Waste Water Treatment Technologies and Practices in Indian Pulp and Paper Industries

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## Indian Paper Industry – A Brief

<table>
<thead>
<tr>
<th>Number of Mills</th>
<th>850 +</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure (operational mills ~ 600 mills)</strong></td>
<td></td>
</tr>
<tr>
<td>Small Scale (&lt; 50 tpd)</td>
<td>~ 250</td>
</tr>
<tr>
<td>Medium Scale (50-100 tpd)</td>
<td>~ 150</td>
</tr>
<tr>
<td>Large Scale (Above 100 -1200 tpd)</td>
<td>~ 200</td>
</tr>
<tr>
<td><strong>Total Installed Capacity (MMT)</strong></td>
<td>25.00</td>
</tr>
<tr>
<td><strong>Operating Installed Capacity (MMT)</strong></td>
<td>21.50</td>
</tr>
<tr>
<td><strong>Production of paper, board &amp; newsprint (MTPA)</strong></td>
<td>17.33</td>
</tr>
<tr>
<td><strong>Consumption of paper, board &amp; newsprint (MTPA)</strong></td>
<td>19.35</td>
</tr>
<tr>
<td><strong>Per capita consumption (KG)</strong></td>
<td>13.2</td>
</tr>
<tr>
<td><strong>Export (MMT)</strong></td>
<td></td>
</tr>
<tr>
<td>Paper &amp; Paper Board</td>
<td>0.97</td>
</tr>
<tr>
<td>Newsprint</td>
<td>-</td>
</tr>
<tr>
<td><strong>Import (MMT)</strong></td>
<td></td>
</tr>
<tr>
<td>Paper &amp; Paper Board</td>
<td>1.48</td>
</tr>
<tr>
<td>Newsprint</td>
<td>1.50</td>
</tr>
</tbody>
</table>

*Ref: CPPRI Survey*
Indian Paper Industry

Diverse Raw materials
- 15+ species of Wood
- Non-Woods: Bagasse, Rice Straw, Wheat Straw, Grasses/Reeds
- Waste Papers: White, Brown and Mixed
- Market Pulps

Diverse Processes
- Mechanical Pulping
- Chemical Pulping – Kraft Process generally for wood pulping
- Chemical Pulping – Soda Process generally for Agro pulping
- Recycled Fibre (RCF) Process – with or without De-Inking

Diverse Products
- Packaging Papers & Coated/Uncoated Paperboards
- Coated/Uncoated Printing & Writing Papers
- Newsprint & Magazine Papers
- Tissues & Hygiene Papers
- Specialty Papers
Technological Issues

- Mostly Second Hand
- Not Designed for Processing Mixed Raw material
- Non availability of sufficient raw material
- High Capital Investment due to imported origin

Obsolescence in technology

Limited scale of operation

Restricts Adoption of State of Art Technology

Becomes uncompetitive in global market

Environmental Impacts

- High effluent load
- High Colour in effluent
- High level of COD, BOD & AOX
- Black liquor management (agro based)
- High resource consumption
- High cost of basic inputs
Technological Issues

- Low cost of water
- Lack of optimum performance of pulp washers.
- Carrying out of most operations at high dilution.
- Lack of water audit / water balance / assessment of optimum water requirement
- Lack of optimization of washer requirement on decker, pulp washers & paper m/c
- Lack of fiber recovery units or low performance of existing fiber recovery units
- Lack of adequate ETP facilities
- Mental block in reuse / recycle of treated effluent / back water
- Lack of awareness, trained manpower and monitoring facilities
ETP in Indian Paper Industry

Effluent Treatment Process Employed in Indian Paper Industry

**Aerobic**
For Treatment of Combined Effluent

**Anaerobic**
For Pretreatment of High Strength Agro residues Raw Material Washings and Pre-hydrolysis Liquor

**Tertiary**
Polishing the Quality of Treated Effluent and meet Stringent Norms in Ganga River Basin
- Chemical Treatment
- Physical treatment: Sand Filter, Dual Media Filter, Activated carbon Filter
# Major Regulatory Agencies in India

National Level: Central Pollution Control Board;  
State level: State Pollution Control Boards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>General Standards</th>
<th>CPCB – Pulp &amp; Paper Mills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Small Scale</td>
</tr>
<tr>
<td>Volume, m³/t</td>
<td>-</td>
<td>Agro based</td>
</tr>
<tr>
<td></td>
<td></td>
<td>:200 (150)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waste Paper:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 (inland discharge)</td>
</tr>
<tr>
<td>pH</td>
<td>5.5-9.0</td>
<td>5.5 –9.0</td>
</tr>
<tr>
<td>BOD₅ at 20°C mg/l</td>
<td>30 (Inland surface water)</td>
<td>30 (inland discharge)</td>
</tr>
<tr>
<td></td>
<td>350 (Public Sewer on land discharge)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 (Land for irrigation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 (Marine / Coastal areas)</td>
<td></td>
</tr>
<tr>
<td>COD, mg/l</td>
<td>250 (inland surface water)</td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>-(Public Sewer on land discharge)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-(Land for irrigation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>250 (Marine / Coastal areas)</td>
<td></td>
</tr>
<tr>
<td>SS, mg/l</td>
<td>100 (inland surface water)</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>600 (Public Sewer on land discharge)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>200 (Land for irrigation)</td>
<td></td>
</tr>
<tr>
<td>TOCl, kg/t paper</td>
<td>-</td>
<td>Not specified</td>
</tr>
<tr>
<td>AOX</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>SAR</td>
<td>-</td>
<td>26</td>
</tr>
</tbody>
</table>
Activated Sludge Process:

- **Primary Treatment**: Influent → Primary Clarifier
- **Secondary Treatment**: Aeration Tank → Secondary Clarifier → Final discharge

**Limitations of Biological Treatment Process**:
- Biological system i.e. ASP is effective for removal of degradable compounds contributing BOD.
- Around 85-90% of the total COD in finally treated effluent is mainly due to bio refractory compounds like degraded lignin, extractives etc.
- Not able to reduce the colour and TDS of the effluent

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Biological Nature of Oxygen Consuming Pollutants

- **Easily Biodegradable**
  - (Free sugar, carbohydrates, sugars, acids etc.)

- **Slowly Biodegradable**
  - (fibers, fines, polysaccharides etc)

- **Resistant**
  - (degraded lignin related compounds)
Need for Tertiary Treatment Options

- To meet the water consumption and discharge norms
- Primary & Secondary Treatment Measures – effective for pollution reduction but not effective to treat waste water for reuse into the process
- Need to adopt tertiary treatment options to treat waste water up to a level making it suitable for reuse into the process
- Selection of tertiary treatment option depend upon the end application of treated effluent
Stringent Environmental Norms

- Specifically for Pulp & Paper Mills in River Ganga Basin
- New Environmental Norms on same lines likely to be introduced soon on National Level

<table>
<thead>
<tr>
<th>Mill Category</th>
<th>Fresh Water Consumption m³/t paper</th>
<th>Waste Water Discharge m³/t paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (Wood Bld.)</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>A2 (Wood unbld)</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>B1 (Agro Bld)</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>B2 (Agro Kraft)</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>C1 (RCF Bld)</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>C2 (RCF Kraft)</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>D (Splty Paper)</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>
### Stringent Environmental Norms

- Specifically for Pulp & Paper Mills in River Ganga Basin
- New Environmental Norms on same lines likely to be introduced soon on National Level

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Discharge norms for Integrated Pulp &amp; Paper Mills Producing Chemical Pulp</th>
<th>Discharge norms for RCF based Mills</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5-8.5</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>TSS, mg/l</td>
<td>&lt; 30</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>TDS, mg/l</td>
<td>&lt; 1800</td>
<td>&lt; 1600</td>
</tr>
<tr>
<td>COD, mg/l</td>
<td>&lt; 200</td>
<td>&lt; 150</td>
</tr>
<tr>
<td>BOD, mg/l</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Colour, PCU</td>
<td>&lt; 250</td>
<td>&lt; 150</td>
</tr>
<tr>
<td>AOX, mg/l</td>
<td>&lt; 8</td>
<td>-</td>
</tr>
<tr>
<td>SAR</td>
<td>&lt; 10</td>
<td>&lt; 8</td>
</tr>
</tbody>
</table>
Stringent Environmental Norms

**Resource Conservation**
- Less availability of surface water
- Declining level of ground water

**Need for Water Conservation / Water Circuit Closure**

**Regulatory Pressure**
- Environmental Compliance
- Disposal Problem - Less availability of river water for dilution
- Improved quality of treated effluent

**Cost Economics**
- High Water Cess
- High raw water and waste water treatment cost
- Energy Conservation

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Tertiary Treatment (EOP)

Carbon Filter / Dual Media Filter / Chemical Treatment etc for polishing Effluent Quality / partial reuse / recycle of waste water to meet the discharge norms

OR

Carbon Filter / Dual Media Filter / Chemical Treatment etc + Ultrafiltration + Nano Filtration + Reverse Osmosis for recovery of process / industrial grade water

Primary Treatment

Primary Clarifier

Secondary Treatment

Aeration Tank

Secondary Clarifier

Influent

Sludge Dewatering

Sludge Return

Sludge Wasting

Waste Water
Fiber Recovery Units for Back water Reuse & Recycling & Reducing Pollution Load to ETP

DAF Units  Spray Filter  Sedicell
Filters as Tertiary Treatment Options for Reuse & Recycling of Treated Effluent

- Activated Carbon Filter
- Micron Filter
- Pressure Sand Filter
- Dual Media Filter
- Multi Media Filter

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Real Time On line Monitoring of Treated Effluent Quality - Mandatory for Indian Paper Industry

All the monitors are linked to Central Server of Regulatory Bodies
Anaerobic Bioreactor Configuration in Indian Paper Industry

Benefits of Bio-methanation:

- Reduce pollution load to subsequent ETP
- Co-generation of energy as biogas rich in methane
- Recovery of Biogas reduces GHG emission responsible for global warming
- Benefits of Carbon Credits
Recent Trends in Indian Pulp & Paper Mills for Improved Environmental Management

- Installation of Borewell Flow meter/ Electronic Flow meter
- Setting up of ETP Lab & Trained manpower
- Installation of Paper Machine Showers of Specified Diameter
- Installation of On line Monitoring system
Recent Trends in Indian Pulp & Paper Mills for Improved Environmental Management

- Installation of Chemical recovery System by Agro Based Mills
- Installation of Diffused Aeration System
- Installation of Tertiary Treatment System
- Installation of Fiber Recovery System
Way Forward

Membrane Systems - Treated Effluent  ➔  Process Water Quality  ➔  ZLD

Ultra filtration  ➔  Reverse Osmosis

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Requirements of Indian Paper Industry

- Cost effective and techno-economic alternative treatment options
- Cost effective color and TDS removal technologies
- Solid waste disposal and management or conversion to value added products
- Demonstration of such technologies on pilot/mill scale
Thank You
ありがとうございました