ZERO LIQUID DISCHARGE CONCEPT, WATER REUSE
REGULATORY REQUIREMENTS

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DISTILLERIES – NATIONAL SCENARIO

• There are around 505 distilleries in the country;
  – 397 - molasses based
  – 108 - grain based
• Total Operating distilleries (as per 2015 data from SPCB) is 347
• Total installed capacity of molasses and grain based distilleries (alcohol) is app. 6262 million liters/annum.
• Annual alcohol production is app. 3000 million liters
POLLUTION LOAD FROM DISTILLERIES

- Molasses-based distillery generates “spent wash” as waste water with high pollution potential and is characterized by
  - dark brown colour
  - low pH (3-4.5 - acidic)
  - very high organic loading
  - BOD (40,000-60,000 mg/l) and COD (80,000-1,20,000 mg/l).
  - High volume of generation, about 8-12 times v/v of alcohol produced.

- Grain based distillery generates “whole stillage” as waste water which is relatively low in pollution potential and characterized by
  - Milky white colour
  - low pH (3-4.5 - acidic)
  - high organic loading
  - BOD (25,000-35,000 mg/l) and COD (60,000-70,000 mg/l).
  - Relatively Low volume of generation
## EXISTING ENVIRONMENTAL STANDARDS – FERMENTATION INDUSTRIES: (DISCHARGE STANDARDS)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>pH</td>
<td>5.5-9.0</td>
</tr>
<tr>
<td>2.</td>
<td>Colour and odour</td>
<td>Shall be removed as far as practicable</td>
</tr>
<tr>
<td>3.</td>
<td>Suspended solids</td>
<td>100 mg/lit</td>
</tr>
<tr>
<td>4.</td>
<td>BOD (3 days at 27°C)</td>
<td>30 mg/lit – inland surface water/rivers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 mg/lit – land/irrigation</td>
</tr>
</tbody>
</table>

Note:— Notified vide S. O. 64(E), dated 18\textsuperscript{th} January, 1988 and lastly amended vide notification number G.S.R. 176(E), dated 2\textsuperscript{nd} April, 1996.
**Previous guidelines and compliance scenario in the sector**

The Charter for Corporate Responsibility for Environment Protection (CREP) action plan in 2003 for distilleries specified:

Existing Molasses based Distilleries to achieve Zero spent wash Discharge in inland surface water bodies by Dec. 2005 through any or combination of the following measures:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Protocol Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration and Incineration</td>
<td>Protocol – area requirement, floor specification, SW to press mud ratio, compost quality, etc are specified</td>
</tr>
<tr>
<td>Compost making with press mud/agricultural residues/municipal waste</td>
<td>Protocol – <strong>BOD</strong> after treatment – <strong>500 mg/l</strong>; after dilution – <strong>100 mg/l</strong> and TDS – <strong>2100 mg/l</strong>; lined storage, pipeline network, IMP, soil and GW monitoring, etc are specified</td>
</tr>
<tr>
<td>Treatment through bio-methanation followed by two stage secondary treatment and dilution with process water for irrigation</td>
<td><strong>BOD&lt;2500 mg/l</strong>, D.O depletion &lt; <strong>4.0 mg/l</strong> at mixing zone; submerged diffuser outlet point shall be decided by SPCB/CPCB in consultation with NIO</td>
</tr>
<tr>
<td>Treatment through bio-methanation followed by secondary treatment for controlled discharge into sea at a point permitted</td>
<td>Protocol – Bio-methanted SW, <strong>BOD – 7000 mg/l</strong> &amp; <strong>pH&gt;7</strong>; lined storage, pipeline or tankers, CLAP, soil and GW monitoring, MOU with Agri. University, etc are specified</td>
</tr>
<tr>
<td>One time controlled land application of treated effluent based on the study and protocol</td>
<td></td>
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</tbody>
</table>

Majority of distilleries adopted bio composting and few industries are allowed to practice ferti-irrigation and land application along with bio composting by some SPCBs, especially Karnataka, T.N etc. Majority of industries failed to comply with protocol for ferti-irrigation and land application and many instances of GW and soil contamination are reported, some of which has lead to litigations before Hon’ble NGT/High Courts etc and remediation projects for decontamination of soil/ground water.
The 147th meeting of CPCB in May, 2008 resolved that:
- establishment/expansion of stand alone distilleries are not to be considered based on composting/irrigation/land application options;
- establishment of new distilleries attached with sugar mills to be considered based on composting/concentration-incineration option;
- existing violating distilleries to switch over to emerging technologies.

The 168th meeting of Central Board in March, 2015 and 59th Conference of Chairmen & Member Secretaries held in April, 2015 endorsed the requirement of adoption of Zero Liquid Discharge in heavily water consuming and water polluting sectors including distilleries and also agreed to the proposed standards.

The Board meeting also resolved to adopt the ZLD/Water conservation measures specified in the action plan for five sectors including distilleries in the Ganga Basin as the National standard and recommended that the same be notified.
ZERO LIQUID DISCHARGE SYSTEM (ZLD)
WHAT IS ZERO LIQUID DISCHARGE

• Installation of facilities and system to enable industrial effluent for absolute recycling of permeate and converting solute (dissolved organic and in-organic compounds/salts) into residue in the solid form by adopting method of concentration and thermal evaporation.

• ZLD will work based on two broad parameters:
  a) Water consumption versus waste water reused or recycled (permeate)
  b) Corresponding solids recovered (percent total dissolved / suspended solids in effluents).
ZERO LIQUID DISCHARGE SYSTEM

I. Primary & Secondary treatment system

Raw effluent is subjected to primary treatment for removal of colour and to reduce BOD/COD by physio-chemical treatment followed by biological treatment or direct biological treatment or direct chlorination treatment.

II. Reverse osmosis treatment system

Water recovery through RO treatment.

III. RO reject management system

Recovery of brine solution from NF treatment (or) recovery of salt and water from evaporators/ solar evaporation systems.
EVOLUTION OF ZLD IN DISTILLERY

Technologies available/adopted for achieving ZLD:

1. For concentration of Spent wash
   - Anaerobic digestion – Biogas
   - Reverse osmosis (RO) - Permeate/Reject
   - Multiple effect evaporation (MEE) – Concentrate/Process condensate

2. For drying/ incineration of concentrated Spent wash
   - **Spray dryer / Rotary dryer**
     • Concentrated spent wash sent to spray drier/rotary drier to obtain dried powder with 4-5% moisture
     • Dried powder used as supplementary fuel along with agro based fuel in boiler/used as fertilizer
   - **Slop fired boiler**
     • 55 to 60 % concentrated spent wash fired in a specially designed boiler with/without subsidiary fuel
     • Utilization of Steam generated for power generation
     • Potash rich ash - by-product
   - **Co-processing**
     • Concentrated spent wash incinerated in cement kiln/thermal power plant
     • Reduction in conventional fuel consumption
ZLD ACTION PLAN FOR GANGA BASIN

• Action plan aims at ensuring Zero Liquid Discharge (ZLD) by molasses based distilleries in the Ganga Basin States through:
  – R.O + MEE or MEE alone with bio-composting
  – MEE & Incineration system
  – advanced process technologies with MEE & Incineration system

• Industries shall also achieve/adopt
  – Reduction in raw water consumption
  – Installation of monitoring system for water consumption & reuse
  – Zero discharge of other effluents apart from spent wash
  – Bio composting guidelines (Registration, packing, etc)
• Direction u/s 18 (1) (b) of the Water Act, 1974 issued on 24.02.2015 to 07 State Boards in the Ganga Basin for ensuring Zero Liquid Discharge (ZLD) by distilleries

• Industries to install either;
  – systems for Solid separation (R.O etc) & evaporation & concentration system (MEE) or MEE only – by December, 2015
  – Incineration system – by March, 2016 (optional)

  OR;
  – adopt advanced technologies (cont. fermentation, multi-pressure distillation, integrated evaporation, etc) for reduction in spent wash generation upto 6-8KL/KL – by March, 2016
  – evaporation & concentration system and incineration – by Sep, 2016

• Industries shall also achieve/adopt
  – Reduction in raw water consumption
  – Installation of monitoring system for water consumption & reuse
  – Zero discharge of other effluents apart from spent wash
## Proposed Environmental Standards: (Zero Liquid Discharge)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Category</th>
<th>Standard</th>
<th>Route to be followed</th>
</tr>
</thead>
</table>
| 1     | Molasses based distilleries including yeast manufacturing | Zero Liquid Discharge     | 1. Concentration (minimum 45-60% solids) and incineration in boiler; **OR** Concentration (minimum 40% by volume with 30% solids) and bio-composting  
2. Other process / non process effluents, RO permeate, MEE condensate etc., shall be suitably treated and reused in the process; and shall not be discharged.  
3. New stand alone units without sugar unit/expansion of stand alone unit shall achieve zero liquid discharge by Concentration and incineration.  

**Note:** Any alternative technology equivalent to concentration and incineration such as spray drier with boiler, rotary dryer with aux fuel & boiler, gasification, co-processing, etc shall be approved from respective State Pollution Control Boards. |
| 2     | Grain based distilleries                      | Zero Liquid Discharge     | 1. Decantation, concentration by evaporation and drying to produce DDGS with 10% (max.) moisture content  
2. Other non process effluents, R.O permeate, MEE condensate etc, shall be suitably treated and reused in the process; and shall not be discharged  
3. Industries operating on both grain and molasses shall have both the above systems |
### Notified Draft Standards: (Zero Liquid Discharge)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Category</th>
<th>Standard</th>
<th>Parameters and limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Breweries, Malteries and Stand alone bottling units</td>
<td>Discharge standards</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>S. No.</td>
<td>Parameter</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td>pH</td>
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<td>2.</td>
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<td></td>
<td>Colour and odour</td>
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<td></td>
<td></td>
<td>Suspended solids</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td>BOD (3 days at 27°C)</td>
</tr>
<tr>
<td>4.</td>
<td>SW boiler</td>
<td>Emission</td>
<td>S. No.</td>
</tr>
</tbody>
</table>
|        |          |          |          |          | Existing boiler – 150 mg/Nm³  
New boiler – 50 mg/Nm³ |

### Benefits of proposed standards:

Major benefits of the proposed standards include:

- ZLD implies no surface / ground water pollution from distilleries.
- Reduction in water consumption of distilleries.
- Conservation of ground water, avoiding its rapid depletion.

It is roughly estimated based on the total production of 2.6 billion litres (avg.) of alcohol in India, that distilleries require around 46.8 billion litres of fresh water annually without the water conservation measures. The implementation of the proposed standards aims at reduction of 40% in the water consumption due to recycle of recovered water from spent wash.
## ENVIRONMENTAL STANDARDS/PRACTICES FOLLOWED IN DISTILLERIES IN OTHER COUNTRIES

<table>
<thead>
<tr>
<th>Country</th>
<th>Environmental Standards/Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>‘Zero discharge’ – Majority of the distilleries are ‘Corn’ based and ‘whole stillage’ is converted into animal feed - DWGS or DDGS</td>
</tr>
<tr>
<td>China</td>
<td>‘Zero discharge’ is mandated for molasses and grain based distilleries; Concentration-incineration is practiced widely in molasses based units</td>
</tr>
<tr>
<td>Brazil</td>
<td>Land application is practiced; however quality of spent wash is far superior (BOD &amp; COD values - 50%) because of use of high quality molasses, ample availability of land, lower density of population and adequate rainfall are supporting factors</td>
</tr>
<tr>
<td>Thailand</td>
<td>Concentration and incineration technologies are practiced</td>
</tr>
<tr>
<td>Philippines</td>
<td>Bio composting is practiced</td>
</tr>
</tbody>
</table>
Financial implications:

**Molasses based distillery (50 KLD)**-
Multi Effect Evaporator:
- Capital cost – Rs. 5 Crores
- Operation cost – Rs. 150/m3 of Spent Wash

Incineration boiler (*optional*):
- Capital cost – Rs. 15 Crores
- Operation cost – Rs. 200/m3 of Spent Wash

**Grain based distillery (50 KLD)**-
Multi Effect Evaporator:
- Capital cost – Rs. 5 Crores
- Operation cost – Rs. 150/m3 of Spent Wash

Dryer:
- Capital cost – Rs. 4-5 Crores
- Operation cost – Rs. 100/m3 of Spent Wash

Consultations with industries & Ministries:
Ministry of Chemicals and Fertilizers has been consulted and comments received from the ministry in consultation with the NSI (National Sugar Industries) and ICC (Indian Chemical Council) has been examined and incorporated accordingly. Industries in the Ganga Basin have been consulted and proposed standards already under implementation in the basin.
Sectors covered:
- 17 categories of industries – 3377 Units
- Common Effluent Treatment Plans - 175
- Common Hazardous Waste Incinerator-25
- Common Bio Medical Waste Incinerator- 179
- Grossly Polluting Industries (Ganga) - 1109

Directions u/s 18 (1) (b) were issued on February 05, 2014 to all Chairmen of SPCBs and PCCs to direct industry for installation of online emission and effluent monitoring system by March 31, 2015. (Extended till June 30, 2015)

CPCB issued directions directly to industrial units in July/August 2015 under Section 5 of EP Act.
Suggestive CPCB Data Policy has been defined for:

- SPCBs
- Technology Providers &
- Industries
DATA POLICY FOR SPCB

• SPCB should:-
  – Obtain Real Time Data from existing portals of Technology Providers operational within their jurisdiction.
  – Develop their own RTDMS with required features using the data from existing Technology Providers’ portals.
  – Not to force industry to shift to a new Technology Provider.
  – Enhance their ambit to other categories of industries like Red, Orange etc.
  – Display the data in public domain through their own system.
  – Communicate OCEMS related additional requirements if any, to CPCB.
DATA POLICY FOR TECHNOLOGY PROVIDER

- Technology Providers have to submit data as per CPCB Requirements mentioned at http://cpcb.nic.in/Online/Procdure_data-submission_CPCB.pdf

- Ownership of Real Time OCEMS data collected on web Portals of Technology Providers lies with CPCB and SPCB.

- Technology Providers will not charge any additional cost to the industry for transferring this data to any other Govt. Agency or SPCB etc.
DATA POLICY FOR INDUSTRY

- Sole Responsibility of Real Time data submission lies with the Industry.
- Each Industry has to ensure 85% data availability every month for all its stations and parameters to be monitored as per C.T.O. given by SPCB and Environmental Clearance given by MOEF & CC.
- Industry can migrate to another Technology Provider ensuring data availability from old TP to new TP’s portal, sharing details with CPCB.
Online Monitoring Systems (OCEMS) – Requirement and implementation status:

CPCB initiated installation of OCEMS in 17 category industries for encouraging self monitoring and ensuring compliance to Standards:

Requirement for distillery sector:

<table>
<thead>
<tr>
<th>Effluent</th>
<th>Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge units</td>
<td>ZLD Units</td>
</tr>
<tr>
<td>OCEMS for pH, TSS, BOD, COD &amp; Flow at the outlet</td>
<td>Online flow meters – raw spent wash and conc. Spent wash line (MEE etc.) PTZ Camera – at bio composting, storage lagoon &amp; relevant location (dryer etc.)</td>
</tr>
<tr>
<td>Status of OCEMS Installation - Distillery</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Number of distilleries</th>
<th>No. of installed units</th>
<th>No. of units closed down</th>
<th>No. of units exempted</th>
</tr>
</thead>
<tbody>
<tr>
<td>347</td>
<td>186</td>
<td>129</td>
<td>32</td>
</tr>
</tbody>
</table>