Revised Discharge Standards and the Challenge of Treating Increasing Sewage Volumes


Formerly with Indian Engg. Services, 1985

Foundation for Greentech Environmental Systems
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Structure of the presentation

- Introduction
- Background
- Countrywide status of sewage treatment
- Capacity created under NRCP
- Status of the metros
- Diverse issues affecting sewage discharges
- Discharge standards for STPs – national and international
- Diverse schools of thought.
- An alternate paradigm.
Introduction

- Current status re sewage treatment capacity and discharge norms.
- The presentation is neither a critique nor a prescription.
- It is experience sharing, bringing out issue and highlighting challenges.
Background

- Okhla Sewage Treatment Plant, 1937!
- Water (Prevention and Control of Pollution) Act, 1974
  - Min. National Standards (MINAS) as recommendations from CPCB to SPCBs.
- Ganga Project Directorate, 1984
  - Ganga Action Plan, 1985
  - Yamuna Action Plan, 1993
- The Environment (Protection) Act, 1986
- The Environment (Protection) Rules, 1986
  - General Standards, 1988
  - General Standards in 1993 (+ / - few parameters).
  - Revised standards for selected parameters, 2017.
## Country wide inventory of STPs

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing STPs across the country</td>
<td>695</td>
</tr>
<tr>
<td>- Operational STPs</td>
<td>615</td>
</tr>
<tr>
<td>- Non-operational STPs</td>
<td>80</td>
</tr>
<tr>
<td>STPs under construction</td>
<td>154</td>
</tr>
<tr>
<td>STPs under planning</td>
<td>71</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>920</strong></td>
</tr>
<tr>
<td>Compliance with discharge quality</td>
<td>~ 40%</td>
</tr>
</tbody>
</table>

Source: CPCB, 2015
Countrywide status of sewage generation & treatment

- Capacity utilisation of existing STP: ~ 30%
- Actual sewage treated (2015): ~ 7,000 mld (11% of total generation)
- STPs’ discharge compliance: ~ 40%.
- Untreated sewage discharge: ~ 55,000 mld (89% of total generation)

<table>
<thead>
<tr>
<th></th>
<th>2004-5</th>
<th>2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewage generation</td>
<td>38,250</td>
<td>62,000</td>
</tr>
<tr>
<td>Installed STP capacity</td>
<td>12,000</td>
<td>23,500</td>
</tr>
<tr>
<td>% installed capacity</td>
<td>~ 30%</td>
<td>~ 38%</td>
</tr>
</tbody>
</table>

Source: MOEF/ CPCB, 2015
Countrywide status of sewage generation & treatment

- MH, TN, UP, NCT Delhi & Guj (5/36) account for:
  - ~ 50% of total generation in the country, and
  - ~ 67% of the total installed STP capacity.

- 7 states/UTs without an STP:
  - Chhattisgarh, Daman & Diu, Assam, Tripura, Arunachal Pradesh and Nagaland.

- Only HP & Sikkim and Chandigarh (UT) have adequate STP capacity to deal with present sewage volume.
Capacity created under River Action Plans

- **Ganga Action Plan Ph-I**
  - States: UP (UK), Bihar (JH) and WB
  - Number of towns: 25
  - Original estimated flow: 1340 mld
  - **Number of STPs: 34**
  - **Aggregate STP capacity: 870 mld**
  - Cost (1994) : Rs. 462 Crore

- **Yamuna Action Plan**
  - States: Haryana, UP (and Delhi)
  - **Number of STPs: 42**
  - **Aggregate STP capacity: 732 mld**
  - Cost (1993-2003) : Rs. 676 Crore

- **National River Action Plan (excluding GAP & YAP)**
  - 14 states (AP, Tel, JH, Guj, Goa, KR, MH, MP, Odisha, Punjab, TN, Kerala, Sikkim and Nagaland)
  - Number of towns: 75
  - Number of river stretches: 31
  - **Aggregate STP capacity created : 2,446 mld**
STP capacity in Metro Cities

- Status in the 65 metro and capital cities (more than 10 Lac Population).
  - Sewage generation: ~15,644 mld
  - STP capacity: ~8,040 mld
  - Coverage: ~51%.
- Delhi & Mumbai: 55% of the total metro capacity.
- Remaining 63 cities account for the balance 45% capacity.
- In most of these cities >50% of the sewage is discharged untreated.
Sewage treatment capacity in Delhi

- Number of STPs: 36
- Sewage generation: 4155 mld
- Aggregate installed capacity: 3110 mld
- Operational capacity: 2755 mld
- Sewage collected and treated: 2065 mld (50% of generation)
- Untreated sewage discharged into river Yamuna: 2090 mld (50%)
- STP capacity utilization: 66%

- 318 mld STP to be commissioned in 2019.
- 564 mld STP is planned at Okhla.
- Over 150 decentralized STPs (1-4 mld) are planned all across NCT for rural settlements.

Discharge norms in Delhi

<table>
<thead>
<tr>
<th>Generation</th>
<th>Norms</th>
<th>Capex /mld</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st generation</td>
<td>30 : 50</td>
<td></td>
</tr>
<tr>
<td>2nd generation</td>
<td>20 : 30</td>
<td>0.9 Cr</td>
</tr>
<tr>
<td>3rd generation</td>
<td>10 : 10; N_{tot} &lt; 10mg/l; P &lt; 2 mg/l</td>
<td>1.8 Cr.</td>
</tr>
</tbody>
</table>
Yamuna in Delhi
STP capacity in Kolkata

- Number of STPs: 5
- Sewage generation: ~ 2200 mld
- Aggregate installed capacity: ~ 180 mld
- Sewage collected and treated: ~ 170 mld (~100% of generation)
- Untreated sewage discharged into East Kolkata Wetland System: 2030 mld (+90%)
STP capacity in Mumbai

- Sewage generation: ~ 2700 mld
- Number of existing STPs: 7
  - Installed capacity: 2130 mld
  - Mainly primary treatment
- Present collection and Tr.: 1384 mld (~50%)
- Untreated discharge: ~ 1300 mld (~50%)
- Proposed new STPs: 7
  - Aggregate capacity: ~ 1700 mld
  - Secondary and tertiary treatment for Re-N-Re!
STP capacity in Chennai

- Sewage generation: ~ 1800 mld
- Number of existing STPs: 12
  - Installed capacity: 764 mld
- Present collection and Tr.: 550 mld (~ 30%)
  - 36 mld treated sewage Re-N-Re in industries.
- Untreated discharge: ~ 1250 mld (~70%)
Diverse issues affecting sewage treatment

- Non-existent or partial sewerage systems.
  - Limitations of trunk sewers.
  - Arbitrary diversions to open drains.
- Weak enforcement for house connection.
- Inadequate conveyance system.
  - Inadequate pumping capacity.
  - Inoperative pumping machinery.
  - Inadequate back up capacity.
  - Unwillingness to operate generators.
- Lack of funds with ULBs for:
  - O&M of Sewage pumping stations.
  - O&M of STPs.
  - Replacement of worn-out equipment.
- Limited technical expertise for operation.
- Rapid deterioration of plant and equipment.
- Lack of MIS and supervision.

- Lack of robust and systemic approach for continuous monitoring and evaluation at the program level.
- Inconsistent paradigms of (1) resource and energy recovery coupled with (2) cost, energy and footprint minimization.
- Lack of inputs towards capacity building.
## Revised STP discharge standards

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water bodies</td>
<td>Land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>6.5 – 9.0</td>
<td>6.5 – 9.0</td>
<td>6.5 – 9.0</td>
<td>NA</td>
<td>6-9</td>
</tr>
<tr>
<td>BOD (mg/l)</td>
<td>30 3d@ 27°C</td>
<td>100 3d@ 27°C</td>
<td>20$ / 30 3d@ 27°C</td>
<td>25 5d@ 20°C</td>
<td>30 5d@ 20°C</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>250</td>
<td>NS</td>
<td>50</td>
<td>125</td>
<td>100</td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>100</td>
<td>200</td>
<td>50$ / 100</td>
<td>35$^a$ / 60$^b$</td>
<td>30</td>
</tr>
<tr>
<td>NH4-N (mg/l, N)</td>
<td>50</td>
<td>NS</td>
<td>5</td>
<td>NS (50)$^#$</td>
<td></td>
</tr>
<tr>
<td>TKj-N (mg/l, N)</td>
<td>82 (100 as NH$_3$)</td>
<td>NS</td>
<td>NS</td>
<td>NS (82)$^#$</td>
<td></td>
</tr>
<tr>
<td>Nitrate-N (mg/l, N)</td>
<td>10</td>
<td>NS</td>
<td>NS</td>
<td>NS (10)$^#$</td>
<td></td>
</tr>
<tr>
<td>Total-N (mg/l, N)</td>
<td>NS (~ 92)</td>
<td>10</td>
<td>NS (~ 92)$^#$</td>
<td>10$^c$ / 15$^d$</td>
<td></td>
</tr>
<tr>
<td>Phosp. (mg/l, P)</td>
<td>5$^\wedge$</td>
<td>NS</td>
<td>NS</td>
<td>NS (5)$^#$</td>
<td>1$^c$ / 2$^d$ $\€$</td>
</tr>
<tr>
<td>Faecal Coliform</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Desirable</td>
<td>100$^*$</td>
<td>&lt; 100</td>
<td>&lt; 1000</td>
<td></td>
<td>10,000$^\¥$</td>
</tr>
<tr>
<td>- Max perm.</td>
<td>10,000$^*$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$: $Metro and state capitals
*: $Recommended under NRCP.
$^\wedge$: $Dissolved Phosphorus
$^\¥$: $Total coliform
$^#$: $Min. National Standards

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<table>
<thead>
<tr>
<th>Notes</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$^a$: &gt; 10,000 PE</td>
<td>$^b$: 2,000-10,000 PE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^c$: &gt; 100,000 PE</td>
<td>$^d$: 10,000-100,000 PE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^\€$: Total (dissolved + suspended)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## WWTP effluent thresholds, EU Directive 91/271/EEC

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Maximum concentration</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemical oxygen demand (BOD$_5$)</td>
<td>mg/l $O_2$</td>
<td>25</td>
<td>Without nitrification</td>
</tr>
<tr>
<td>Chemical oxygen demand (COD)</td>
<td>mg/l $O_2$</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>Total suspended solids (TSS)</td>
<td>mg/l</td>
<td>35</td>
<td>60 (Discharge &lt; 10,000 PE)</td>
</tr>
<tr>
<td>Total phosphorus ($P_{tot.}$)</td>
<td>mg/l P</td>
<td>2</td>
<td>1 (Discharge &gt; 100,000 PE)</td>
</tr>
<tr>
<td>Total nitrogen ($N_{tot.}$)</td>
<td>mg/l N</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>COD : BOD ratio</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sample according to size of WWTP</td>
<td>Population Eq.</td>
<td>COD</td>
<td>BOD\textsubscript{5}</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------</td>
<td>-----</td>
<td>---------------------</td>
</tr>
<tr>
<td>Class 1: &lt; 60 kg/d BOD\textsubscript{5} (raw)</td>
<td>1,000</td>
<td>150</td>
<td>40</td>
</tr>
<tr>
<td>Class 2: 60 to 300 kg/d BOD\textsubscript{5} (raw)</td>
<td>1,000-5,000</td>
<td>110</td>
<td>25</td>
</tr>
<tr>
<td>Class 3: 300 to 600 kg/d BOD\textsubscript{5} (raw)</td>
<td>5,000-10,000</td>
<td>90</td>
<td>20</td>
</tr>
<tr>
<td>Class 4: &gt; 600 to 6,000 kg/d BOD\textsubscript{5} (raw)</td>
<td>10,000-100,000</td>
<td>90</td>
<td>20</td>
</tr>
</tbody>
</table>

Note:
1. Qualified sample or 2 h mixed sample.
2. No specification for N and P for smaller plants.

COD : BOD ratio = 3.75 - 5
Indian revised standards – few observations

- Uniform standards for discharge into water bodies or on land for irrigation.
- Uniform standards for plants/ ULBs of all sizes.
  - 30:100 remains for all non-metro cities.
- MINAS apply for all other parameters not specified in the Oct 2017 Notification.
- Do not specify nature and duration of samples; permissible violations in a month/year.
- Apparent resistance in lowering of standard for COD
  - COD: BOD ratio is between 8 – 12.5
- The challenges of nitrogenous oxygen demand and phosphorus are yet to get consideration.
- Correlation between Total-Nitrogen and Faecal Coliform is yet to be addressed.
Diverse schools of thought

- Full treatment in one go - effluent quality at par with the best.
- Energy and resource recovery.
- Minimalist approach:
  - Minimising foot print.
  - Minimising energy requirement.
  - Minimising capital and operating costs.
- Water resources diversion for productive uses.
- Ecological discharge in rivers.
- Zero discharge from STPs.

Lessons from the past

- There are no easy solutions.
- Resources are limited.
- Slow speed in capacity creation
  - Last 30 years - average capacity @ 750 mld/annum.
An alternate paradigm

- Can we keep things simple – practicable and affordable?
- Wider geographical coverage over the watershed/ river basin versus few plants producing high effluent quality.
- To start with, aim for moderate effluent quality.
- Plant upgradation in stages to achieve higher effluent quality.
  - Phase-I: Enhanced Primary Treatment.
  - Phase-II: Secondary Treatment.
  - Phase-III: Tertiary Treatment.
## Comparative organic load reduction assessment

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Unit</th>
<th>Conventional approach</th>
<th>Enhanced Primary Treatment approach</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewage quantity</td>
<td>mld</td>
<td>62,000</td>
<td>62,000</td>
<td></td>
</tr>
<tr>
<td>Quantity being treated</td>
<td>mld</td>
<td>7,000</td>
<td>43,400</td>
<td>11% v/s 70%</td>
</tr>
<tr>
<td>Raw BOD</td>
<td>mg/l</td>
<td>200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Final BOD</td>
<td>mg/l</td>
<td>30</td>
<td>50</td>
<td>75% reduction</td>
</tr>
<tr>
<td>BOD reduction</td>
<td>mg/l</td>
<td>170</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td><strong>BOD load reduced</strong></td>
<td>Tonnes/day</td>
<td><strong>1,190</strong></td>
<td><strong>6,510</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BOD load discharged</strong></td>
<td>Tonnes/day</td>
<td><strong>11,210</strong></td>
<td><strong>5,890</strong></td>
<td></td>
</tr>
</tbody>
</table>
Thank you very much