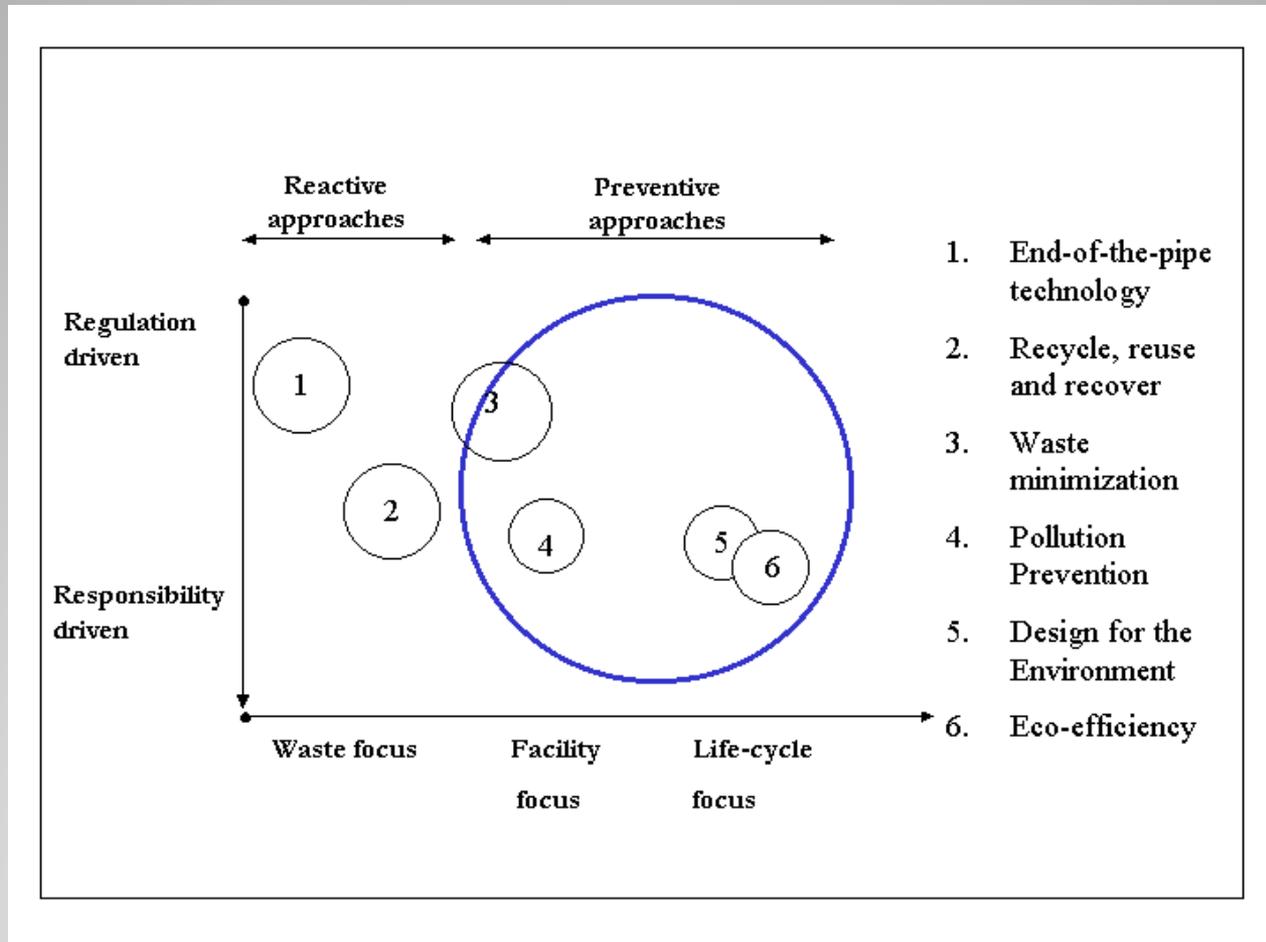
Source: UNIDO/UNEP

Tracking the Influence of Quality Programmes on Productivity



Source: UNIDO/UNEP

Similar-Sounding Concepts^[1]



Source: UNIDO/UNEP

[1] Modified from: Berkel, R. Van & J.V.D. Meer (1997), Training Course for Future Trainers on Environmentally Sound Technology Transfer. IVAM Environmental Research, University of Amsterdam.

Common Characteristics of Developing Country Industries

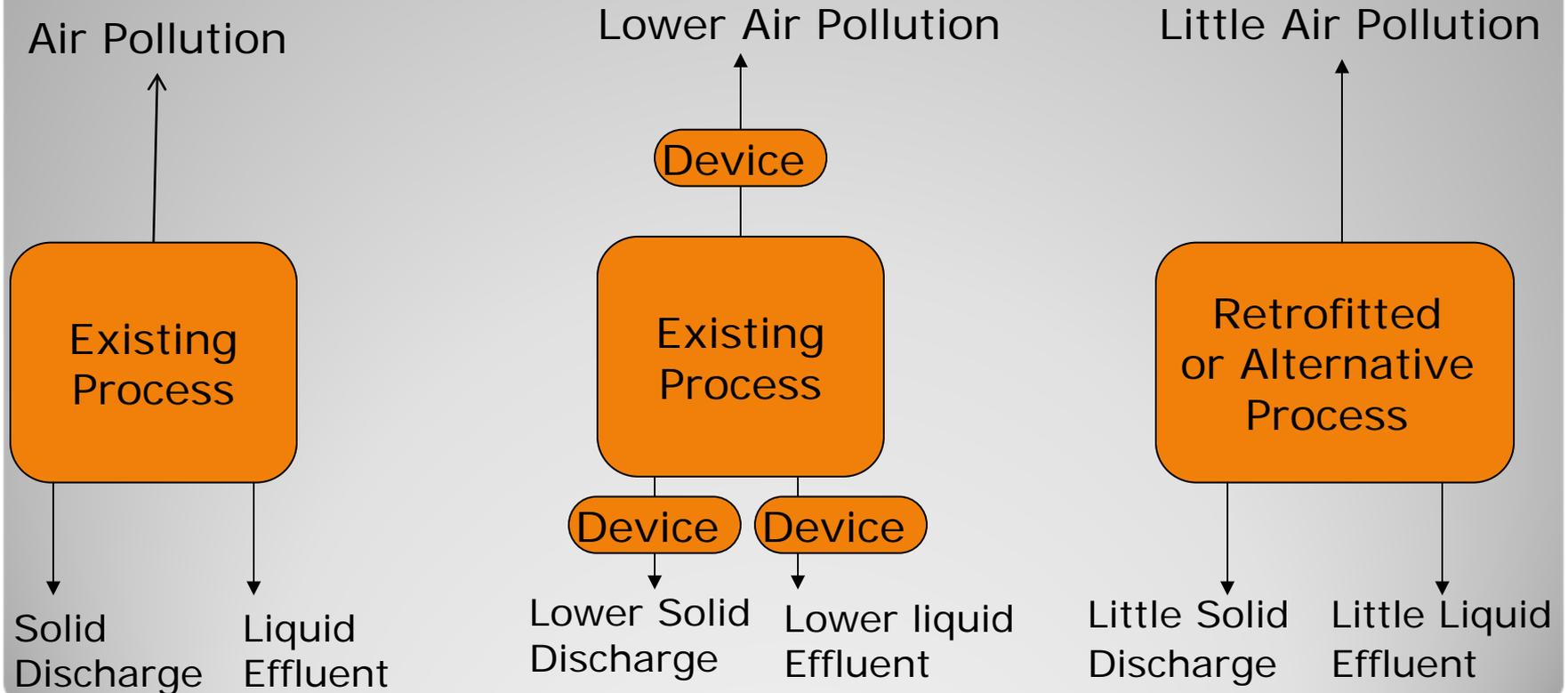
- Utilities (electricity, gas and water) are priced below cost
- Environmental regulation compliance low; in some cases standards too lax
- Usually discharge fees do not exist (e.g. wastewater discharge fee)
- No incentives for efficient devices; sometimes these are taxed more

How Standards assist 3R

No Standards

Standards

Tighter Standards



End-of-Pipe Solution

3R Solution

3-R Options for Industries

- **Waste Audit & Housekeeping**
- **Change raw materials**
- **Existing Process modification**
- **Processes that produce less wastes**
- **Product Design: for less wastes**

Six-step 3R implementation in Industry?

1. Meet all environmental standards set by the government
2. Perform a material, energy and water **Audit**
3. Establish an Environmental Management System (**EMS**)
4. Get ISO 9001 and **ISO 14001** certification
5. Look for superior solutions to waste minimization, and use Life-Cycle-Analysis [**LCA**] to choose appropriate solution
6. Strive for **ZERO EMISSION** through the concept of industrial ecology

3R and Industrial Wastes

Fundamental concept is

SOURCE REDUCTION

Prevent the creation of the waste by:

1. Using a better process and plant
2. Using high quality raw materials
3. Cleaner operation and maintenance

EXAMPLES OF SOURCE REDUCTION

Textile (use of less dye)

Increase fixation levels for reactive dyes (better process)

Use appropriate recipe and follow recipe properly (better process)

Coal Fired Boiler (less ash)

Use low ash coal (better raw material)

Glass and Ceramics (less breakage)

Use of better sand and chemicals (better raw materials)

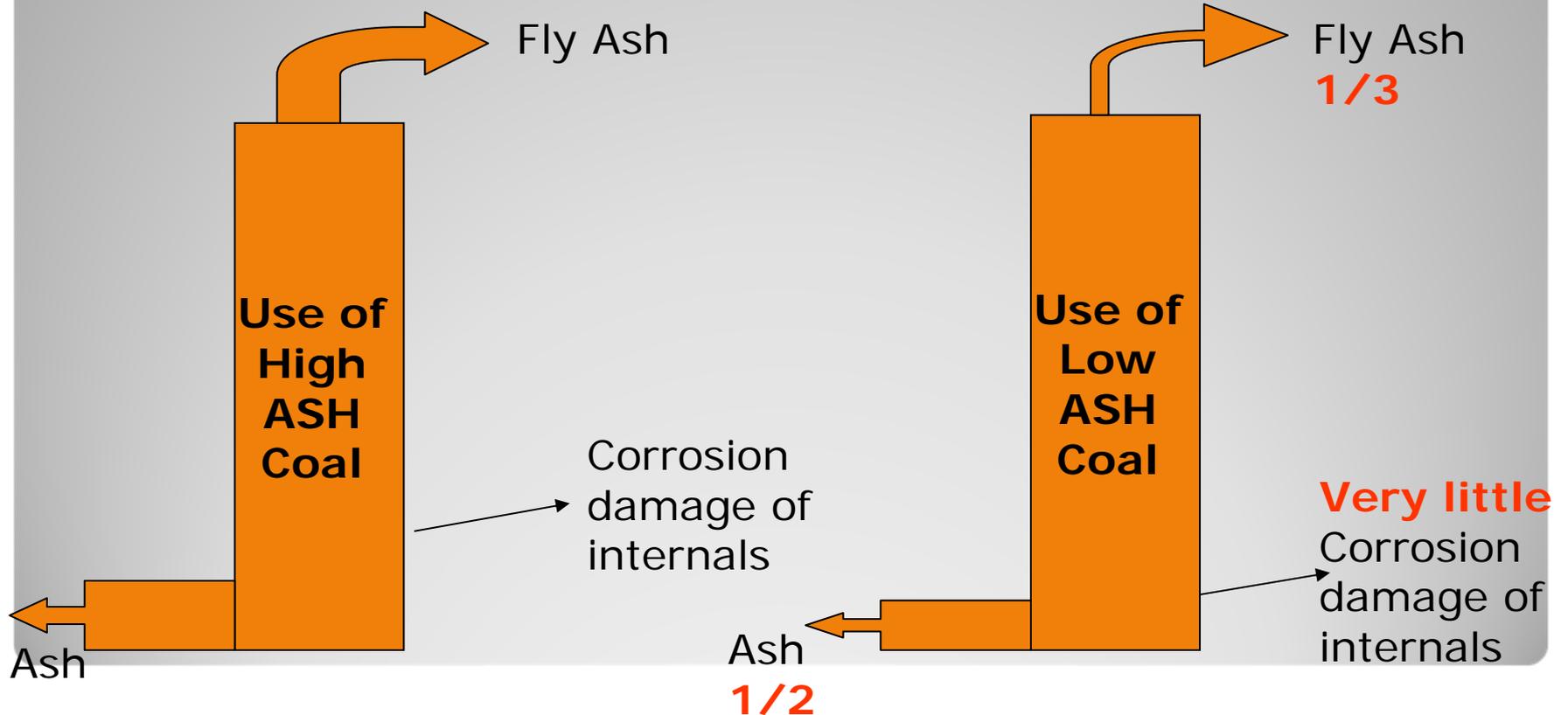
Use of high quality annealing chamber (better process and plant)

Instrumentation and control (better plant and operation)

Reducing wastes through the use of higher quality coal

High Ash Coal = \$50/t

Low Ash Coal = \$75/t



Typical industries in developing countries

- Textile dyeing plants
- Leather tanning factories
- Fertilizer plants (Urea, TSP and DAP)
- Ceramic industries
- Pulp and paper mills
- Sugar, food and allied industries

More than 90% of the non-recycled wastes come from these

Pollution from Dyeing Plants



SEI Study of Kaliakoir Cluster

- Skin problems may for example be related to the high pH of the water, which has been found to be as high as pH 10.9 in some places in the khal (Chadwick and Clemett, 2003).
- Such alkaline conditions could certainly irritate the skin and result in sores.
- The high pH levels are likely to be the result of the large quantities of caustic soda and soda ash used in the dyeing process to achieve a pH of between pH 10.5 and pH 11.5.

OTHER PROBLEMS: High BOD/COD kills aquatic life

Textile Dyeing: 2 Basic Approaches

- REACTIVE – End-of-pipe treatment (ETP)

- Dilution
- Flocculation
- Activated Sludge
- Membrane Separation



Cost Increases

- PREVENTIVE – Cleaner Production / 3R

- Auditing and Housekeeping
- Better Processes
- Product Design (industrial ecology)

Alternative Production and Cost Savings in Winch Dyeing



Samiya Ahmed
Alexandra Clemett
Matthew Clark
Kelvin Tapley



Cost Savings from Alternative Production

1.1 Improved Fixation

Fixation levels for reactive dyes, when doing deep dyeings, can be as high as 70%. Tests in several factories in Bangladesh, have shown that currently fixation ranges from 40-65%, some 5-30% below the possible maximum.

1.2 Right First Time

Further savings can be made by ensuring that the recipe is carefully developed to suit the dye type being used (see Chapter 2) and that the recipe is accurately followed on the factory floor. Research in factories in Bangladesh suggests that errors due to incorrect recipes or not following the recipe could result in around 20% of fabric being re-shaded and around 10% being re-bleached and re-dyed. If this is the case then it is possible to make yet more savings by improving the number of “right first time” dyeings.

Housekeeping

- 4.1 Storage
- 4.2 Handling of Chemicals
- 4.3 Liquor Ratio
- 4.4 pH Control
- 4.5 Temperature Control

Summary

Improving efficiency and saving money in textile dyeing need not be expensive. Simple changes to procedures and housekeeping can save considerable amounts of money. Taking the time to observe process inefficiencies, calculate financial losses from these inefficiencies and make plans to correct them can do a lot to improve the competitiveness of a factory. It will also reduce pollution.

Recycling of Industrial Wastes

- ❑ Some types of waste [glass/plastic/paper] can be easily recycled, and are being recycled
- ❑ With some minor treatment, waste of one industry can become the raw material for another industry [gypsum/fly ash]
- ❑ Wastes can be reprocessed in the factory to produce products that can be sold [fluorine] or reused in the same process [chromium]
- ❑ Sent (or sold) to recyclers [spent catalyst]

EU – Industrial Water Guidelines

1. Changes in processes leading to less water demand
2. Higher recycling rates
3. The use of rainwater

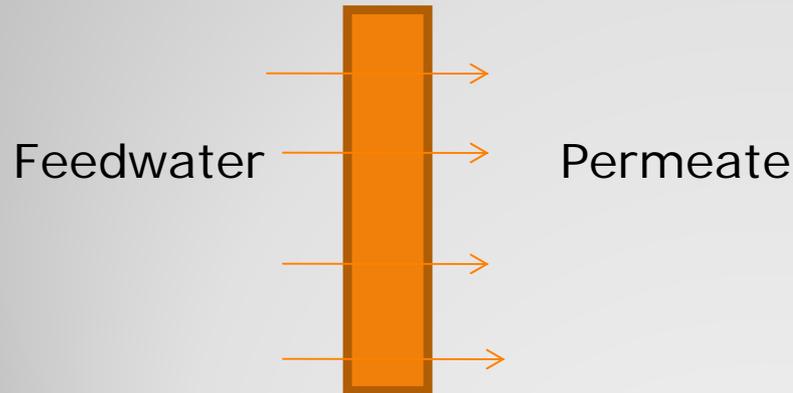
These measures can lead to estimated savings of between 15 and 90% with an global estimate up to 43% of today's water abstraction.

Water Recycling in Textile Industry

- The **TEXTILE INDUSTRY** is very water intensive. Water is used for cleaning the raw material and for many flushing steps (e.g., scouring, desizing, dyeing, washing, etc.) during the whole production.
- Produced waste water has to be cleaned from fat, oil, color and other chemicals.
- **Membrane Filtration** would be a preferable option compared to other wastewater treatment techniques because of the constant quality of effluent, that is partly or almost completely softened and free of color and surfactants.

Types of Membranes

Process	Particles Separated	Size
Microfiltration	Macromolecules	> 100 nm
Ultrafiltration	Molecules	> 10 nm
Nanofiltration	Small Molecules	> 1 nm
Reverse Osmosis	Ions	Smaller than 1 nm



Achieving a balance between selectivity and productivity is the key

Water Reduction in Chemical Industry

Some Common Options:

- condensate recovery and recycling as boiler feedwater and as process water
- replacement of once-through cooling water systems with recirculating systems
- recovery of filter wash water for process use
- recovery of process water of plant washing
- local effluent treatment facilities to recover high quality water

Leather Tanning

- ❖ Significant industrial activity in most developing countries; some countries also import raw hides
- ❖ Highly polluting (solid, liquid, gaseous)
- ❖ Produces huge quantities of organic wastes (BOD), which can be used in a biogas digester to produce energy



Children crossing dangerous wastewater



- ❖ Produces wastes containing chromium, which can be recovered both from **chrome shaving** and tanning wastewater
- ❖ Produces significant H_2S pollution in the 1-2 km radius

Children playing with chrome shavings

TSP Fertilizer

- The typical rock phosphate based plant is standard
- Produces huge quantities of gypsum waste
- Produces fluorine, which is vented
- Gypsum can be utilized, and fluorine can be recovered
- Alternative process exists
- Imported phosphoric acid is an option to minimize pollution

CERAMIC AND TILES

- Broken ceramic objects and tiles in factories are difficult to dispose being heavy and bulky
- Many industries dump these on surrounding low lying land
- Ceramics and tiles do not degrade causing severe nuisance in these unauthorized dumps
- Can be recycled by crushing, but is expensive. Therefore, industries do not want to do it
- Government enforcement of solids disposal regulation can easily solve the problem

Bangladeshi Industries that have benefitted from EMS

Indicator	Bengal Pacific (Pvt.) Ltd.	Bengal Plastic Industries Ltd.	Arbab Poly Pack Ltd.
Savings per year	\$44,000	\$26,000	\$44,000
Water consumption reduction	10.3 (%)	5.2 (%)	29.6 (%)
Power consumption reduction	4.6 (%)	10.8 (%)	1.0 (%)
Material wastage minimization	12.6 (%)	30.5 (%)	14.2 (%)
Chemical wastage reduction	20.0 (%)	1.0 (%)	8.9 (%)
GHGs reduction	29.5 (%)	1.7 (%)	2.7 (%)
Water treatment plant load reduction	Significant	Significant	Significant
Incinerator load reduction	N/A	N/A	9.1 (%)
Risk minimization	Significant	Significant	Significant

Awareness barriers

- 3-R is a new concept – awareness low
- Waste minimization, energy efficiency and pollution prevention are looked upon by industrialists as financial burden
- Positive aspects of 3-R, i.e., that it can increase productivity and save costs is not known to most industrialists
- Culture of CSR is in a nascent state in most developing countries

GOVERNMENT'S ROLE - I

- Pollution control authorities remain focused on end-of-pipe regulatory type approach
- 3-R cannot gain much ground without a proactive role of government
- It is important for pollution control authorities to realize that promotion of 3R makes pollution control more manageable

GOVERNMENT'S ROLE – II

- Both incentive and penalty based regulatory approach is needed to promote 3R in industries
- Government owned banks and loan agencies should fund 3R initiatives
- Policy and regulatory support (making polluters pay, rationalization of energy and water prices, incentives for efficient processes) needed to promote 3R

How can 3-R be funded ?

- For Win-Win options, awareness barrier need to be removed only, because industries can fund these themselves
- For marginal options, bank finance is important. Developing countries' banks do not understand 3-R type projects
- For non-bankable projects (i.e., $IRR < MARR$), CDM financing can be tapped

Thank You