

CHARTER FOR EFFLUENT TREATMENT BY SUGAR FACTORIES SITUATED IN RIVER GANGA BASIN

CENTRAL POLLUTION CONTROL BOARD

Ministry of Environment, Forest & Climate Change

CONTENTS

1. INTRODUCTION:

India is the second largest producer and biggest consumer of sugar in the world. The production of sugar is taken up using sugarcane as the raw material in all the factories except for one, which uses sugar-beet as the raw material. Sugar production, in general, remains around 24-28 million tonnes per annum; however, there are years of even lower production of sugar as the sugar production in the country is highly cyclic. At present, there are about 529 operational sugar factories including 32 integrated and standalone sugar refineries. Excluding sugar refineries, sugar is produced in the sugar factories by conventional Double Suphitation process producing direct consumption plantation white sugar. On the other hand, production of refined sugar is two-stage process producing firstly raw sugar from sugarcane juice and then further processing the raw sugar to obtain refined sugar. As such, the production of plantation white sugar and raw – refined sugar differs significantly in terms of unit operations, processing technique, quality of the product, CAPEX and OPEX.

In order to make the units sustainable, the concept of value addition through better utilization of by-product is gaining favour. This includes cogeneration of power using bagasse and carrying out power export whereas the molasses is used in integrated distilleries for production of rectified spirit, extra neutral alcohol or anhydrous alcohol (fuel alcohol). However, hardly 35% of the sugar units do have integrated power export and distillation facilities and thus, the potential of value addition through the by-product utilization has not been fully in harnessed. However, integration of these units with sugar units has assumed a significant importance considering impact of discharge of these units on environment.

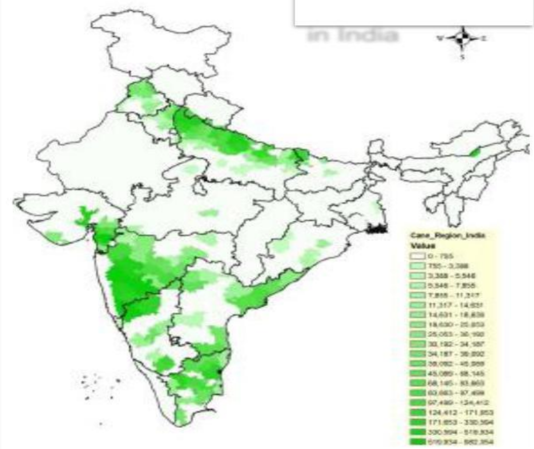
In spite of the fact that the sugarcane contains about 70% water (w/w) and with this much quantity of water available, there appears to be little need for drawing water from outside i.e. through natural resources. However, still most the plantation white sugar factories draw substantial amount of fresh water from these natural resources, @ 50-150 liters per ton of sugarcane crushed to meet their requirement, which increases further in case the sugar factories are integrated with co-generation unit or it produces refined sugar or both. Although, the sugar factories have realized the importance of the subject matter but still there is long way to go. It is emphasized upon that such lowering of fresh water consumption shall also help in reducing waste water (effluent) discharge from the factories.

2. INDIAN SUGAR SCENARIO:

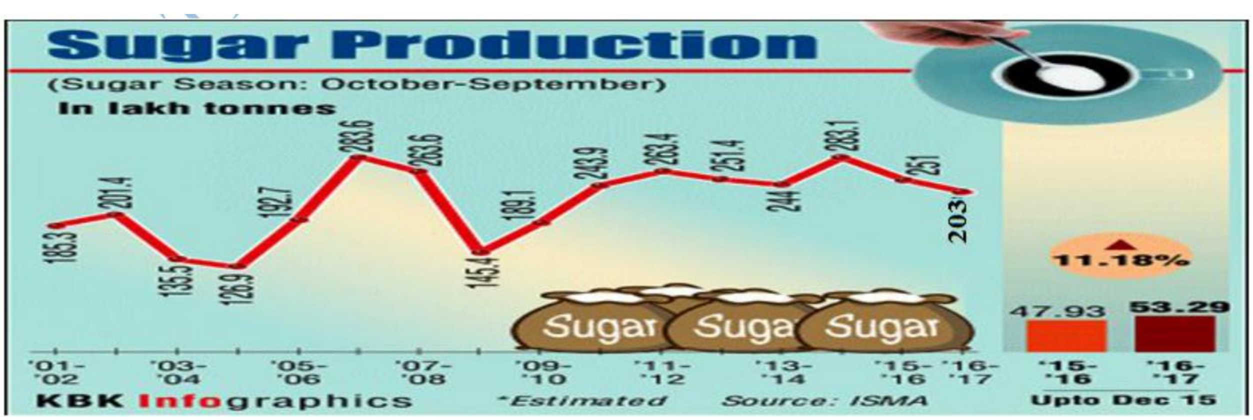
The sugarcane and sugar production varies to a significant extent due to various reasons out of which two prime reasons are: climatic conditions and payment of cane price to the farmers. The general sugarcane and sugar scenario of the country is as under:

- India is Second largest producer and top most consumer of sugar in the World
- Sugar production in India is cyclic in nature while consumption is constantly climbing
- In India, 50 million farmers cultivate sugarcane on average 5 million ha area
- The Sugar Industry is mainly under three sectors viz. Cooperative, Private and Govt. Sector
- There are over 600 sugar mills with crushing capacity varying from 1000 to 21,000 tons per day
- The yield of sugarcane per ha is high in tropical state like Tamil Nadu (Avg. 110 t/ha) and as we move towards North Productivity goes down (Avg. 55 t/ha) while all India's average yield is 65 t/ha
- Sugar accumulation in sugarcane is highest in North Karnataka and Center South Maharashtra because of favorable agro-climatic conditions

Intensity wise Sugarcane Grown Regions in India



India which is the world's largest sugar consumer, the total sugar use in the country grew from 17.527 mln tonnes in 2005 to 26.001 mln tonnes in 2014, corresponding to an impressive average annual growth of 3.4%. Per capita consumption also shows an average annual growth of 1.6%, improving from 16.3 kg in 2006 to 19.8 kg in 2015, which indicates that consumption dynamics are driven by both population and income growth. As per ISMA and other reports, bulk consumers contribute for 60-65% of total sugar consumption in the Indian market.



The details with respect to no. of sugar factories and their capacities etc. are as given below:

S.No.	State	Installed**		Operational***		Closed****		Upcoming*****	
		Capacity*	No. of Sugar Mills	Capacity*	No. of Sugar Mills	Capacity*	No. of Sugar Mills	Capacity*	No. of Sugar Mills
Major sugar producing states									
Sub-tropical belt									
1.	Bihar	67079	28	47990	11	19089	17	0	0
2.	Haryana	50850	16	50850	16	0	0	0	0
3.	Punjab	62600	24	48350	17	14250	7	0	0
4.	Uttarakhand	44500	10	44500	10	0	0	0	0
5.	Uttar Pradesh	830591	158	803453	137	27138	21	7000	2
	Sub Total	**1055620**	**236**	**995143**	**191**	**60477**	**45**	**7000**	**2**
Tropical Belt									
6.	Andhra Pradesh	110104	33	96758	29	13346	4	3500	1
7.	Telangana	27500	11	26250	10	1250	1	0	0
8.	Gujarat	80250	28	74000	24	6250	4	0	0
9	Maharashtra	663572	246	638259	231	25313	15	199500	57
10.	Karnataka	279555	80	258632	74	20923	6	129500	37
11.	Tamil Nadu	164050	46	156917	44	7133	2	0	0
Sub Total		**1320531**	**444**	**1250816**	**412**	**74215**	**32**	**339500**	**97**
Potential States									
12.	Chhattisgarh	7500	3	7500	3	0	0	3500	1
13.	Odisha	14200	8	11250	6	2950	2	0	0
14.	Madhya Pradesh	45075	25	36025	20	9050	5	21000	6
Sub Total		**66775**	**36**	**54775**	**29**	**12000**	**7**	**24500**	**7**
Minor Players									
15.	Puducherry	3250	2	3250	2	0	0	0	0
Sub Total		**3250**	**2**	**3250**	**2**	**0**	**0**	**0**	**0**
Industry closed / on the verge of closure									
16.	Goa	1250	1	1250	1	0	0	0	0
17.	Assam	3313	3	0	0	3313	3	0	0
18.	Dadra Nagar & Haveli	1250	1	1250	1	0	0	0	0
19.	Kerala	1516	2	0	0	1516	2	0	0
20.	Nagaland	1000	1	0	0	1000	1	0	0
21.	Rajasthan	3750	3	1000	1	2750	2	0	0
22.	West Bengal	4400	3	3800	2	600	1	0	0
Sub Total		**16479**	**14**	**7300**	**5**	**9179**	**9**	**0**	**0**
Grand Total		**2467155**	**732**	**2311284**	**639**	**155871**	**93**	**364000**	**104**

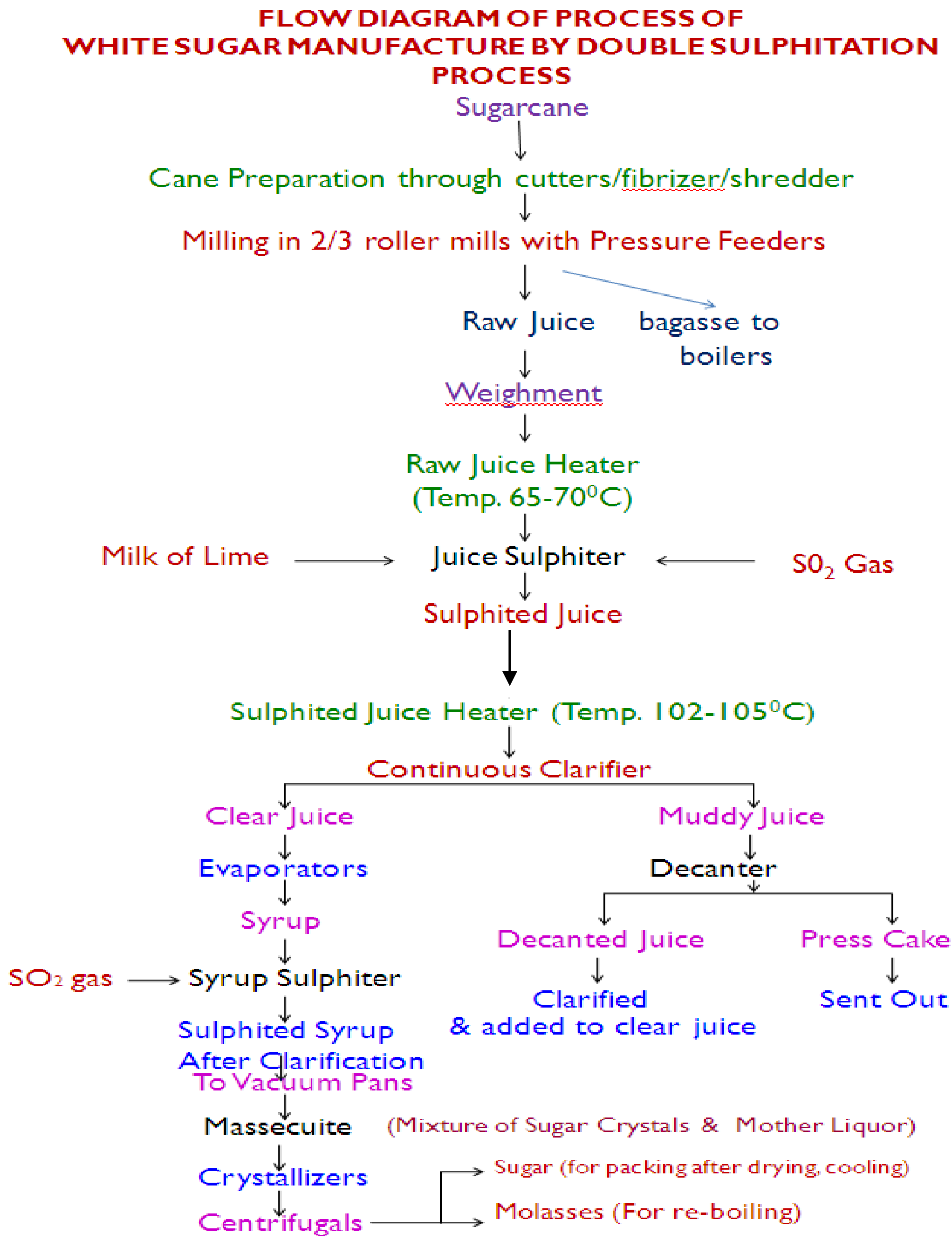
Sugar manufacturing base in the country

Position as on 31.07.2017

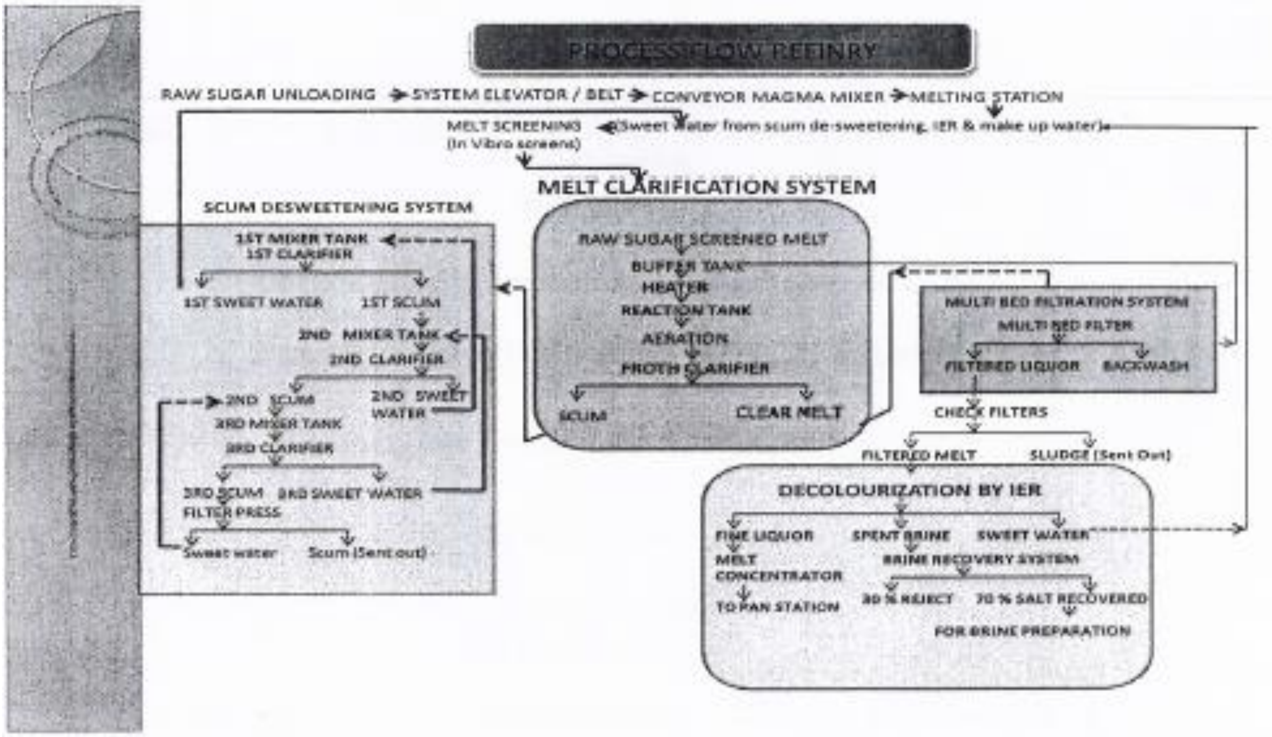
**As per Directorate of Sugar and Sugar Technologist Association of India (STAI) capacity in terms of tons crushing per day.*
***Registered capacity.*
****Sugar Mills which have worked at least once in the last five sugar seasons.*
*****Sugar Mills, which have not worked even once in the last five sugar seasons.*
******New Sugar mills under erection @ average of 3500 TCD capacity and expected to be operational by 2016-17 sugar seasons.*

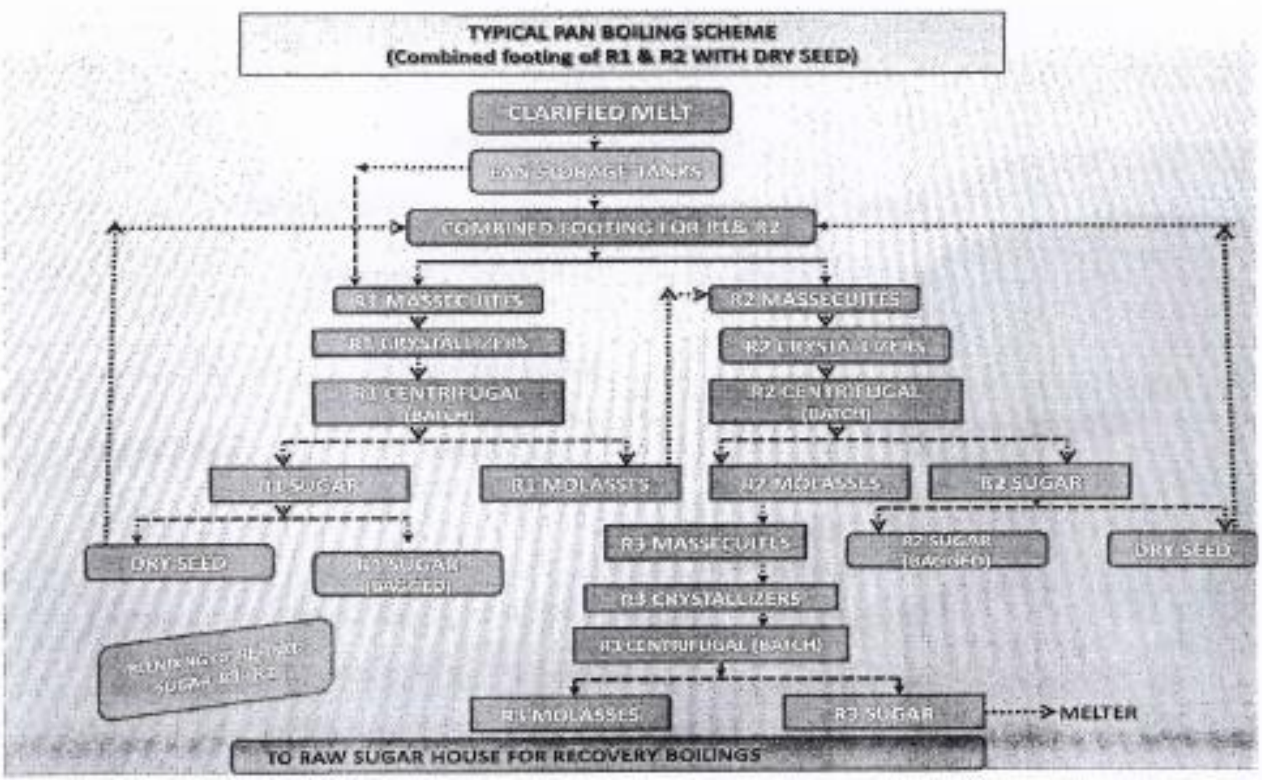
3. PLANTATION WHITE & REFINED SUGAR PROCESSES:

Production of plantation white sugar comprises basically sections of (i) Sugarcane handling, cane preparation and milling (ii) Steam and power generation (iii) Juice Clarification (iv) Evaporation (v) Crystallization and Centrifugation as depicted in the following process flow diagram:



On the other hand, production of Refined Sugar is a two stage process i.e. production of raw sugar from sugarcane juice by Defecation Process and then melting the raw sugar, clarifying the melt and re-crystallizing it to obtain the Refined Sugar.


PROCESS FLOW REFINRY
RAW SUGAR UNLOADING
SYSTEM ELEVATOR / BELT
CONVEYOR MAGMA MIXER
MELTING STATION
MELT SCREENING (In Vibro screens)
(Sweet water from scum de-sweetening, IER & make up water)
MELT CLARIFICATION SYSTEM
RAW SUGAR SCREENED MELT
BUFFER TANK
HEATER
REACTION TANK
AERATION
FROTH CLARIFIER
SCUM
CLEAR MELT
SCUM DESWEETENING SYSTEM
1ST MIXER TANK
1ST CLARIFIER
1ST SWEET WATER
1ST SCUM
2ND MIXER TANK
2ND CLARIFIER
2ND SCUM
2ND SWEET WATER
3RD MIXER TANK
3RD CLARIFIER
3RD SCUM
3RD SWEET WATER
FILTER PRESS
Sweet water
Scum (Sent out)
MULTI BED FILTRATION SYSTEM
MULTI BED FILTER
FILTERED LIQUOR
BACKWASH
CHECK FILTERS
FILTERED MELT
SLUDGE (Sent Out)
DECOLOURIZATION BY IER
FINE LIQUOR
SPENT BRINE
SWEET WATER
MELT CONCENTRATOR
TO PAN STATION
BRINE RECOVERY SYSTEM
30 % REJECT
70 % SALT RECOVERED
FOR BRINE PREPARATION


TYPICAL PAN BOILING SCHEME
(Combined footing of R1 & R2 WITH DRY SEED)
CLARIFIED MELT
PAN STORAGE TANKS
COMBINED FOOTING FOR R1& R2
R1 MASSECUITES
R2 MASSECUITES
R1 CRYSTALLIZERS
R2 CRYSTALLIZERS
R1 CENTRIFUGAL (BATCH)
R2 CENTRIFUGAL (BATCH)
R1 SUGAR
R1 MOLASSES
R2 MOLASSES
R2 SUGAR
DRY SEED
R1 SUGAR (BAGGED)
R3 MASSECUITES
R2 SUGAR (BAGGED)
DRY SEED
R3 CRYSTALLIZERS
R3 CENTRIFUGAL (BATCH)
R3 MOLASSES
R3 SUGAR
MELTER
TO RAW SUGAR HOUSE FOR RECOVERY BOILINGS

4. QUALITY OF INDIAN PLANTATION WHITE & REFINED SUGARS:

The quality parameters for plantation white sugar and refined sugar as per BIS specifications are as follows:

The specifications of Plantation White Sugar as per BIS specifications (IS 5982:2003) and quality as produced is given in the following table.

S No.	Particulars	IS 5982:2003 Plantation White Sugar	As produced
1.	Loss on drying, percent by mass, *Max*	0.10	0.03-0.05
2.	Polarization, *Min*	99.5	99.6-99.7
3.	Reducing sugars, percent by Mass, *Max*	0.10	0.04-0.06
4.	Colour in ICUMSA units, *Max*	150	80-130
5.	Conductivity ash, percent by mass *Max*	0.10	0.02-0.05
6.	Sulphur dioxide, mg/kg/ *Max*	50#	15-40
7.	Lead, mg/kg/ *Max*	5.0	Below detection limit
8.	Sediment	-	Less than 20 ppm

As amended

At present, Refined Sugar having a Pol% 99.85-99.90 with colour value of 25-45 IU is generally being produced in the country. The specifications of Refined Sugar as per BIS specifications (IS 1151:2003) and quality as produced is given in the following table:

S No.	Particulars	IS 1151:2003 Refined Sugar	As Produced
1.	Loss on drying, percent by mass, *Max*	0.05	0.03-0.04
2.	Polarization, *Min*	99.7	99.85-99.90
3.	Reducing sugars, percent by Mass, *Max*	0.04	0.025-0.035
4.	Colour in ICUMSA units, *Max*	60	25-45
5.	Conductivity ash, percent by mass *Max*	0.04	0.012-0.02
6.	Sulphur dioxide, mg/kg/ *Max*	15	-------
7.	Lead, mg/kg/ *Max*	0.5	Below detection limit
8.	Chromium µg/kg. Max	20	Below detection limit
9	Floc test	----	Negative
10.	Sediment	----	Less than 10 ppm

5. EFFLUENT GENERATION, IT'S QUANTITY, QUALITY& TREATMENT:

The standalone plantation white sugar producing sugar factories generate effluent to the extent of 180-300 liters per ton of sugarcane crushed. The variation is attributed mainly to indiscriminate use of fresh water and want of proper "Water Management & Recycling System". Higher fresh water intakes not only poses threat by overexploiting the natural resources but also results in higher effluent generation, again escalating the cost of its treatment and in many cases infringements in the quality of effluent puts potential threat to environment. The effluent discharge from standalone plantation white sugar factories has been widely varying between 180 to 300 liters per ton of sugarcane crushed, whereas, from the plantation white sugar factories having integrated co-generation it has been observed as higher by about 15-20%. For the refined sugar units, because of the process technique, it is expected to be higher by around 10% as compared to plantation white sugar units in both the cases.

Sugar factories, in general, lack attitude on taking measures to minimize fresh water requirement and effluent generation or even to adopt desired infrastructure for treating the effluent so as to have consistency in quantity and quality of effluent. Any expenditure on solid and liquid waste management finds the last priority of the entrepreneur considering it as un-productive expenditure deviating from its social responsibility.

5.1 Sources of Effluent Generation in a plantation white sugar factory: The four major sections contributing towards generation of effluent in a sugar factory producing plantation white sugar are considered as:

a) Mill House: cooling water for bearing and gland cooling, mill washings, spillages and leakages etc.

b) Boiling House: cooling water for gland cooling, gas and massecuite cooling, cleaning water from heat exchangers, leakages, spillages, overflows, floor washings, waste water from laboratory and surplus condensate.

c) Steam & Power House: cooling water for gland cooling and oil cooler etc., back wash/reject from DM/RO plant, boiler and cooling tower blow down etc.

d) Process Cooling Tower/Spray Pond: Vapours generated during the course of evaporation/boiling getting mixed with injection water and overflowing as an excess water.

5.2 General Composition of Effluent in Plantation White Sugar Factory:

A general analysis of untreated effluent from plantation white sugar factory producing sugar by Double Sulphitation Process is as given below:

S.No.	Parameters	Observed Values
1	pH	5.5-8.0
2	BOD for 3 days at 27^0 C (mg/l)	500-1000
3	COD (mg/l)	1500-2500
4	TSS (mg/l)	100-400
5	TDS (mg/l)	1000-2500
6	Sulphates (mg/l)	750-800
7	Colour	Light Brown
8	Temperature	30-40
9	Chlorides (mg/l)	180-210
10	Oil and grease (mg/l)	16-20

5.3 Sources of Effluent Generation in sugar refinery:

The sources of effluent generation are almost similar in an integrated sugar refinery and a plantation white sugar factory except for no cooling water is required for sulphur di-oxide gas cooling, hence no waste water is generated from this section. However, since for de-colorization of the sugar melt, use of Ion Exchange Resins is made, considerable amount of effluent is generated during the back wash and re-charging of the Ion Exchange Column and thus the matter of brine recovery assumes greater significance in case of sugar refineries.

5.4 General Composition of Effluent in Backend Refined Sugar Factory:

S.No.	Parameters	Observed Values
1	pH	5.5-6.5
2	BOD (mg/l)	600-1000
3	COD (mg/l)	1500-2500
4	TSS (mg/l)	100-400
5	TDS (mg/l)	1000-2500
6	Colour	Light Brown
7	Temperature C)	30-40
8	Oil and grease (mg/l)	16-20

5.5 Existing Process of Effluent treatment in Plantation White Sugar Factories & it's limitations:

For a sugar mill producing plantation white sugar by Double Sulphitation Process, especially spray pond overflow/PCT blow down in Double Sulphitation process contains high concentration of sulphates because of use of sulphur di-oxide for the juice clarification and bleaching of colouring compound present in the syrup. While concentrating the juice in the Evaporators and further concentrating the sulphured syrup in vacuum pans for crystallization of sucrose, the sulphur di-oxide/sulphur compounds along with the vapour reach to the spray pond/PCT through injection water.

Effluents from plantation white sugar factory do contain appreciable organic and inorganic loads. They have appreciable Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) values. The amount of inorganic substances present in the effluents as reflected from the values of sulphates, phosphates, calcium and potassium also remains higher. At present, the effluents from various sources in a sugar factory are treated in a common Effluent treatment Plant mostly by "Activated Sludge Process". However, due to presence of Sulphates, difficulty is faced in treating the overflows from spray pond/PCT which contain higher amount of Sulphates which suppresses the activity of micro-organisms. Melanoidins also which have antioxidant properties, are considered toxic to the micro-organisms. Almost all the sugar factories face problem in treatment of their waste waters owing to it and it is considered important to remove the sulphate content, especially, prior to its further treatment.

5.6 Existing Process of Effluent treatment in Refined Sugar Factories & it's limitations:

At present, the effluent from the refined sugar factories are also treated in the similar manner as in the case of plantation white sugar factories. However, in absence of use of Sulphur di-oxide gas, the issue related to presence of sulphate content in higher quantities in Spray Pond overflow/Process Cooling Tower blow down do not occur. However, the sugar refineries having Ion Exchange columns for de-colorizing the sugar melt are encountered with another problems of brine reject.

Colorants from the sugar liquor in a sugar refinery are removed using special Ion-Exchange resins. Desorption of the colorants from the loaded resins is achieved using alkaline sodium chloride solution. The regeneration waste poses a disposal problem, due to its high salinity and BOD. The disposal of regeneration effluents in sugar refineries having Ion-Exchange Columns has gradually become more crucial, as awareness of environmental protection is rapidly growing in most countries. In addition to providing a clean and hygienic process for raw sugar refining at an attractive capital and operating cost, an ion-exchange decolorization plant generates a daily volume of liquid effluents that is proportional to the volume of resins regenerated. Typically, an ion-exchange de-colorization plant will generate effluents with following approximate composition:

Chemical Oxygen Demand	: 15,000-25,000 mg/ltr.
Total Organic Carbon	: 2500-3,000 mg/ltr
TDS	: 35,000-40,000 mg/ltr.
pH	: 8-9
Temperature	: 80-85 deg.C
NaCl	: 20 to 25 g/L

Although this composition is very close to the salinity of seawater, its high color and high chemical oxygen demand (COD) usually prevent straight forward disposal. The combination of very high salinity and high COD content, including barely degradable colorants does not simplify the disposal of this effluent. The brine recovery thus is assuming a greater significance in the sugar refineries having Ion Exchange process of de-colorization of the sugar melt.

6. OBJECTIVES OF CHARTER IMPLEMENTATION PROGRAMME:

The purpose of formulating this charter is to enforce appropriate technologies for effluent treatment in sugar factories in Ganga basin and to motivate them as well to comply with the prescribed environmental norms, accomplish desired level of environmental protection and achieve prescribed norms of discharge so as to meet objectives of the National Mission for Clean Ganga. This is possible through adoption of well established efficient process technologies for sugar production, downstream effluent treatment technologies & practices and environmental performance, besides substantial reduction of fresh water consumption as well as wastewater generation.

CPCB has taken initiative to assess the effluent treatment plant performance and achieving the prescribed norms by sugar factories in the Ganga basin. CPCB conveyed meeting of sugar factories first on 11th May 2017 and subsequently on 24th May 2017 at Lucknow (U.P.) to discuss the issue with various stakeholders of the Sugar Industry. In these meetings it was decided that all the sugar factories situated in the Ganga Basin shall up-grade the effluent treatment facilities at their end and will get Effluent Treatment Plant (ETP) adequacy reports and up-gradation plan prepared from reputed institutions like National Sugar Institute (NSI), Indian Institute of Technology (IIT) or from Vasantdada Sugar Institute (VSI). CPCB also constituted an Expert Committee on sugar sector.

The terms of reference of the committee are:

1. To identify and assess issues related to environmental pollution from sugar mills.
2. To assess the availability and efficiency of cleaner/advance technology, state of the art technology and to formulate an action plan/ charter for upgradation of manufacturing process technology, ETP system and adoption of best practices for implementation of the notified environmental standards by sugar mills identified as discharging effluent into river Ganga main stream and its tributaries and to prepare a time bound road map for it.
3. To assess and validate ETP adequacy, augmentation/up gradation reports, water audit and mass balance reports, action plans for implementation of the new notified environmental standards, and irrigation management plan prepared by individual sugar mills identified as discharging effluent in to river Ganga main stem and its tributaries.

The Expert Committee consists of representatives from NSI, IIT, VSI, Indian Sugar Mills Association, UP Sugar Mills Association and industry representatives. The charter has been developed based on the deliberations that took place during the several meetings of the Expert Committee.

The Charter suggests Bare Minimum Technologies as an indication of the set of desired technologies for implementation by the sugar industry operating in the Ganga River Basin States. The Charter takes a holistic approach for pollution prevention by emphasising on process technology up-gradation, adoption of best practices, besides quantum improvement in effluent treatment technologies including reduction fresh water requirement through water recycling and implementation of on-line monitoring system. Compliance with the prescribed standards is mandatory. There will be no compromise with regard to the industry meeting the prescribed standards.

It is expected that through preparation of adequacy assessment reports, the individual sugar factories would be able to identify the gaps in process and downstream technologies and prepare an action plan to upgrade the technologies and comply with the norms. The time limit decided to comply with the suggested norms is as specified in the charter. This charter will help the sugar factories to meet the time limit.

7.0 PROPOSED ACTION PLAN:

In order to improve the health of the surrounding surface water bodies and for environment protection, discharge of sugar factory effluents should be made as per the prescribed parameters. The sugar factory effluents, appropriately treated, could be effectively used as a source of energy or soil nutrients or water that can be used for various processes. Condensate conservation, re-cycling of various cold and hot waters and adoption of suitable technologies for treatment of waste waters in accordance with the load `of pollutants is key to success.

Success of the system lies in reducing fresh water consumption through process improvements and implementation of recycle and reuse of water. Several technological and process improvements are available to reduce net water consumption and thereby reducing the amounts of effluents generated. Suggested technological up-gradation / measures for reduction in water consumption for achieving the benchmark / overall goal are mentioned in the Charter. Second is to have quantum improvement on the individual ETPs by adding effective and additional treatment units. This would result in achieving the desired quality parameters of the treated effluent and paving way for its effective utilization in agriculture or elsewhere with putting a threat on the environment. Extensive and regular monitoring protocol is to be followed by regulatory authorities for improved environmental performance.

Third party involvement is recommended for planning, assessment, design and monitoring of implementation of measures as prescribed in the Charter for process technologies as well as ETP up-gradation and its evaluation. NSI, IITs, VSI and Indian Sugar Mills Association as well as UP Sugar Mills Association can play a pivotal role in facilitating the individual sugar factories, concerned SPCBs and CPCB in implementing the Charter in a time bound and efficient manner.

Considering the available well established and emerging technologies, a holistic approach comprising of up-gradation of process technology, adoption of best practices, and revised protocols should be considered. Instead of end-of-pipe treatment approach an integrated water and waste management system based on green chemistry concept should be developed.

To start with a resource institute or organization with necessary expertise in this area can be identified. CPCB/SPCB along with the resource institute can chart-out the programme for achieving the quantitative and qualitative discharge from sugar factories in Ganga River Basin. Unlike other industries, the quality of raw material and process technology as well vary to a certain extent from one sugar factory to another. In addition to this, the sugar factories have to be differentiated as plantation white sugar and refined sugar factories with or without co-generation of power (i.e. power export). All such consideration including configuration of plant and machinery, process technology and availability of the existing infrastructure for water conservation and effluent treatment has to be kept in consideration.

For reduction in effluent quantity, various measures for efficient treatment, reuse and recycling of water shall have to be ensured which include firstly installation of necessary flow meters at various consumption and discharge points so as to ascertain the ground realities and thus to take corrective action at desired places. Condensate cooling and/or polishing system can be selected from various technologies available for treatment and reuse so as to reduce fresh water consumption and in turn to reduce effluent generation as well.

Important issues such as configuration of plant and machinery, process technique requirement of trained manpower, capital investment necessary for up-gradation and additional cost burden can be worked-out.

Following objectives and methodology can be considered,

a. To identify and record Sugar Factories in Ganga River Basin based on capacities, type and number of operating days/annum, distance from river etc.

b. Field visits to all such sugar factories to ascertain working during the last three crushing seasons with respect to average crush rate, total sugarcane crushing, processing technique, products manufactured, integration with power export unit and other units etc.

c. To study the existing water conservation/re-cycling system and available Effluent Treatment Plant.

d. To study the details of existing quantitative and qualitative effluent discharge and earmarking gray areas for improvement.

e. Field visits and discussion with management of sugar factories to estimate the cost of advanced and emerging technologies to be established.

f. To finalize the configuration of up-gradation of processing technique including adoption of efficient process equipments, requirement of water consumption and waste water discharge monitoring system from various sources. Development of downstream effluent treatment system for each sugar factory to achieve prescribed norms of effluent discharge.

g. To prepare the combined action plan of all selected sugar factories for fiscal and financial assistance from Central (under Ganga Action Plan) and State Governments seeking soft loans, subsidy etc. to establish the emerging green technologies in selected sugar factories.

Above approach and subsequent modernization of sugar factories can defiantly help the factories in Ganga River Basin to achieve desired norms of effluent discharge.

8. PROCESS TECHNOLOGIES VIS A VIS WATER USAGE & EFFLUENT GENERATION:

Enhancement in technical efficiency including matters relating to energy and water conservation have drawn greater importance in the recent times and significant changes in the processing techniques or plant & machinery have been carried out with a view to achieve the targets. A plantation white sugar production plant undertakes various unit operations for production of sugar using sugarcane as the raw material. In the following paragraphs, existing techniques of processing along with best available techniques have been discussed not only to derive higher technical efficiency but also to have lower fresh water requirement and waste water generation thereof.

8.1. Sugarcane handling, cane preparation and milling -

The sugarcane is generally received at the sugar factories through different modes e.g. dunlop carts, tractor-trollies and trucks etc., thus, to facilitate its unloading and feeding to the cane carrier, different systems viz. grab unloader, sling bar and truck-tipplers are in vogue in different parts of the country. The cane stalk is broken into fine chips by using a combination of cane leveller, cane cutter and fibrizer or shredder or some such equipment so as to facilitate extraction of maximum quantity of juice from the cells. This prepared cane is fed to a series of cane crushing mills, comprising 2-roller or conventional 3-rollers along with other force feeding devices. Generally, 4-5 such mills are employed to extract maximum quantity of juice available in the cells. To facilitate maximum de-sugarization of material fed, hot water known as imbibition water is employed for its leaching. The quantity of such hot water (re-circulation of condensate) varies to a large extent from one factory to another @ 180-300 added water % fibre or say around 25-40% on cane and calls for optimization as in many cases it is applied arbitrarily without carrying out any scientific analysis. The juice so extracted is sent for further processing whereas residual fibrous material known as bagasse is used in boilers as fuel.

Alternatively, few factories, particularly in the tropical regions, have adopted different technology altogether for extraction of juice where in place of a milling tandem “Diffusers” have been installed, which are reported to give higher juice extraction, side by side consuming less power and also offering other advantages of lower maintenance cost and facilitating outdoor installation. However, this technique has been adopted by hardly 2% of the sugar factories in the country and is still in infant stage. It is pertinent to mention here that the milling technique has been revolutionized during the last decade by incorporating highly efficient cane preparatory devices and milling equipments, which have resulted in the Reduced Mill Extraction (RME) to the extent of 96% or even more and thus, resulting in lower loss of sugar in bagasse. The advent of two rollers trash plate less mills combined with pressure feeding devices has resulted in lower power requirements.

This along with change in driving arrangement i.e. by use of ACVFD motors and planetary gears, has enabled reduction in power consumption to a greater extent. All these with proper instrumentation and automation to regulate cane feeding and working of individual mill has enabled sugar factories to obtain higher efficiencies at the milling station with lower power requirement.

The following table shows the performance of the latest methods of juice extraction:

	Three Roller Mill with Pressure Feeder	**Two Roller Mill with Pinionless Drive**	**Cane Diffuser with Dewatering Mill**
Power Consumption in kWh per ton of cane	8.5 – 9.0	7.0 – 8.0	6.5 – 7.0
RME	96.0 - 96.5	96.0 - 96.5	97.5 – 98.0
Moisture % bagasse	48 - 49	47 - 48	48 - 49

It is pertinent to mention here that significant quantities of water are required for gland/bearing cooling purposes for the cane preparatory devices, mills and pumps etc. It is important to have a closed loop system for re-circulating such waters after due screening and cooling through fan-less cooling tower(s) of desired capacity rather than using continuously fresh water as is practiced still by many of the sugar factories.

8.2 Juice heating and clarification –

In a Double Sulphitation process, the raw juice heating is carried out to a temperature of 65-70^{0}C and is subjected to further treatment with lime and sulphur di-oxide gas so as to carry out precipitation of impurities in a specially designed continuous vessel known as “Juice Sulphitor”. The separation of precipitated impurities from the juice is carried out in continuous settlers known as “clarifiers”. During the last decade, there has been a phenomenal change in the system of juice heating with a view to achieve steam economy without sacrificing any system efficiency. This has led to development of condensate heaters, direct contact heaters, plate type heat exchangers in place of conventional tubular juice heaters. The direct contact juice heaters, in particular, working at a narrow temperature difference, have enabled higher steam economy in the processing house. These juice heaters since do not have tubular or plate type heat exchange surfaces, chemical or mechanical cleaning is not required as is required in the conventional heaters, thus, saving water required for their cleaning and hence lower effluent loads. The vapour condensate obtained from various tubular/ plate type juice heaters is collected and utilized for various other purposes in the boiling house.

The system of removing precipitated impurities from the juice is more or less conventional and still the Rapi Dorr 444 type clarifiers are in use. However, with some changes in the juice withdrawal and by using commercially available polyacrylamides, the retention time in these clarifiers has been brought down to a level of around 2 hours or even less resulting into lower heat loss, colour development and sugar loss. Trials of “ Tray-less” or “Short Retention Time” clarifiers have also been reported by the sugar factories producing plantation white sugar but could not get favour due to issues associated with quality and consistency of the quality of clear juice. Here precipitated impurities are removed from the juice as thick liquor known as “muddy juice”.

With a view to recover sugar to the extent possible, the muddy juice is again filtered conventionally in rotary vacuum filters so as to separate juice known as “filtered juice” and “filter cake” separately. Again, hot water (vapour condensate) is applied through atomizers and drip plates @ around 125-150% of the quantity of filter cake to recover sugar to the maximum extent possible. Recently the technique of decantation employing high speed decanters has also been put to use by some sugar factories. Although the technology is to prove its worth, but since it does not need any filtering aid like bagacillo as in case of rotary vacuum filter, the saved bagacillo can be used as fuel in boilers, thus, giving impetus to power generation. Side by side, use of hot water for de-sugarization of press cake is not made as is required in case of rotary vacuum filters.

8.3. Preparation of Clarificants:

In Double Sulphitation process, milk of lime and sulphur dioxide are the two primary clarificants used. As far as preparation of milk of lime is concerned, the conventional technique of slaking the lime is followed wherein a rotary lime slaker is used. However, for milk of lime screening, there is a growing trend of using vibro screens and hydrocyclones, which facilitate removal of grit to a larger extent. The vapour condensate available is used for slaking the quick lime and subsequent preparation of lime slurry or milk of lime. Vapour condensate to the extent of around 1.8-2.0 % on cane is used for such purposes, the quantity being dependent on the quality of cane juice.

On the other hand, for production of the sulphur dioxide gas, which is used for juice and syrup sulphitation, the conventional pool type sulphur furnaces have given way to continuous film type sulphur furnaces, which ensures higher and consistent concentration of sulphur dioxide and hence, efficient juice and syrup sulphitation. This has also enabled installation of automatic pH control systems wherein the quantity of SO_2 gas may be varied as per the requirement resulting in not only better clarification but also in reduction in sulphur and lime consumption. The gas so generated is at a temperature of 700-800^0 C and thus needs to be cooled to about 70-75^0 C before it is applied. For the purpose, gas coolers are employed where cold water is circulated in the jacket. With a view to reduce fresh water consumption, it is essential that this water is re-circulated after proper cooling through cooling towers along with other re-circulating waters and the fresh water is used for first fill only.

8.4. Evaporation:

Evaporation is the heart of unit operations in the processing house of a sugar factory. The working of the boiling house and process steam consumption is very much dependent on working of evaporator system. Previously till the year 2010, the process steam consumption to the extent of 45% on cane was considered to be satisfactory, but with advancement in evaporator configuration and their design, the process steam consumption has been brought down to the extent of 36-38% on cane, in general, and efforts are on through further modifications to bring it below 30% on cane through extensive vapour bleeding, re-configuration and by introducing improved design of plate type or other evaporators. As mentioned above, as far as the design features are concerned, the conventional Robert type evaporator bodies have been replaced partly or fully with Film type (rising or falling film) evaporators in the evaporator set. Since this film type evaporator work at lower delta T, have lower retention time and head loss, it has been possible not only to achieve higher steam economy, but also better and consistent working of the evaporator. The configuration of the evaporator set which used to be single effect vapour cell, followed by Quadruple effect or Quintuple effect evaporator has been overtaken by either Quadruple or Quintuple effect evaporator with extensive vapour bleeding, particularly, from the succeeding bodies. This has also changed the scenario with respect to availability of condensates from various bodies. A schematic diagram of evaporator configuration is enclosed as **Annexure I.**

The evaporator system is being further upgraded and instead of operating the evaporator set at higher vacuum, it is being operated on lower vacuum by some of the factories so as to get high temperature vapours from various bodies for different uses. Although there are certain prerequisites for implementing such system, but has resulted in further saving of steam to the extent that it could be brought down to the extent of 25-28% on cane. A schematic diagram including type of evaporator bodies, operating parameters and vapour bleeding system is enclosed as **Annexure II**.

It is also pertinent to mention that the factories are also taking advantage of heat which is available in the condensate by flashing them and for the purpose, Condensate Cigars have been installed. This has further resulted in reduction in steam consumption by approx. 1.5% on cane. As far as utilization of condensates available from various Evaporator bodies is concerned, the exhaust steam condensate is used essentially as boiler feed water, whereas, other condensates are used for imbibition, filter cake wash, milk of lime preparation, molasses dilution and miscellaneous other purposes. Further, as mentioned in the earlier paragraphs, the factories have already installed condensate heaters for the first or second stage heating of raw juice, besides which heat exchangers have been put for heating the wash water for centrifugals and also the air to be used for drying the sugar on hoppers, all leading to reduction in steam requirements for the boiling house. It is important to recover the condensates to the maximum extent, particularly, the exhaust steam condensate, preferably above 96% so as to reduce requirement of makeup water as boiler feed water and to have higher efficiency at steam generating units.

As far as cleaning of the Evaporator bodies is concerned, most of the factories practice chemical cleaning followed by mechanical cleaning. In some cases, where long tube rising or falling film evaporators are used, only chemical cleaning is also practiced. However, most the factories lack in proper handling of such washings and add them to the Effluent Treatment Plant directly in an un-controlled manner disturbing its working due to higher pollution loads. Thus, it is important that the factories should construct 'Hazardous Tanks" of adequate capacity to collect such washing and discharge them in a controlled manner to the ETP. Alternatively, the "Hydro-jet" cleaning of the Evaporators is worth trying which is possible without necessity of undertaking the chemical cleaning. Once standardized, it will result into lower requirement of water for cleaning purposes as it would be possible to re-use the water after allowing the wash water to stand for some time in settling tanks.

8.5. Syrup Sulphitation and Pan boiling:

The syrup obtained from the evaporators is again subjected to treatment with sulphur dioxide in pursuit of making good quality sugar and this is an established practice followed by all the sugar factories producing plantation white sugar. The syrup pH is brought down to the extent of 5-5.2 to have bleaching and also causing reduction in the viscosity in the syrup. This syrup is subjected to further concentration in vacuum pans whereupon reaching to certain super-saturation crystallization of the sugar takes place.

Not only the technique of pan boiling has undergone a sea change during the last couple of years, but also the features of vacuum pans employed for the purpose have been modified to a greater extent. While many of the factories have switched over from the conventional 3-massecuite boiling system to 3½-massecuite boiling system, boiling A_1& C_1massecuitesso as to attain low colour sugar and to keep purity of molasses also on lower side simultaneously. As far as the pan boiling equipments i.e. vacuum pans are concerned, the advent of continuous vacuum pans have resulted in use of low temperature vapours from evaporators causing significant reduction in steam consumption of the process house. Installation of the continuous vacuum pans, horizontal or vertical, has also resulted in many other advantages viz. stabilized working of the evaporators, lower injection water requirement and thus lower power requirements, lower manpower requirements, reduced downtime and maintenance cost etc. It is pertinent to mention here that such continuous pans are widely being used for low grade massecuite boiling, but for high grade massecuites, their utilization is limited. Besides this, to improve upon the efficiency of the crystallization, continuous and conventional batch pans are being provided with mechanical circulators, which improves circulation resulting into better exhaustion of molasses and hence, lower loss of sugar in molasses.

It is also pertinent to mention that boiling of liquor is carried out in several stages i.e. A, B and C massecuites to attain maximum quantity of the sugar from the mother liquor. The standard pan boiling schemes for 3-massecuites and 3½-massecuites are enclosed as **Annexure III.** It is also pertinent to mention here that depending upon the boiling scheme, the total quantity of massecuites, injection water and the steam requirement changes and so the availability of the condensate from different pans. It also has got direct bearing on requirement of hot water for molasses conditioning and pan boiling operations. However, the use of hot water except for grain hardening and molasses conditioning should be minimized by exercising proper control during the pan boiling operations as this will not only improve the quality of the bagging sugar but will also lower the steam consumption of the plant.

8.6. Crystallization and Centrifugation:

Not much has happened during the last decade or so as far as crystallization in motion and centrifugation of various massecuites are concerned. The practice of hot curing of A massecuite and curing of B & C massecuites after cooling and conditioning is still in vogue. Thus, while A massecuite cooling does not require any circulation of water, cooling water is required for B & C massecuites cooling and also hot water in the case of other massecuites, C-massecuite in particular, for re-heating to 50-52^{0}C. As regards, cooling of B- and C- massecuite, the quantity of water to be used for cooling purposes being substantial, it is essential to re-circulate the same water after cooling rather than continuously drawing fresh water. For the purpose, system as suggested or used by the factories for SO_2 gas cooling should be implemented or the factories should develop common facilities for cooling and re-circulation of such waters. Due to various advantages now almost all the factories prefer to use continuous vertical crystallizers for B & C massecuites treatment, whereas for A massecuite, the conventional batch type air cooled crystallizers are used. However, the driving arrangement has undergone a change with use of planetary gear box in place of worm and worm wheel type reduction gears for considerable reduction in power consumption.

Regarding centrifugals with the advent of re-cycling type fully automatic batch type centrifugals, the same are now being widely used by the sugar industry in India. With a view to have consistency in the quality of sugar discharged and energy efficiency, the wash water application at A centrifugals has seen a change where the condensates from evaporators are heated to a high temperature in condensate heaters facilitating optimum sugar wash with relatively lower water requirements. Regarding B & C massecuites, the practice of using continuous machines is an established practice and the distribution or curing scheme changes to some extent depending upon boiling scheme. It is important to apply minimum and measured quantity of wash water at the centrifugals so as to minimize the loss of sugar in molasses and also to control the steam consumption. With proper boiling of massecuites and curing at saturation temperatures, the plantation white sugar factories have already reduced the wash water requirement at low grade massecuite curing during the last decade or so.

8.7 Sugar conditioning, grading and handling:

It is a known fact that the sugar discharged from the centrifugals is at a relatively high temperature containing appreciable moisture and hence not fit for bagging as such so as to prevent its deterioration upon storage. The simplest way of removing moisture and cooling to a temperature of preferably below 40^{0}C is through using of grasshoppers where firstly hot air and thereafter cold air is blown. The factories are now becoming more concerned towards the health hazards and it is being observed that they are putting dust catchers etc. to minimize concentration of sugar dust particles in the packing house atmosphere and also to recover the sugar.

It is pertinent to mention that while going for expansion, sometimes the factories find it difficult to modify the existing system of hoppers or to provide additional set of hoppers to cope up with the requirements. Under the circumstances and otherwise also use of FBDC (Fluidized Bed Drying & Cooling System) is becoming popular and many such installations have come up in the Indian Sugar Industry as well. Such sugar is now being bagged through automatic weighing and bagging system in 50 kgs, 100 kgs or in consumer packs as per the requirements.

8.8 Sugar and molasses storage:

The sugar recoveries in the country vary from 10-14% (sub-tropical to tropical region). During the season, while average recovery remains around 10.5% on cane. Similarly, the molasses %, the quantity of molasses produced is a function of juice quality and processing technique and varies from around 3.75% to 5.5% on cane in various sugar producing states, the national average being around 4.5% on cane.

For construction of sugar go-down, stacking of sugar bags and for storing molasses, the BIS specifications are in place which are generally followed by the sugar factories. However, to keep the temperature of stored molasses within permissible limits to minimize deterioration, sugar factories use sprays of cooling water all along the outer surface of steel tanks, sometimes without proper arrangement for its re-circulation after cooling. Hence, the matter requires greater attention to reduce fresh water requirement and effluent generation as well.

8.9 Steam and Power Generation: The sugar industry has seen quite a big change in the system of steam and power generation focusing more on adopting high pressure and temperature boilers with matching turbines so as to achieve higher thermo-dynamic efficiency. The minimum boiler pressure which now factories are adopting is 87 kg/cm^2g, although, they have gone upto 125 kg/cm^2g in order to achieve still higher efficiencies and saving bagasse. Use of bagasse dryer has also made its entry again to enhance bagasse saving and higher steam generation. The table given below speaks for power generation and power export potential while working at different boiler pressures and also through efficient gain obtained as a result of bagasse drying.

Bagasse % cane =30

Full Burning of bagasse leaving 1% for Vacuum Filter and windage losses

Turbine is considered as Extraction cum condensing

25 % of the steam produced is condensed

Power Generation Potential while using different steam pressure & temperature conditions and with bagasse drying is shown in following table:

Particulars	67 bar 500 ^{0}C	87 bar 515^{0}C	110 bar 530^{0}C	125 bar 545^{0}C	140 bar 555^{0}C
Power generation (Kwh/Ton Cane) Bagasse having 50% moisture	119	129	145	160	174
Power generation (Kwh/Ton Cane) Considering bagasse drying by 10 units	140	148	162	176	187

70-80 % of the produced bagasse is used as fuel in the boilers to generate steam and there by power for processing of the cane to produce sugar which requires about 90 to 100 GJ of thermal and electrical energy. Adoption of medium pressure and high pressure root for generation of power, not only saves fuel but also helps the factory economy by way of exporting power to the grid. Moisture content of bagasse to the tune of about50 % reduces the boiler efficiency to a larger extent. Adoption of bagasse drying methods increases the efficiency of the boiler there by increasing power export as given in the table above.

Equipments used in various unit operations to generate steam and power for standalone sugar factory and sugar factory having co-generation are given in following table:

Sugar factory (stand alone)	Sugar factory with co-generation
1. Water treatment plant (DM Plant)	1. Water treatment plant (DM / RO)
2. De-aerator (Optional)	2. De-aerator
3. Boiler	3. Boiler with attemperator
4. Wet scrubber	4. Wet scrubber/ Electrostatic Precipitator
5. Steam turbine (Back pressure)	5. Steam turbine (Back Pressure/ Extraction Condensing/ Condensing)

	6. Water cooled surface Condenser/ACC
	7. Steam Ejector
	8. Cooling Tower

8.9.1. Steam and Power Generation Process: Following operations are carried out for steam and power generation in a standalone sugar factory (having low-medium pressure boilers):

1. Treatment of raw water in DM plant
2. De-aeration of treated water in de-aerator
3. Steam generation in boiler
4. Power generation in steam turbine
5. Exhaust steam generation from power turbine and consumption in boiling house.
6. Condensate return (particularly exhaust steam condensate) to boiler for reuse as feed water.
7. Waste water generation from DM plant and boiler blow down.
8. Recycling of waste water to wet scrubber.

b. Following operations are done in steam and power generation in a sugar factory with co-generation power plant (having high pressure boilers):

1. Raw water treatment in DM/RO plant
2. De-aeration of treated water in de-aerator
3. Steam generation in boiler
4. Power generation in steam turbine and extraction of steam as per requirement in boiling house
5. Condensate return (particularly exhaust steam condensate) from boiling house and from condensing mode of condensing turbine
6. Waste water generation from boiler blow down, WTP and cooling tower blow down

8.9.2. Boiler Specifications:

1. Super heated steam is generated in bagasse fired water tube boilers at different pressures and temperatures based on boiler specifications Normal range of boilers used in stand-alone sugar factories and with co-generation are given as below:

Working pressure (Kg/cm^2)	Type of furnace	Steam temperature (°C)	Fly-ash arrestor	WTP	Factory configuration
21	Horse shoe/dumping grate	350±5	Wet scrubber	DM plant	Stand alone sugar factory
32	Dumping grate/ travelling grate	410 ±5	Wet scrubber	DM plant	Stand alone sugar factory
45	Dumping grate/Travelling grate	450 ±5	Wet scrubber/ESP	DM plant	Stand alone sugar factory/co-generation
67	Travelling grate	485 ± 5	Wet scrubber/ ESP	DM+RO	Co-generation
87	Travelling grate	515 ± 5	ESP	DM+RO+UF	Co-generation
110	Travelling grate	540 ± 5	ESP	DM+RO+UF	Co-generation
130	Travelling grate	545 ± 5	ESP	DM+ RO+ UF	Co-generation

Above specifications at steam generation are based on the normal practices and based on the installation of boilers in standalone sugar factories and sugar factories with co-generation.

Depending upon the working pressure and temperature of boiler, the feed water quality is to be ensured and the best practice to ensure it and minimizing fresh water consumption is by utilizing maximum possible quantity of exhaust steam condensate from the Evaporator bodies. For the boilers up to 45 kg/sq. cm g pressure, vapour condensate of the I boiled vapours may be used with care, whereas, for higher pressure, it may not be possible to do so without improving its quality through Condensate Polishing Unit (CPU).

8.9.3. Steam Turbine Specifications: Factory uses following configurations of steam turbines:

a. Pure back pressure turbine

b. Single extraction back pressure turbine

c. Double extraction back pressure turbine

d. Single extraction condensing turbine

e. Double extraction condensing turbine

f. Condensing turbine

8.9.4 Fresh Water Consumption at Steam Generation: Fresh water is used during initial operation at the start of sugar factory at water treatment plant of the steam generation units, however, after stabilization of operation only small quantity of fresh water is used to make up water losses from boiler blow down, loss of return of condensate from boiling house and other unaccounted losses. In absence of flow meters for continuous monitoring and recording of fresh water consumption at steam generation in the factories, an estimation has been made based on the data and information provided by the factories for fresh water consumption. It is estimated that average fresh water consumption in co-generation power plant with high pressure boilers and Extraction-Condensing turbines varies from 10% to 15 % on cane crushed to cope up with the losses as per following details:

S.No	Particular	Fresh water, liters/ton of cane
1	Boiler blow down	15 - 20
2	Exhaust condensate loss in boiling house taken at 40 % steam consumption	15 -20
3	DM/RO rejection @ 25% of WTP capacity	10 - 15
4	Drift and evaporation loss in cooling tower during season	15 -20
5	Cooling tower blow down	20- 25
	Total	**75 - 100**

However, co-generation with low pressure boilers and back pressure turbines, the fresh water consumption is estimated from 5% to 7% on cane crushed. In case of standalone sugar factories with low pressure boilers and back pressure turbines, fresh water consumption is estimated to 1.5% to 2.0 and many times WTP remains in-operative. Boiler blow down water loss and exhaust condensate return loss in case of low pressure boilers up to 45 kg/sq cm g is usually made up from second condensate of evaporator and only in case of sugar trace in second condensate, it is make up by treated water of DM Plant.

8.9.5 Waste Water Generation from Steam and Power Generation Sections: Sources of waste water generation are considered as following:

1. Boiler blow down
2. DM/RO rejection
3. Gland leakages from boiler feed pumps
4. Cooling tower blow down
5. Gland cooling, wet sludge of wet scrubber etc.

It is estimated that waste water generation from steam and power generation may be 6.5% to 7.5% of cane crushed for co-generation with high pressure boiler and Extraction-Condensing turbines. For use of back pressure turbine in cogeneration, it may be about 3-4% of cane crushed and for stand-alone sugar factory without co-generation, it may be about 2.5 to 3.5% on cane crushed.

8.9.6Air Pollution: All sugar factories have either Wet Scrubbers or Electrostatic Precipitators to arrest fly ash and particulate matters from stack gases and maintaining the permissible limit of particulate matters below 150 mg/N m^3 in stack gases. Since sugar factories are achieving standards as per CPCB direction notified on air pollution, the technology in vogue is considered up to the mark.

8.9.7 Sugar Refining Process: As discussed in chapter 5, production of refined sugar differs substantially from production of plantation white sugar process as this being a two stage process, firstly producing raw sugar and then from sugar producing the refined sugar. The milling, steam and power generation operations being alike, the difference lies in the processing section where raw sugar is produced by the Defecation Process and then from raw sugar the desired quality of refined sugar is produced either by Phosphofloatation or Carbonation Process. For producing very good quality of the refined sugar use of Ion Exchange Resins or Active Carbons is made. Thus, while some of the unit operations viz. Sulphur di-oxide gas production, juice and syrup sulphitation are not required as in case of plantation white sugar, several more are added viz. melting of raw sugar, its clarification & de-colorization and necessity of having two different streams for raw & refined sugar crystallization, centrifugation and handling.

Almost all the back end sugar refineries in India use Phospho-floatation Process for production of refined/sulphur less sugar with or without employing Ion-exchange Process. The processing techniques necessitates higher steam and power consumption and also the water mass balances keeping in view the melting of raw sugar, de-colorization of sugar melt and production of two distinct qualities of sugar i.e. raw and refined sugar. While the advanced techniques shall have to be implemented at common places as been described earlier for the plantation white sugar, the brine recovery in case of sugar refineries assumes greater significance and shall require proper attention by employing proper membrane based or other suitable technologies to attain a brine recovery of at least 80%.

9. MODEL WATER MANAGEMENT SYSTEM & MONITORING:

9.1 Water Management: The sugarcane itself contains about 70% of water and after meeting all the requirements, about 10-12% of water is rendered surplus. However, the factories also draw fresh water for various uses and the consumption varies from 5% to around 15% on cane. Thus, for any conventional Double Sulphitation plant producing the plantation white sugar, the approximate effluent generation remains of the order of around 180-200 litres per tonne of cane i.e. 18-20% on cane, which may however vary depending upon the facilities for co-generation of export of power, boiler pressure & temperature and system of cold and hot water re-circulation.

The factories have realized the importance of conserving the natural resources and have adopted measures for condensate management and water recycling as a whole to reduce the fresh water intake and also to minimize the effluent generation by installing cooling towers and reservoirs of appropriate capacities. It is important that each and every drop of water is to be conserved and used so as to avoid exploitation of the natural resources. The factories should take all possible measures to collect hot or cold water without any contamination and re-use the water. The general trend with regard to use, recirculation of hot and cold water is presented in the table give below: -

Table -1: Hot water generation & requirement during processing

S.No.	Particulars	% on cane
A- Hot Water Generation		
1	Clear juice % on cane	118-120
2	Total condensate generation at clear juice brix -13.83 and syrup brix- 60	92-93
3	Flashing and condensation losses	2.5-3
4	**Net condensate available (excluding exhaust condensate) in process**	**90-91** **Say 90**
B- **Hot Water Required During Processing**		
1	For imbibition at mills	35-40
2	For MOL preparation & chemical prep.	2-3
3	At vacuum filter for filter cake wash	5-6
4	Movement water required for pan boiling	3-4
5	SHWW for batch centrifugals	3-4
6	Hot wash water for continuous C/F	2-3
7	For (B+C+C1+A1) Sugar melting	5-6

8	For Evaporator bodies chemical boiling & pan water boiling	2-3
9	Miscellaneous	3-4
	TOTAL	**68-72** **Say 70**
10	Surplus hot condensate available after using in process	20
11	Drift and evaporation losses while cooling of surplus hot condensate	0.5
	Surplus condensate Available After Cooling	**19.50**

Table -2: Cold water requirement

S.No.	Particulars	% on Cane
1	Cutter Bearing Cooling	5-6
2	Shredder Bearing Cooling	7-8
3	Mill Bearing Cooling	15-16
4	Mill Drive Bearing Cooling	10-12
5	Various Pump Gland Cooling	3-4
6	Sulphur Burner Gas Cooling	8-9
7	Air Compressor /Air blowers Cooling	4-5
8	Office, Lab , Washing& colony	6-7.5
11	Cleaning of Heat Exchanger Tubes	2-2.5
12	Boiler feed water make up	10-15
13	Other misc use	1.5-2.0
	Total	80-83

As mentioned earlier, in pursuit of lowering the fresh water consumption and waste water discharge, the factories have installed cooling towers alongwith UGRs. The surplus condensate after cooling can be used as make up water replacing the fresh water and the system has already been adopted by many sugar factories. Similarly, most of the re-circulating water for cooling can be re-used after cooling through fan-less cooling tower(s) and storage in underground reservoirs. Any shortfall in the quantity of cold water can be met through surplus cooled condensate instead of using the fresh water thus reducing fresh water requirement and effluent generation as well. A model hot and cold water recirculation system has been worked out by the Institute also and is enclosed as **Annexure-IV**.

9.2 Monitoring- Role of Automation & Instrumentation: Although, many and particularly those sugar factories established during the last decade have adopted reasonable instrumentation and automation so as to derive higher technical efficiency but still large no. of sugar factories lack on having such facilities and no proper monitoring or recording of process parameter including utilization of fresh water, usage of cold (fresh) water and hot (condensate) water for various usage is carried out. Even the factories which have gone for DCS based automation, in general, do not have facility for observing behaviour of water usage at various unit operations. The stand alone plantation white sugar factories, except for the first fill while starting the crushing season, should not require fresh water more than 5% on cane, i.e. 50 liters per ton of cane for its processing needs on continuing basis.

This shall be possible only when apart from taking various appropriate measures at various unit operations, closed loop hot and cold water circulation systems are put in place and proper monitoring and recording of water usage is made so as to take corrective action. The factories generally provide a flow meter in the common line of the tube well delivery catering to the needs of sugar plant, co-generation, colony and other misc. purposes and thus it is not possible to ascertain the fresh water requirements for sugar process house. Similarly, except for the imbibition water, flow meters are generally not provided by the sugar factories to measure and ascertain the flow of cold and hot water for various purposes. In their own interest and for proper water management, the sugar factories should install flow meters for following purposes and record the readings:

1. All tube wells should be equipped with water flow meters to measure the abstraction. The system should facilitate measurement of fresh water for use in sugar plant and at other places viz. co-generation units, human needs and residential buildings separately.

2. Flow meters for cold water usage to be provided at various unit operations/ places to measure:
   a. Power turbine cooling water quantity
   b. Mills, Fibrizer (& other cane preparatory devices) bearing and pumps/compressor gland cooling water quantity
   c. Requirement at DM/RO plant at boiler
   d. Sulphur di-oxide gas cooling
   e. B and C Massecuite cooling
   f. Final molasses cooling

g. As make water for shortfall at any unit operation including spray pond/process cooling tower.

h. Cleaning and human requirements including laboratory requirements.

3. Flow meters for hot water usage to be provided at various unit operations/ places to measure:

   a. Imbibition water at mills.

   b. Filter cake wash water at Rotary Vacuum Filter

   c. Water requirement at melting, pan Boiling and molasses conditioning etc.

   d. Wash water at Centrifugals

4. Installation of flow meters at following places to determine generation of gross effluent quantity and also its generation from major sources. They may be installed at:

   a. Outlet of mill house and boiling house.
   b. Outlet of steam generation house.
   c. Outlet of cooling tower/spray pond i.e. over flow.
   d. Inlet of Effluent treatment plant
   e. Outlet of Effluent treatment plant. It should also have an integrated real time monitoring system to monitor and transmit data relating to flow rate and other important parameters of pH, TSS and BOD etc.

In case of Sugar Refineries, necessary flow meter for brine reject is also required to be provided.

10. EXISTING NORMS/STANDARDS/GUIDELINES FOR EFFLUENT DISCHARGE FROM SUGAR FACTORIES:

As per the existing guidelines, the norms of waste water (effluent) discharge are:

Notification dated 14th January 2016 SR 35 (E)…regarding Effluent generation by Sugar Industry…

Parameters	Standard
pH	5.5-8.5
TSS (mg/liter)	100 (for disposal on land) 30 (for disposal in surface waters)
BOD (mg/liter) BOD (3days at 27 deg.C (mg/liter)	100 (for disposal on land) 30 (for disposal in surface waters)
Oil & Grease, mg/liter	10
TDS (mg/liter)	2100
Final waste water discharge limit	200 liter/ton of can crushed
Final treated effluent discharge restricted to 100 liter/ton of cane crushed and waste water from spray pond overflow or cooling tower blow down to be restricted to 100 liter per ton of cane crushed and only single outlet point from unit is allowed.	
Emissions from stack, mg/nm^3	150

11. EFFLUENT TREATMENT:

11.1 Envisaged Effluent Treatment Processes for Plantation White Sugar Factories:

Necessary up-gradation of the existing process for Effluent Treatment is considered necessary keeping in view the problems associated with treatment of Spray Pond overflow/Process Cooling Tower blow down from plantation white sugar factories. Approach for sulphate removal is completely physiochemical in nature involving precipitation of sulphate by addition of milk of lime and polyacrylamide chemical as a flocculants to aggregate the primary flocs and then it may be sent for settling in clarifier or lamella clarifies or in any other clarifiers adopted by the sugar factories.

To remove **sulphates** from waste water hydrated lime ($Ca(OH)_2$) may be added which may precipitate it as calcium **sulphate** and the same may be removed by settling/filtration.

$$Na_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2NaOH$$

The configuration of the ETP may differ as per effluent characteristics and availability of existing plant and machinery. The factories may opt for common treatment of all the waste water streams considering removal of Sulphates or may consider separate treatment of different waste water streams keeping in view their effluent loads and presence of Sulphates.

Four different options for separate & combined treatment of spray pond/PCT overflow are given below:

1. Separate treatment of spray pond overflow/ process cooling tower blow down by precipitating sulphur/sulphates using milk of lime/alum/hydrogen peroxide, removing precipitates through micro settlers followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

2. Combined treatment of entire effluent by precipitating sulphur/sulphates using milk of lime/alum/hydrogen peroxide, removing precipitates through micro settlers after removal of oil and grease followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

3. Spray pond overflow/ process cooling tower blow down to be treated for removal of sulphates and subsequently to be treated with boiling house & mill house effluent using anaerobic filters followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

4. Combined treatment of entire effluent for removal of sulphates and subsequently treated using anaerobic filters followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

Since technology development is a continuous process and it is possible that few more techniques of Effluent shall come up in future. Adoption and implementation of all such techniques shall be carried out by the sugar factories only after validation by the third party detailed elsewhere in this charter.

11.2 Envisaged Effluent Treatment Processes for Refined Sugar Factories:

The refined sugar factories having Ion Exchange Process for de-colorization of sugar melt shall have to ensure Double Stage Brine Recovery System so as to have brine recovery not less than 80%. Such refined sugar factories shall have to ensure proper collection of brine reject and their disposal via treatment in main ETP or by incinerating the same along with bagasse in boiler. However, the Sulphur-less Sugar producing units without having Ion-Exchange de-colorization system (generally they are also termed as refined as refined sugar units) shall not be required such system and also the sulphate removal system.

12. BEST AVAILABLE TECHNOLOGIES AND TARGETS:

12.1 For reducing effluent generation:

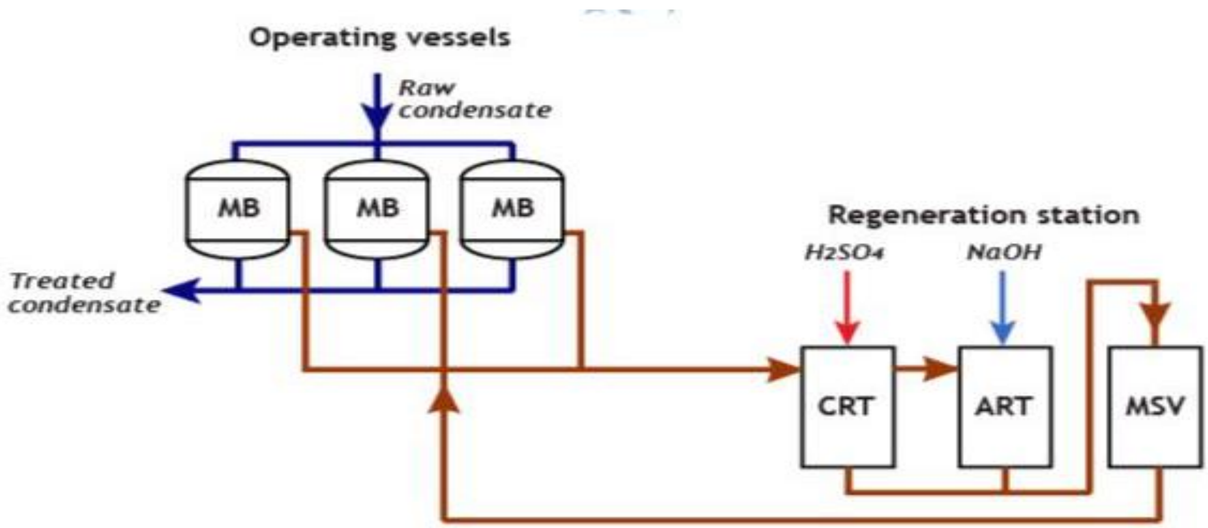
As discussed in the earlier paragraphs, it is possible to further reduce the fresh water consumption and waste water generation by adopting the best available technologies/ techniques and improved practices during the course of sugar production. While the configuration, type of plant and machinery, processing parameters and processing technique plays a major role in determining fresh water consumption and effluent discharge, it is equally important to monitor and adopt measures to minimize fresh water usage and generation of effluents from various processing units. Hence, sugar factories, in general, should focus on following to reduce fresh water consumption and waste water (effluent) discharge:

1. Provision of flow meters so as to record and control use of fresh water for different purposes i.e. sugar plant, co-generation, residential building and other uses is to be given top priority. Any reduction in the with-drawl of fresh water from natural resources shall result in corresponding lower waste water generation from the sugar factories.

2. Flow meters are also required to be provided at various unit operations of cold and hot water consumptions. Factories may consider providing some such broad loops so as to monitor and control the quantities of hot and cold water at major unit operations.

3. It is of utmost importance for the sugar factories to develop and implement a "Model condensate conservation cum Hot & cold Water Management System" focusing on maximum recycling of water so as to minimize fresh water consumption and hence the effluent generation as well. For the purpose, necessary system comprising cooling towers and underground reservoirs etc. may be implemented separately for cold re-circulating water and surplus condensate. As far as re-circulating cold waters are concerned, the factories may install separate cooling systems for different streams viz. for mill house, boiling house and power house.

4. Efforts should be made to use surplus condensate as replacement of fresh water at various places viz. for cooling purposes or as make up water at spray pond/process cooling tower or as boiler feed water. The factories should identify the different condensates available as per their quality and plan for their utilization accordingly. Quality of surplus condensates may further be improved to the desired extent e.g. for use as boiler feed water by installing Condensate Polishing Units. The units may be based on Reverse Osmosis, Demineralization and based on biological treatments. One such system for polishing the raw condensate is presented below, however, the choice will lie upon the quality of condensate and its end use.



5. The blow down from the co-generation cooling towers, DM/RO reject and boiler blow down etc. may also be treated through such polishing units or reverse osmosis units so as to recover good quality water which may be used as replacement for fresh water for various applications viz. cleaning of heat exchangers, dilution, gas, massecuite and molasses cooling etc.

6. Construction of small pits with smooth cleaned inner surface preferably with ceramic tiles may be carried out near to boiler feed pumps, condensate pumps,

injection pumps, spray pumps and RVF vacuum pumps to collect gland cooling water in their respective pits without any contamination. Similar arrangement may be provided at other places also. Reclamation of gland cooling water and other cooling water may be ensured and make up may be made from cold surplus condensate. Condensate recovery should also be ensured from all steam traps/vapour/steam line drains.

7. Hydro-jet cleaning of tubular heat exchangers appears to be a promising technique to reduce generation of effluent having higher pollution loads in comparison to conventional chemical + mechanical cleaning. The plantation white sugar factories may standardize the system of its use keeping in view the other benefits involved viz. lower cost of cleaning and damage to the heat exchange elements.

8. In case chemical cleaning of the heat exchangers is practiced, an underground reservoir of adequate capacity (so as to facilitate addition @ 5% max. v/v of total effluent) may be provided to collect washings and their addition to ETP gradually so as to avoid shock loads.

9. Good housekeeping must be ensured by preventing spillages, leakages and overflows etc. which otherwise increases the load of pollutants in the waste waters coming out of different sections of the factory.

10. Proper maintenance of process parameters is necessary to avoid over sulphitation of syrup and also preventing entrainment so as to minimize contamination of the process cooling tower/spray pond water, in particular. External catchalls may also be provided in the last body of the Evaporator and also in the pans.

11. Likewise, unnecessary blowing of safety valve and loss of exhaust steam/vapours through noxious gas removal system to be minimized. The radiation, condensation and losses due to leakages are also required to be minimized.

12. Dry cleaning of factory floors etc. using bagasse should be practiced instead of wet cleaning using water. The factories should resort to rain harvesting as a measure towards avoiding exploitation of natural resources and using ground water indiscriminately.

14. Most of the sugar factories are having wet scrubbers for arresting fly ash and suspended particulate matters. It has been observed that recovery of water from wet sludge remains poor which is attributed mainly to insufficient sludge drying and water recovery area. This results into increase in effluent generation and has also increased make up water. It is recommended to provide proper sludge drying facility with effective collection of water from sludge with effective recycling to minimize effluent generation and make up water requirement.

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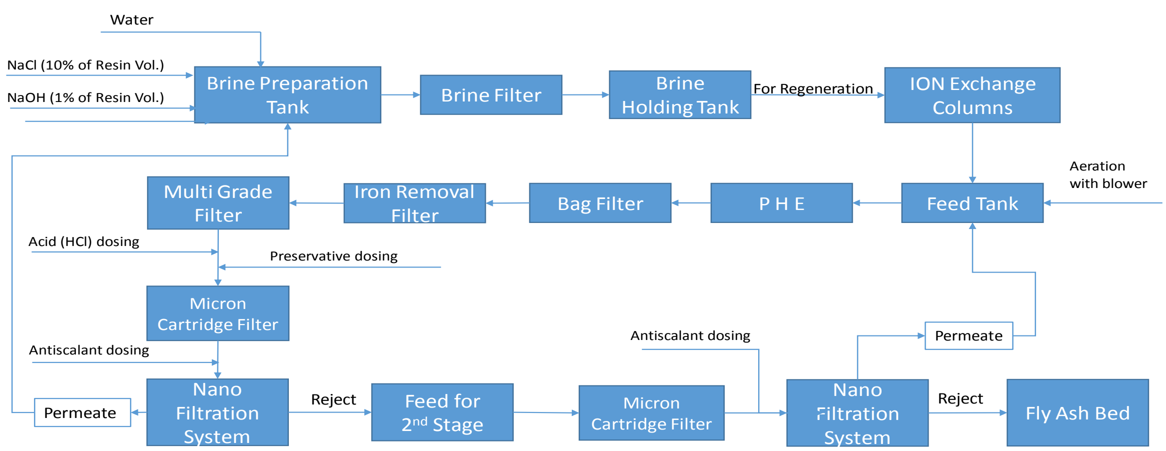

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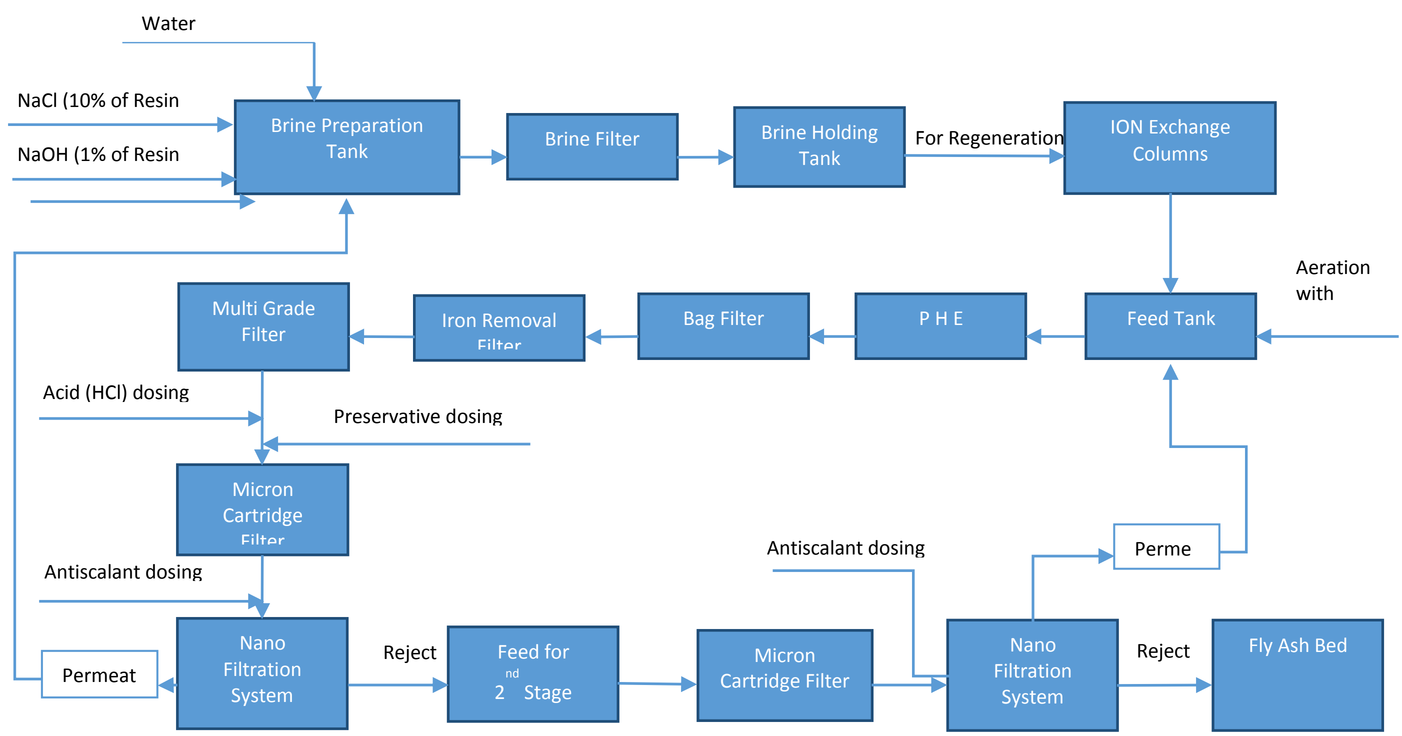


12.2 For Effluent Treatment:

The envisaged system for treating effluents from plantation white sugar factories have been discussed in the earlier paragraphs. However, an efficient Effluent Treatment Plant should be installed considering the following:

1. Units of adequate capacity to facilitate primary, secondary and tertiary treatment with provision for treatment of spray pond overflow/process cooling tower blow down so as to effectively remove sulphates.

2. Diffused aeration system to be preferred over the conventional surface aeration system in the equalization and aeration tank.

3. Instead of having sludge drying beds, keeping in view the limitation of area, the factories may also install Rotary Belt Filters or Filter Presses or Decanters for filtration of scums.

4. Provision of flow meter at the inlet and outlet of the Effluent Treatment Plant. It should also have an integrated real time monitoring system to record and transmit data relating to flow rate and other important parameters of pH, TSS and BOD etc.

5. Sugar factories to develop adequate infrastructure for operation and maintenance of the Effluent Treatment Plant along with adequate laboratory facilities for analyzing various waters/effluent for pH, TDS, TSS, BOD, COD and MLSS etc. The overall working of the Effluent Treatment Plant and Water Management System should be monitored by a qualified Environment Engineer, assisted by the following staff:

   5.1 For Operation & Maintenance of ETP: Fours nos. Operators either Intermediate in science or ITI having undertaken training on operation and maintenance of ETP from some recognized institute/college/university.

   5.2 For Analysis: Four nos. Analytical Chemists either Graduate in Science with at-least one-week training on analysis of such waters/effluent from some recognized institute/college/university or Intermediate with Certificate in Quality Control from National Sugar Institute or some other recognized institute/college/university.

13. STAKE HOLDERS:

Various Stakeholders of the programme are as under:

1. Indian Sugar Mills Association (ISMA)
2. National Federation of Cooperative Sugar Factories Ltd. (NFCSF)
3. UP Sugar Mills Association
4. Experts & Resource Institutes (NSI/IITs/ NEERI/ VSI)
5. State Pollution Control Boards (SPCBs)/ PCCs
6. Central Pollution Control Board (CPCB)
7. Ministry of Environment, Forests & Climate Change (MoEFCC)
8. National Mission Clean Ganga (NMCG)

14. PLAN OF ACTIVITIES:

Plan of Activities 1: Facilitation of Charter

Activities	Action By	Time
Identification of third party such as NSI, II 's or VSI by the sugar factory to facilitate the charter implementation and coordination	Sugar Factory	In off -season

Plan of Activities 2: Technological & Process improvements

Activities	Action By	Time
Self Assessment : Inventory of existing process technologies & practices, Identification of up-gradation requirement and preparation of action plan for upgradation with supporting document &pert chart	Sugar Factory	Monthly
Third Party Evaluation & Validation: Evaluation/validation of the reports on inventory, up-gradation requirements and action plan	Third Party & CPCBs	Half Yearly
Implementation of action plan envisaged as per document of individual sugar factory	Sugar Factory	As per Schedule
Submission of monthly progress reports to third Party/ CPCB	Sugar Factory	Monthly
Verification of progress	Third Party & CPCB	Periodic
Regulatory Review : Verification of the progress	SPCB	Periodic

Plan of Activities 3: Water Conservation & Water Recycling

Activities	Action By	Time
Installation of sealed flow meters on bore wells and inlet pipe line of different sections/equipments in sugar process house, steam & power generation etc.	Sugar Factory	Immediate
Maintenance of Online continuous effluent monitoring system to monitor final effluent discharge	Sugar Factory	Regular
Maintenance of log book to record daily water drawl from bore wells and water consumption at various stations/equipments	Sugar Mills	Daily
Maintenance of log book to record recirculation of treated effluent within the plant/colony/irrigation/other purposes	Sugar Factory	Daily
Self Assessment : Preparation of report of existing water consumption- section /equipment wise, reuse/recycle practices; Preparation of work plan to achieve fresh water requirement targets	Sugar Factory	Monthly
Third party Evaluation & Validation: Evaluation/validation of above work plan for implementation	Third Party/ SPCB	Half Yearly
Implementation of action plan	Sugar Factory	As per schedule
Submission of progress reports to third party & SPCB	Sugar Factory	Monthly
Verification of progress report	Third Party & SPCB	Periodic
Regulatory review : Verification of the progress	SPCB	Periodic

Plan of Activities 4: Assessment, Augmentation and up-gradation of ETP for improved environmental performance

Activities	Action By	Time
Self Assessment : Preparation of ETP adequacy assessment report; proposed augmentation and up-gradation plan, design & drawing, monthly pert chart	Sugar Factory	In off-season
Third party evaluation & validation : Evaluation & validation of adequacy report , proposed augmentation & up-gradation plan, design & drawing	Third Party & CPCB	Half Yearly
Implementation of action plan	Sugar Factory	As per schedule
Submission of progress reports to third party & SPCB	Sugar Factory	Monthly
Verification of progress report	Third Party& SPCB	Half Yearly
Regulatory review : Verification of the progress	SPCB	Periodic

Plan of Activities 5: Monitoring and surveillance of environmental Compliance

Activities	Action By	Time
Self monitoring & Reporting : ETP performance monitoring by individual sugar factory and maintenance of log book as per	Sugar Factory	Daily

prescribed format		
Submission of performance report to third party & SPCB	Sugar factory	Monthly
Review meetings of sugar factory to improve ETP performance & sample quality control	Third party & SPCB	Quarterly
Regulatory Monitoring; Periodic/surprise monitoring and review meetings	SPCB	Periodically/ Quarterly
Organisation of training programmes on process technology, best practices, ETP operation & maintenance , sample analysis etc.	Third party/SPCB/CPCB	Periodically

Plan of Activities 6: Strengthening of Environmental Cell and laboratory in the Sugar Factory to ensure improved environmental Compliance

Setting up of laboratory facility at Sugar Factory for manual Analysis:

(a) Minimum analysis facility for pH, DO, TSS, TDS, BOD, COD, MLSS/MLVSS, Colour

(b) Appointment of Scientific and Technical staff (at least one Environment Chemist and three duly trained/qualified Analytical Chemists)

(c) Training of the staff at reputed training institutes e.g. NSI/VSI/IIT etc.

(d) Frequency of Analysis

Parameters	Frequency of Sampling
pH	Two hourly
TSS, mg/Lit	Two hourly
BOD, mg/Lit	Every Day

COD, mg/Lit	Every day
TDS, mg/Lit	Two hourly
MLSS/MLVSS	Every day
DO	Daily
Colour	Thrice a day

14.1. Operation & Maintenance of ETP

To achieve the designed performance from ETP, it is necessary to operate it under optimum condition so as to meet the environmental discharge standards for which regular maintenance and analysis of performance parameters during season is necessary. For proper and optimum operation of ETPs, the sugar factory should ensure:

(a) Key guidelines for Operation & Maintenance

i. Ensure proper and optimum conditions as per the designed specification and manufacturer's instruction.

ii. Avoid fluctuation in effluent flow and pollution load so as to reduce the shock load to biomass and system as a whole.

iii. Ensure proper addition of nutrients.

iv. Maintain required level of MLSS/MLVSS concentration during biological treatment.

v. Maintain desired level of DO in the aeration tank (1-2 mg/L).

vi. Ensure timely and periodic withdrawal of sludge from the clarifiers.

vii. Proper maintenance of pumps, motors and auxiliary instruments etc.

viii. Periodic maintenance and running of standby pumps, motors etc.

(b) Documentation

Fresh water consumption, influent quantity, effluent discharge, effluent analysis, chemical consumption at ETP and steam & power consumption should be properly recorded in prescribed formats and periodically reviewed by competent authority.

14.2 Creation of Environmental Management Cell (EMC)

Every sugar factory will set up an Environmental Cell to effectively monitor the environmental compliance. The Environmental Cell will constitute of:

a. Unit / Business Head

c. ETP in-charge/ Environmental Engineer

d. Process Head

e. Environment Chemist

14.1 Duties of Environmental Management Cell

i. The Environmental Cell shall review the water consumption, measures taken and identify the areas for water conservation, resource recovery and pollution reduction every week.

ii. A detailed minutes of the decisions taken will be recorded and circulated to all members of Environmental Cell and follow up of the decisions will be monitored by the Unit Head & ETP in-Charge.

iii. Review to be made in case of non compliance by any department.

iv. Internal Audit to be done by the EMC on quarterly basis.

v. External Environmental audit on annual basis.

15. RESOURCE PLANNING:

(a) Responsibility of individual sugar factories:

It will be the sole responsibility of the sugar factories to implement the Charter and to comply with the prescribed norms/ standards. The entire cost towards implementation of the Charter as per the Plan of Activities shall be borne by the individual sugar factories. They shall carry out all the activities related to self assessment, preparation of action plan, including PERT Chart, implementation of the Charter and self compliance reporting. Participating sugar factories may take technical/ logistic assistance of experts or industry Associations for carrying out various activities as per the Plan of Activities. Some of the activities to be carried out by the individual factories are as under:

1. Preparation of inventory of existing process technologies and practices.
2. Identification of process technological up-gradation requirement w.r.t. the Charter.
3. Preparation of Action Plan, including monthly PERT Chart for implementation of the Charter for technological and process up-gradation.
4. Implementation of technological up-gradation action plan and submission of monthly progress report.
5. Preparation of ETP adequacy assessment report w.r.t. environmental compliance, actual production, effluent quantity, quality and targeted fresh water consumption; design, drawing and preparation of proposed augmentation and up-gradation plan, including monthly PERT Chart in accordance with the Charter.
6. Implementation of ETP up-gradation action plan and submission of monthly progress report.
7. Installation of sealed flow meter along with running hours meter on bore wells and log books so as to ascertain usage of fresh water for various uses.
8. Installation of flow meters at major areas of cold and hot water consumption. Maintenance of log book by individual process unit for recording daily water consumption.

9. Installation of flow meters for measuring generation of effluent from various prominent areas and maintenance of log book. This includes provision of flow meters at spray pond over/process cooling tower blow down and ETP inlet.

10. Setting up of online effluent monitoring system to monitor quality and quantity of effluent generation.

11. Colour coding of pipe lines carrying recycled process water and fresh process water.

12. Setting up of maximum water consumption targets for individual unit operation.

13. Report preparation of existing water consumption- section wise, reuse/ recycle practices, strategies/ work plan to achieve fresh water consumption targets on fortnightly basis.

14. Self monitoring and reporting: Daily ETP performance monitoring and maintaining Log Book as per the prescribed format.

15. Participation in periodic review meeting to be held by Third Party (NSI/IIT/VSI/ SPCB/ CPCB).

16. Strengthening of Environmental Cell and Laboratory facilities by recruiting competent staff and establishing analytical facilities.

19. Organising training programme for their personnel.

(b) Third Party: NSI/IIT/VSI

Each of the participating mills may identify either any one of the identified Third Parties or their respective SPCBs/ PCCs for evaluation & validation of their technical reports (self-assessment and planning reports: Preparation of inventory, ETP Adequacy & up-gradation, and Action plans to implement the Charter), and physical verification of individual sugar factories progress reports under the Charter Implementation Programme. Third parties, after verification/ validation of the progress reports, shall forward these reports to concerned SPCBs & CPCB on quarterly basis. However, regulatory verification shall be carried out by the concerned SPCB/ CPCB to ensure timely implementation of the Charter and compliance with the prescribed norms.

Third Party shall play pivotal role in encouraging their member sugar factories in implementation of the Charter and shall facilitate individual factories by arranging technical support. National Sugar Institute (NSI), IIT's and Vasantdada Sugar Institute (VSI) have been identified as Consultants as well as Third Party to facilitate the industry in implementation of the Charter and monitoring.

Participating sugar factories will have option to select and join any one as the Third Party from the list of third parties. Once joined the selected Third Party, the participating mills shall not be allowed to change their selected Third Party for a period of at least one year.

The Third Party shall perform following activities:

First Phase:

1. Evaluation & validation of individual sugar factory's Action Plan, including PERT Chart for implementation of the Charter for technological and process up-gradation.

2. Evaluation & validation of ETP adequacy assessment report w.r.t. environmental compliance of each sugar factory, actual production, pollution load generation and targeted water consumption; and design, drawing and proposed augmentation and up-gradation plan, including PERT Chart in accordance with the Charter.

3. Evaluation & validation of assessment report of individual sugar factory for existing water consumption- section wise reuse/ recycle practices; and their strategies/ work plans to achieve fresh water consumption targets.

4. Submission of validated individual mills action plans to concerned SPCBs and CPCB.

Quarterly/Half Yearly Activities:

1. Verification of progress made by individual sugar factory on process technology / ETP up-gradation as per their action plans

2. Verification of data with respect to fresh water consumption, effluent generation, its quality and water recycling achievement etc. in respect of each sugar factory.

3. Verification of progress reports submitted by participating sugar factories.

4. Compilation of Implementation Status Report for Submission to SPCBs/ CPCB
5. Compilation of ETPs performance report for submission to SPCBs/ CPCB
6. Organising Quarterly review meetings with participating distilleries/ SPCBs/ CPCB

Periodical:

To organise training/ workshop programmes on process technology & best practices, ETP operation & maintenance, sampling & analysis, etc for sugar factory personnel.

Cost of engaging third party/expert will be borne by the member sugar factories. Participating sugar factories shall pay/ reimburse fee to their selected third party towards meeting the expenditure for carrying out various activities/ responsibilities assigned/ to be assigned from time to time to the third party under the Charter. Each of the identified Third Parties shall provide the estimated project cost as per the scope of work to member distilleries willing to join them, who shall also be responsible for ensuring the payment of the services to third party.

(c) SPCBs:

SPCBs/ PCCs shall ensure proper implementation of the Charter by the individual sugar factories. They shall be responsible for monitoring and surveillance activities to ensure

environmental compliance. Participating sugar factories will not be allowed, under any circumstances, for bypassing of ETP systems and discharge of partially/ untreated effluent or episodic discharge. In case of any violation of the prescribed norms, concerned SPCBs will take appropriate actions, including issuance of closure directions, under the Water/ Air Acts/ E (P) Act.

Each of the participating sugar factory shall have option to join either any one of the identified Third Parties or their respective SPCBs/ PCCs for evaluation & validation of their technical reports (self assessment and planning reports: Preparation of inventory, ETP Adequacy & upgradation, and Action plans to implement the Charter), and physical verification of their progress reports under the Charter implementation programme.

Some of the activities identified for SPCBs/ PCCs are as under:

- To ensure proper implementation of the Charter by the individual sugar factories.
- To undertake monitoring and surveillance activities to ensure environmental compliance.
- To take appropriate actions under the Water/ Air Acts/ E(P)Act in case of any violation of prescribed norms.
- Participation in evaluation /validation of the status assessment reports, action plan for Charter implementation/ process/ ETP up-gradation.
- To arrange quarterly review meetings of sugar factories, Third Parties & CPCB to facilitate sugar factories in timely implementation of the Charter.

Surveillance Activities:

Verification of progress reports (on half yearly basis in case directly submitted by participating sugar factories, and on random basis in case of submission through Third Party.

Compilation of Implementation Status Report for Submission to CPCB on Half Yearly Basis.

Extensive Surprise monitoring

(d) CPCB:

CPCB shall supervise and co-ordinate with stake holders namely participating sugar factories, Third Parties, Expert Institutions, and SPCBs/ PCCs. CPCB shall periodically review the progress of implementation of the Charter and carry out environmental compliance assessments. Based on findings of the review meetings, CPCB shall take necessary actions namely modification in the Charter/ Action Plan/ roles & responsibilities of participating agencies.

Some of the activities identified for CPCB are as under:

1. Participation in review meetings organised by third parties/ SPCBs.

2. Organising quarterly/ half-yearly review meetings of participating sugar factories/ third parties/ SPCBs to review the progress of the Charter implementation programme.
3. To supervise, co-ordinate and support to stake holders.
4. To take necessary actions namely modification in the Charter/ Action Plan/ roles & responsibilities of participating agencies, interpretation of the provisions prescribed under the Charter, approval for any state of the art technology, etc.
5. Surprise monitoring.

16. CONDITIONS NECESSARY FOR TIMELY IMPLEMENTATION OF THE CHARTER:

1. The implementation of the Charter will be considered to be commenced on the date of issuance of directions/ instructions from SPCBs/ PCCs and the entire action plan will be implemented as per specified dates.

2. Participating sugar factories will submit their time bound action plans in the form of affidavit to their respective SPCBs/ CPCB for implementation of the Charter as per the Plan of Activities and other Terms & Conditions.

3. Sugar Factories shall sign MoUs/ Agreements with their selected Third Parties to participate in the programme as per the Plan of Activities and to reimburse the third party expenditure and shall sanction the project as per their mutual agreed ToR.

4. Sugar Mill Associations, which have agreed to implement the Charter as per CPCB/ SPCBs guidelines, will be allowed to achieve short term, and long term objectives as prescribed by the Charter within the agreed implementation period. Participating sugar factories will not be allowed, under any circumstances, for bypassing of ETP systems and discharge of partially/ untreated effluent or episodic discharge. In case of any violation, SPCBs/ CPCB will take appropriate actions, including issuance of appropriate directions under the provisions of
Water/ Air.

Acts/ Environment (Protection) Act:

1. No regulatory impediments: Any process modification, construction activity or any other action required to be undertaken by a sugar factory in pursuit of the objectives of this Charter should receive necessary clearances from SPCBs with utmost speed. Concerned authorities should set in place a fast-track, single-window clearance mechanism.

2. Any order/ direction prescribed by any court of law/ tribunal in respect of individual industrial unit or in general, shall overrule the provisions/ norms prescribed under this Charter, and shall be complied by the sugar factories.

3. SPCBs/ PCCs may prescribe conditions/ norms, etc. stringent than those prescribed under this Charter, and shall be complied by the sugar factories.

4. MoEFCC/ CPCB/ SPCBs/ PCCs may issues directions/ instructions and/ or take up programmes for implementation of advanced technological and managerial tools to achieve further higher technological and compliance status in future for prevention, control and abatement of environmental pollution and to meet the objectives of National Mission for Clean Ganga (NMCG).

5. For any clarification and modification in the Charter, Chairman, CPCB will be the sole authority.

17. TARGETS:

The sugar factories should not only aim to achieve the current norms of discharge pronounced but also look forward for doing better in the interest of the environment, nation and their self interest. At present, only one set of norms exists for the sugar factories irrespective of the type of sugar being produced, availability of co-generation facilities and configuration of the machinery.

It is reiterated that for controlling the effluent generation to meet the above norms and to improve further it would be essential that fresh water requirements are brought down by the sugar factories through measures discussed in the foregoing paragraph. Any effort in this regard shall not meet with complete success unless restrictions on fresh water abstraction are forced upon the sugar factories. As such, the sugar factories may restrict their fresh water consumption as per following details:

S.No.	**Type of Sugar Unit**	**Fresh Water Usage (per ton of sugarcane)**	
		Short term	**Long term**
1	Standalone Plantation White Sugar Factories	50	30
2	Plantation Whiite Sugar Factories having high pressure boiler (above 67 kg/cm g pressure) and carrying out power export.	80	50
3.	Standalone Integrated Sugar Refineries	80	50
3.	Refined Sugar Factories having high pressure boiler (above 67 kg/sq cm g pressure) and carrying out power export.	100	60

Thus, the notification with respect to generation of effluent by the sugar industry may be revised considering following:

1. Considering four distinct cases of sugar factories:

   (a) Stand-alone Plantation White Sugar Factories

   (b) Plantation White Sugar Factories having high pressure boilers (above 67 kg/sq cm g pressure) and carrying out power export.

(c) Stand-alone Integrated Sugar Refineries.

(d) Refined Sugar Factories having high pressure boilers (above 67 kg/sq cm g pressure) and carrying out power export.

2. Addition of Sulphate Content as one more parameter for quality assessment of effluent in case of plantation white sugar manufacturing sugar factories.

3. Modifying the existing norm of effluent discharge *"Final treated effluent discharge restricted to 100 liter/ton of cane crushed and waste water from spray pond overflow or cooling tower blow down to be restricted to 100 liter per ton of cane crushed and only single outlet point from unit is allowed"* considering the practicality and also the requirement of treating the spray pond overflow or process cooling tower blow down by indicating the total quantity of treated effluent quantity permissible.

4. Inserting norms for maximum permissible drawl of fresh water in case of plantation white sugar factories.

5. The short and long term recommendations shall have to be complied by 30th September 2018 and 31st March 2019 respectively.

Keeping above in view, following four distinct norms for effluent generation/discharge may be prescribed for the plantation white sugar factories:

(a) Stand-alone Plantation White Sugar Factories

Proposed norms of effluent generation by Standalone Plantation White Sugar Factories

Parameters	Short Term	Long Term
pH	5.5-8.5	5.5-8.5
TSS (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
BOD (mg/liter), max BOD (3days at 27 deg.C (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
Oil & Grease, mg/liter, max	10	10
TDS (mg/liter), max	2100	2100
Final treated effluent discharge limit, max	180 liter/ton of cane crushed	160 liter/ton of cane crushed
Emissions from stack, mg/nm^3, max	150	150

(b) Plantation White Sugar Factories having co-generation (carrying out power export)

Proposed norms of effluent generation by Plantation White Sugar Factories carrying Power Export

Parameters	Short Term	Long Term
pH	5.5-8.5	5.5-8.5
TSS (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
BOD (mg/liter), max BOD (3days at 27 deg.C (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
Oil & Grease, mg/liter, max	10	10
TDS (mg/liter), max	2100	2100
Final treated effluent discharge limit, max	200 liter/ton of cane crushed	200 liter/ton of cane crushed
Emissions from stack, mg/nm ^{3}, max	150	150

(C) Stand-alone Backend Refined Sugar Factories

Proposed norms of effluent generation by Refined Sugar Factories

Parameters	Short Term	Long Term
pH	5.5-8.5	5.5-8.5
TSS (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
BOD (mg/liter), max BOD (3days at 27 deg.C (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
Oil & Grease, mg/liter, max	10	10
TDS (mg/liter), max	2100	2100
Final treated effluent discharge limit, max	200 liter/ton of cane crushed	180 liter/ton of cane crushed
Emissions from stack, mg/nm ^{3}, max	150	150

(D) Backend Refined Sugar Factories with Co-generation

Proposed norms of effluent generation by Refined Sugar Factories with Co-generation

Parameters	Short Term	Long Term
pH	5.5-8.5	5.5-8.5
TSS (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
BOD (mg/liter), max BOD (3days at 27 deg.C (mg/liter)	30 (for disposal in surface waters or land)	30 (for disposal in surface waters or land)
Oil & Grease, mg/liter, max	10	10
TDS (mg/liter), max	2100	2100
Final treated effluent discharge limit, max	200 liter/ton of cane crushed	200 liter/ton of cane crushed
Emissions from stack, mg/nm^3, max	150	150

18. BARE MINIMUM TECHNOLOGY (BMT)

BMT is indicative of the systems, equipment, processes and practices that are generally considered essential to achievement of the objectives of this Charter.

Technology actually required, or implemented, by individual sugar factories to achieve the same documented level of environmental protection, may differ on account of their unique set of circumstances like scale of operations, equipment & system configuration, product portfolio, raw material etc.

Bare Minimum Technologies (BMT)			
Sl. No	**Functional Area**	**Facility Required**	
		BMT/Optional	**Type of facility**
1	**Cane preparation and juice extraction**		
1.1	Cane unloading	BMT	Cane carrier of suitable width & length with variable speed drive
		BMT	Hydraulic grabs with cross and longitudinal travel trolleys/ sling bar for cane unloading
			Truck /trolley tippler
1.2	Cane Preparation		System to ensure Preparatory Index (PI) of 85+ by installation of :
		Optional	Cane kicker
		BMT	cane leveller/cane chopper, cane cutter and swing hammer fibrizer/cane shredder
		BMT	Rake elevator below fibrizer/ shredder with variable drive
		BMT	Interlocking system in cane preparatory devices with cane carrier
		BMT	Closed loop water circulation for cooling of bearings of preparatory devices
1.3	Cane Milling	BMT	To attain a Reduced Mill Extraction (RME) of 96+ , a milling tandem comprised of 4 three rollers mills with toothed UFR and Donnelly chute with rake carriers between the mills or any other combination using 2/3 rollers mills with UFR/TRF/GRPF/TRPF
		BMT	Each mill driven by a variable speed DC drive with speed reduction through enclosed reduction gear box/ planetary gear
		BMT	Interlocking of all Rake elevator & rake carriers with mills
		BMT	Hydraulic loading and hot water Compound Imbibition using hot water of 85^{o}C @ 250-300% on fibre or as required. Flow measurement & control system to be installed
		BMT	Closed loop water circulation for cooling of mill bearings & mill drives
1.4	Spillage Monitoring & Control	BMT	Spill pits/tanks, and drainage system for containment/recovery, dry cleaning of floors with bagasse.

2.0	**Steam Generation**		
		BMT for < 45 kg/cm^2 pressure boiler	Bi-drum boiler with tube bank, front, roof, rear and sides water walls. Super heater, economiser, air pre-heater with ID, FD SA fans etc. Wet scrubber for arresting ash and particulate matters (PM)
		BMT for > 45 kg/cm^2 pressure boiler	Bi-drum boiler with tube bank, front, roof, rear and sides water walls. Primary & secondary Super heaters, atemperator, economiser, air pre- heater, de-aerator, ID, FD, SA fans etc. Electrostatic Precipitator (ESP) for arresting ash and particulate matters (PM)
2.1	Instrumentation & control	BMT	Instrumentation , automation & control through DCS
2.2	Waste water re-cycling	BMT	Closed loop re-circulation of waste water generated from RO/DM reject and boiler blow down after treatment in ETP
2.3	Ash disposal	BMT	Supply to cement plant/ filling of low lying land/ bio-composting
3.0	**Power Generation**		
3.1	With/ without Incidental co-generation	BMT for boiler pressure up to 45 kg/cm^2	Back pressure/ Bleed cum back pressure steam turbine coupled with an alternator to generate electricity at 11 KV
3.2	With incidental co-generation	BMT for boiler pressure above 45 kg/cm^2	Back pressure/ Bleed cum back pressure/ Extraction cum condensing steam turbine coupled with an alternator to generate electricity at 11 KV
3.3	With incidental and off season co-generation		Extraction cum condensing (EC) steam turbine coupled with an alternator
			Water cooled condenser, cooling towers of suitable capacity for EC turbine
			Closed loop cooling water circulation at power generation with cooling tower of suitable capacity
			Suitable switch yard for power export to grid
4.0	**Handling of Discharges**		
4.1	**Waste water Discharges**		
4.1.1	Wastewater Treatment	BMT	Separate treatment of spray pond/ PCT overflow for sulphates removal followed by combined treatment with other wastewater streams after removal of oil & grease passing through primary, secondary and tertiary treatment
		BMT	Primary treatment : comprising course & fine screening, stabilization/equalization with aeration, settling in clarifier, primary sludge dewatering
		BMT	Secondary treatment : comprising anaerobic treatment in case of high COD, aerobic treatment with diffused

			aeration (Activated Sludge Process), secondary settling in secondary clarifier, thickening of sludge through centrifuging/ decanting /sun-drying(sludge drying beds)
		BMT	Tertiary treatment : comprising of multi-grade filter (MGF) and activated carbon filter (ACF) of suitable capacity
4.1.2	Effluent Treatment Plant (ETP) design	MBT	
4.1.3	Treated wastewater disposal		As per norms of CPCB/SPCB
4.1.4	Condensate Polishing Unit	BMT for surplus condensate for factories having boiler > 45 kg/cm^2 steam pressure	Reverse Osmosis (RO) followed by MGF and ACF or any other proven technology. Treated condensate may be used for various purposes e.g. power plant cooling tower make-up.
4.2	**Atmospheric Discharges**		
	Stacks		All stacks to be preceded by ESP or multi cyclone with wet scrubber as appropriate to arrest ashes and particulate matters
5.0	**General Pollution Abatement Measures**		
5.1	Resource Management		Optimum use of all material resources through input-output analysis and establishment of moving targets for specific consumption of inputs. Cost audits to be moderated by environmental considerations.
5.2	Good house keeping		Containment and management of material spillages to prevent contamination of soil, ambient air and ground water, besides increasing pollution loads and vitiating workplace environment.
5.3	Chemical cleaning of heat exchangers		Trial & use of hydroject cleaning in place conventional chemical + mechanical cleaning to the extent possible. Construction of " Hazardous Tank" to collect washings of chemical cleaning & for adding gradually in main ETP
5.4	Monitoring & control		Factory –wide fresh water distribution networks be colour coded (as per BIS) to identify process, utility and domestic supplies.
6.0	**Environmental Management Systems**		
6.1	Environmental Control Laboratory		Establishment of testing facilities, manned by trained and dedicated staff, for routine monitoring of effluent generation and performance measurement of pollution control systems, equipment and devices. The staff will also be responsible for maintaining proper records and initiating non-compliance warnings.
6.2	Environmental Audits/ Third party inspection		Half Yearly Comprehensive Audit/ third party inspection
			Performance audit/inspection by third party during season

7.0	**Compliance Monitoring**		
7.1	Off-line routine monitoring		Routine analysis of pH, TSS, COD, BOD, TDS, DO, Colour, MLSS etc. for waste water (effluent) and treated effluent from ETP
			Routine analysis of PM, SO_2, NOx , CO_2, O_2 for stacks
			pH, TSS, COD, TDS, MLSS, colour daily. Air quality measurements as prescribed by SPCB
7.2	Flow measurement		Magnetic flow meter with remote mounted transmitter and totalizer feature with connectivity to a remote PC through an RTU
7.3	Online Continuous Monitoring for wastewater		Online monitoring for flow, pH, TSS, BOD, TDS of treated water as required by SPCB
7.4	Online Continuous Monitoring for air emission		Particulate Matter (PM) emission from stacks as required by SPCB
8.0	**Manufacturing of Plantation White Sugar**		
8.1	Juice weighment	BMT	Mass flowmeter of suitable capacity with arrangement for check weighment. System to have auto juice flow control system to have stabilized flow to process.
8.2	Juice heating	BMT	Heating the raw juice and sulphited juice to 68-70 ^{0}C and 103-104^{0}C in tubular/DCH/PTHE/Condensate heaters of suitable heating surfaces in multiple stages. Similarly heating the clear juice in Tubular/PTHE/DCH to desired temperature. Condensates to be utilized for various purposes in mill and boiling house.
8.3	Clarification	BMT	Clarifying the heated raw juice by addition of milk of lime @ 1.2-1.8%, v/v and SO_2 gas in a juice Sulphiter preferably having auto pH control system.
8.4	Milk of lime preparation	BMT	Slacking quick lime with condensate and screening it through hydro cyclone/vibro screen/Koran classifier.
8.5	SO_2 generation	BMT	Generation of sulphur di-oxide in film type sulphur furnace having combustion control and molten sulphur feed control system with efficient cooling of gas to 70-72^{0}C. Re-circulation of cooling water through fanless cooling towers to minimize fresh water usage.
8.6	Settling	BMT	Use of efficient Rapi Dorr 444 type or equivalent clarifier with retention time not exceeding 2 ½ hours.
8.7	Filtration	BMT	Filtration of underflow/muddy juice from clarifier to recover juice in RVF. Hot condensate of about 70^{0}C to be used for cake wash. Alternatively use of Decanters. Quantity of wash water to be monitored by installing flow meters.
8.8	Evaporation	BMT	Concentration of juice so as to convert it in to syrup using Multiple Effect Evaporators, Quadruple or Quintuple with

			extensive vapour bleeding system to have heat recovery arrangement through installation of condensate cigar & condensate Heaters. Exhaust steam condensate to be used as boiler feed water, whereas condensate from other bodies to be used for meeting requirements of mill & boiling house. For boilers up to 45 kg/cm^2 g pressure, II^{nd} body condensate to be used partially as boiler feed water make up, whereas, for higher boiler pressure, it is to be used after treatment though CPU.
8.9	Syrup Sulphitation	BMT for	Bleaching the syrup obtained from Evaporators to a pH 5.2-5.4 using SO_2 gas.
9.0	Crystallisation	BMT	**a.** Further concentration of sulphited syrup in vacuum pans (single effect evaporators) to carryout crystallization of sugar. Low head batch pans/ low head batch pans with mechanical circulator/continuous vacuum pans to be used. Level of boiling mass in pan and fluctuation in vacuum to be avoided to inhibit entrainment. Tell tail bottles to be provided to periodically check any entrainment. Use of hot water during pan boiling to be measured by installing flow meter & efforts to be made to keep it as low as possible. Condensates to be utilized in a closed loop for meeting mill & boiling house requirements. **b.** Cooling & conditioning of massecuite boiled in vacuum pans in air/water cooled batch/ continuous crystallizers. A – massecuite to be hot cured, B-massecuite cooled to about 52-54°C & C massecuite to be cooled to 40-42°C & then reheated to 52-54°C. Proper cooling arrangement to be provided for re-circulating cooling waters.
9.1	Centrifugation	BMT	Separation of sugar crystals from mother liquor by centrifuging in fully automatic recycling type batch centrifugal in case of A- Massecuite and in continuous machines in case of other massecuite. Quantity of wash water to be monitored & controlled by installing flow meters.
9.2	Cooling & Condensing		Installation of single entry stainless steel jet condensers. The difference between vapour and tail pipe temperature to be less than 10^0C. For spray ponds, minimum drop of 13^0C or within 7^0C of wet bulb temperature, whichever is less, to be achieved. For cooling towers, minimum drop of 20^0C or within 5^0C of wet bulb temperature, whichever is less, to be achieved.
9.2	Sugar Dryer	BMT	Drying of sugar on grass hoppers or fluidized bed dryers to the extent that level of moisture should not be more than 0.03 % w/w.

10.0	**Additional steps for production of Refined Sugar**		
10.1	Raw sugar melting	BMT	Raw sugar melting in sweet water generated from IER and hot condensate.
10.2	Filtration	BMT	Filtration of raw sugar melts through vibro screen / stationary screen of about 0.75 mm opening.
10.3	Remelt liquor heating	BMT for phosphatation process.	Remelt filtered liquor heating in DCH or PTHE up to 85^0C of suitable heating surfaces.
10.4	Clarification	BMT	Clarifying the heated remelt liquor by addition of colour precipitant of about 100-150 ppm & about 400-500 ppm P_2O_5 on solid and milk of lime of 2-2 ½ ^{0}Be. Retention time in reaction tank to be about 8 minutes and in floatation clarifier to be about 30 minutes.
10.5	Filtration	BMT	One or two stage filtration of underflow using MBF/ candle / leaf filters of suitable filtering area & filtration rate of about 0.45-0.50 m^3/m^2/hr.
10.6	Decolourization	BMT for ion exchange resin	Decolourization of clarified liquor in two stage IER columns used in series or in parallel using Acrylic & Styrenic type resins. Two stage brine recovery system to be provided for facilitating 80% recovery.
10.7	Melt Concentration	BMT	Evaporation in Double / Triple Effect Evaporator to convert it in to concentrated liquor of about $74\text{-}75^0$Bx. Condensates to be utilized for various purposes of melting etc.

19. CHECK POINTS:

1. All the tube wells should be equipped with water flow meters having totalizer to measure the abstraction. The system should facilitate measurement of fresh water for use in sugar plant and other places viz. co-generation units, human needs and residential buildings separately. Suitable log books also to be maintained.

2. Flow meters for cold water usage to be provided at various unit operations/places to measure:

   a. Power turbine cooling water quantity

   b. Mills, Fibrizer (& other cane preparatory devices) bearing and pumps/compressor gland cooling water quantity

   c. Requirement at DM/RO plant at boiler, wet scrubber

   d. Cooling tower of co-generation

   e. Sulphur di-oxide gas cooling

   f. B and C Massecuite cooling

   g. Final molasses cooling

   h. As make water for shortfall at any unit operation including spray pond/process cooling tower.

   i. Cleaning and human requirements including laboratory requirements.

3. Flow meters for hot water usage to be provided at various unit operations/ places to measure:

   a. Imbibition water at mills.

   b. Filter cake wash water at Rotary Vacuum Filter

   c. Water requirement at sugar melting, pan boiling and molasses conditioning etc.

   d. Wash water at Centrifugals

4. Installation of flow meters at following places to determine generation of gross effluent quantity and also its generation from major sources. They may be installed at:

   a. Outlet of mill house and boiling house.

   b. Outlet of steam generation house.

c. Outlet of cooling tower/spray pond i.e. over flow.

d. Inlet of Effluent treatment plant

e. Outlet of Effluent treatment plant. It should also have an integrated real time monitoring system to monitor and transmit data relating to flow rate and other important parameters of pH, TSS and BOD etc.

5. Recirculation of water employed in SO2 gas coolers with proper cooling through cooling towers.

6. Construction of small pits with smooth cleaned inner surface preferably with ceramic tiles near to boiler feed pumps, condensate pumps. Injection pumps spray pumps and RVF vacuum pumps to collect gland cooling water in their respective pits without any contamination.

7. Dry cleaning of factory floors etc. using bagasse instead of wet cleaning using water.

8. Construction of 'Hazardous tanks' of adequate capacity to collect wash water generated during chemical/mechanical cleaning of evaporator tubes and discharging it in a controlled manner to the ETP. Alternatively, cleaning of evaporator tubes by 'Hydrojet', and reuse the water after allowing the wash water to stand for some time in settling tanks.

9. Use of hot water should be minimised by exercising proper control during the pan boiling operations except for grain hardening and molasses conditioning to improve the quality of the bagging sugar and also lower the steam consumption.

10. Re-circulation of cooling water used for cooling B and C- massecuites with proper cooling through cooling towers arrangement rather drawing fresh water.

11. Minimum and measured quantity of wash water to be applied at centrifugals for B and C massequite curing to minimize loss of sugar in molasses and to control steam consumption.

12. Installation of CPU (Condensate Polishing Unit) where high pressure boiler more than 45 kg/cm2 working pressure are used.

13. Use of membrane based (2-stage) or other suitable technologies to attain a brine recovery of at least 80% in sugar refineries having Ion Exchange Resins for de-colorization of the sugar melt.

14. Use of surplus cooled condensate as make up water replacing the fresh water thus reducing fresh water requirement and effluent generation as well.

15. Closed loop hot and cold water circulation systems should be put in place and proper monitoring and recording of water usage is made so as to take corrective action.

16. Four different options for separate & combined treatment of spray pond/PCT overflow are given below:

    a. Separate treatment of spray pond overflow/ process cooling tower blow down by precipitating sulphur/sulphates using milk of lime/alum/hydrogen peroxide, removing precipitates through micro settlers followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

    b. Combined treatment of entire effluent by precipitating sulphur/sulphates using milk of lime/alum/hydrogen peroxide, removing precipitates through micro settlers after removal of oil and grease followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

    c. Spray pond overflow/ process cooling tower blow down to be treated for removal of sulphates and subsequently to be treated with boiling house & mill house effluent using anaerobic filters followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

    d. Combined treatment of entire effluent for removal of sulphates and subsequently treated using anaerobic filters followed by secondary aerobic treatment and tertiary treatment through sand filter and activated carbon filter.

17. Maintaining of Retention /contact time in various units of ETP viz. equalization tank, aeration tank, primary and secondary clarifiers, multi-grade filters, multi grad and activated carbon filter etc. as given in table below:

Equipment Type	Function/ Description of equipment	Retention /contact time
Bar screen Chamber	To remove course materials and derbies from the effluent	Retention time: 30 minutes RCC chamber with Mild Steel epoxy for screen
Oil & grease trap	Used for recovery of oil & grease from effluent	Retention time : 45 minutes
Equalization Tank with aeration	It helps in pH and temperature stabilization	Retention time: 6 hrs. Diffused aeration in the tank to be provided
pH correction tank[#]	It neutralizes the raw effluent by dosing either acid or alkali depending on the pH of raw effluent.	One RCC tank to give retention of 10 minutes of effluent.
		One agitator in the tank is to provided
Primary clarifier	Used for recovery of suspended solids from the effluent.	Retention time: 5-6 hrs
Aeration Tank	Used for degradation of organic matter present in the effluent	Retention time: 24-28 hrs
Secondary clarifier	Used for separation of biological suspended solids from the effluent	Retention time : 7-8 hrs
Multi Grade Filter	It is to remove the residual suspended solids of the biologically treated effluent	Contact time : 20.0 – 25.0 minutes
Activated carbon filter	The adsorb various colouring impurities	Contact time : 20.0 – 25.0 minutes
Sludge drying bed OR	To dewater the sludge and recover the associated water through bed	Not less than 0.03 m^3 per ton of cane.
Centrifuge OR	To dewater the sludge and recover the associated water through centrifuging the sludge	The equipments to be of adequate capacity for handling the sludge generated in the process.
Filter press	To dewater the sludge and recover the associated water through filter press	

In case of plantation white sugar factories, installation of sulphate removal system.

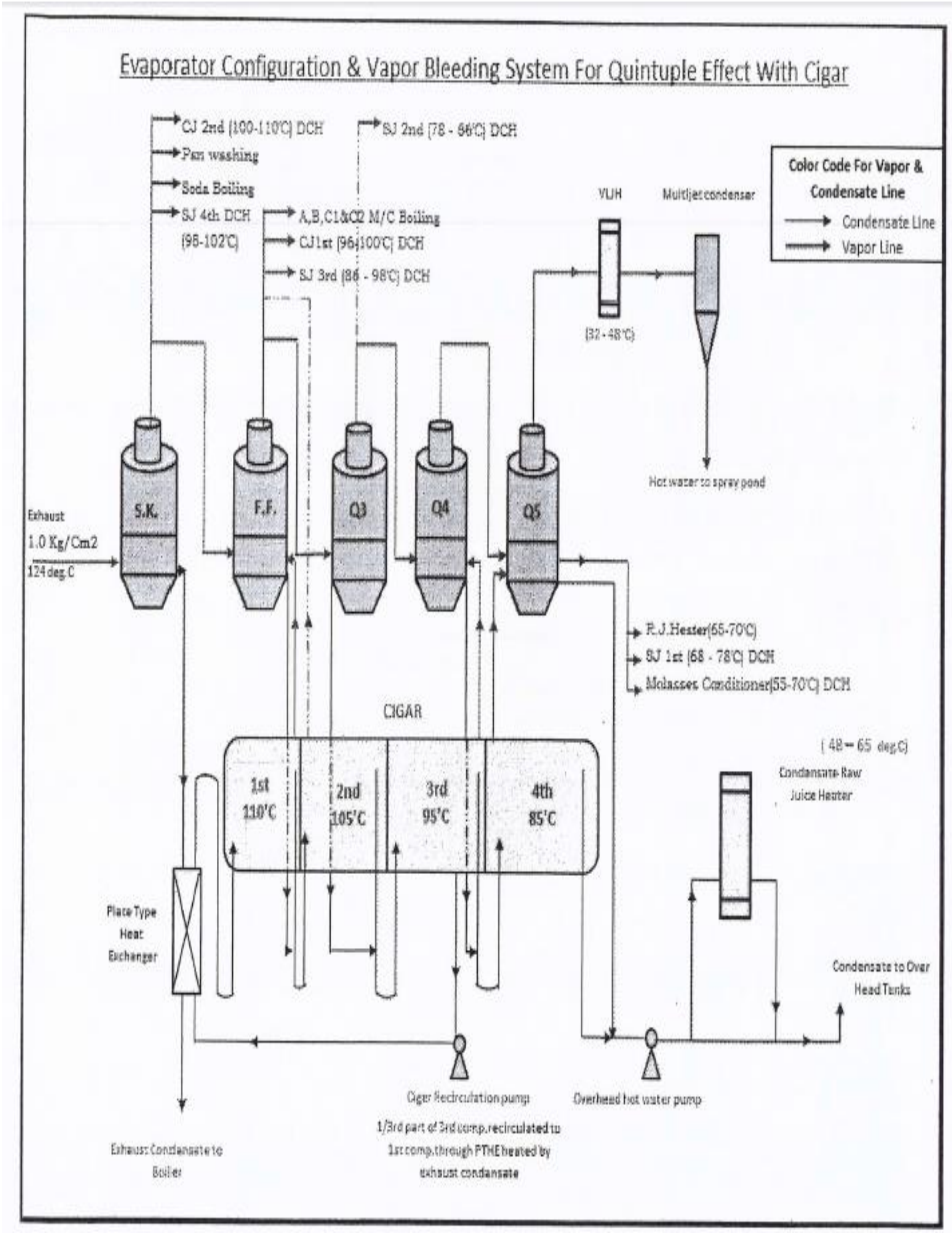
In case of Refined Sugar Units having Ion-Exchange Process of decolourization, two stage brine recovery system to be installed to ensure 80% recovery of brine.

18. Adoption of rain water harvesting system.

19. Development of proper infrastructure for operation and maintenance of ETP by recruiting /hiring required technical staff.

20. Development of analytical facilities (laboratory) for analysis various streams of water, untreated and treated effluent for various parameters viz. pH, BOD, COD, TSS, TDS and MLSS etc.

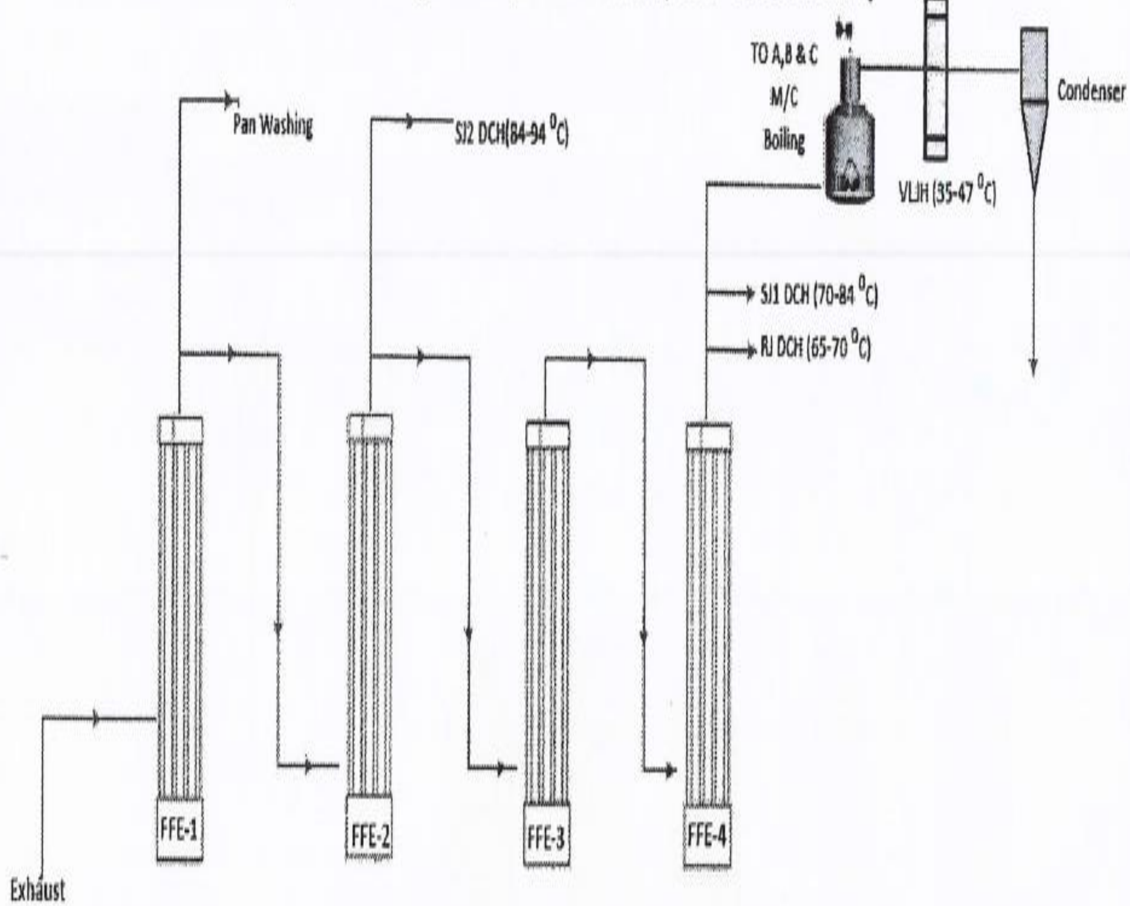
Annexure-I



Evaporator Configuration & Vapor Bleeding System For Quintuple Effect With Cigar
CJ 2nd (100-110°C) DCH
Pan washing
Soda Boiling
SJ 4th DCH
(96-102°C)
SJ 2nd (78 - 86°C) DCH
A,B,C1&C2 M/C Boiling
CJ1st (96-100°C) DCH
SJ 3rd (86 - 98°C) DCH
Color Code For Vapor & Condensate Line
Condensate Line
Vapor Line
VLJH
Multijet condenser
(32 - 48°C)
Hot water to spray pond
Exhaust
1.0 Kg/Cm2
124 deg.C
S.K.
F.F.
Q3
Q4
Q5
R.J.Heater(65-70°C)
SJ 1st (68 - 78°C) DCH
Molasses Conditioner(55-70°C) DCH
CIGAR
1st
110°C
2nd
105°C
3rd
95°C
4th
85°C
(48 – 65 deg.C)
Condensate Raw Juice Heater
Plate Type Heat Exchanger
Condensate to Over Head Tanks
Cigar Recirculation pump
Overhead hot water pump
1/3rd part of 3rd comp. recirculated to 1st comp. through PTHE heated by exhaust condensate
Exhaust Condensate to Boiler

Annexure-II

Evaporator Configuration (Steam Consumption - 26 % on cane)

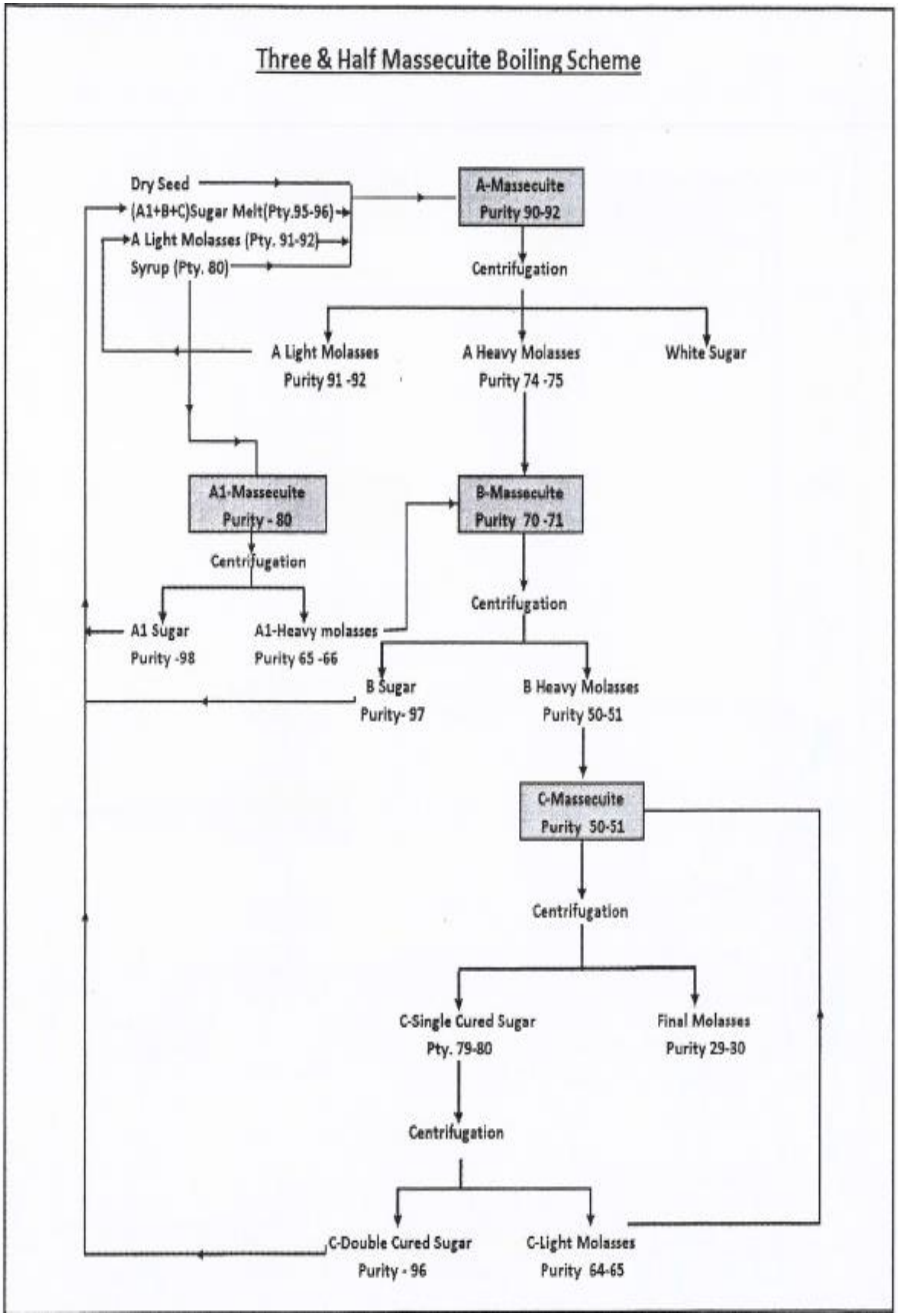


Pressure-0.6-0.7 kg/cm^2

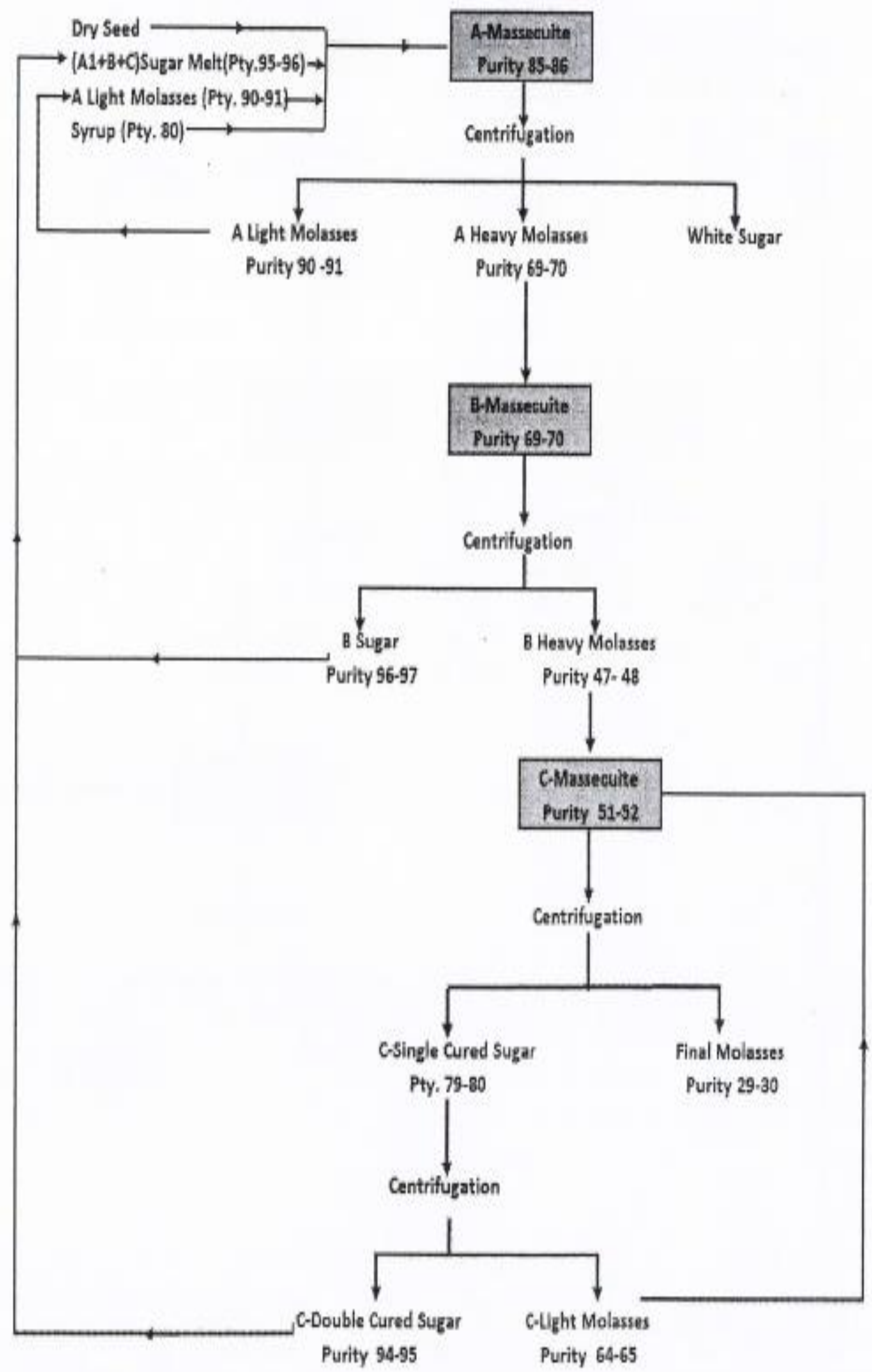
Temp.- 120ºC

- Raw Juice 2nd stage heating (47-62 °C) by PTHE with hot condensate.
- Raw Juice 3rd stage heating (62-65 °C) by DCH operating on NCG collect from all SCP calandria.
- After SJ 2nd stage heating to 94 °C juice directly goes to clarifier.
- Inlet temp. of clear juice is 88 °C, which is heated up to 108 °C in FFE-I body (no separate clear juice heater).

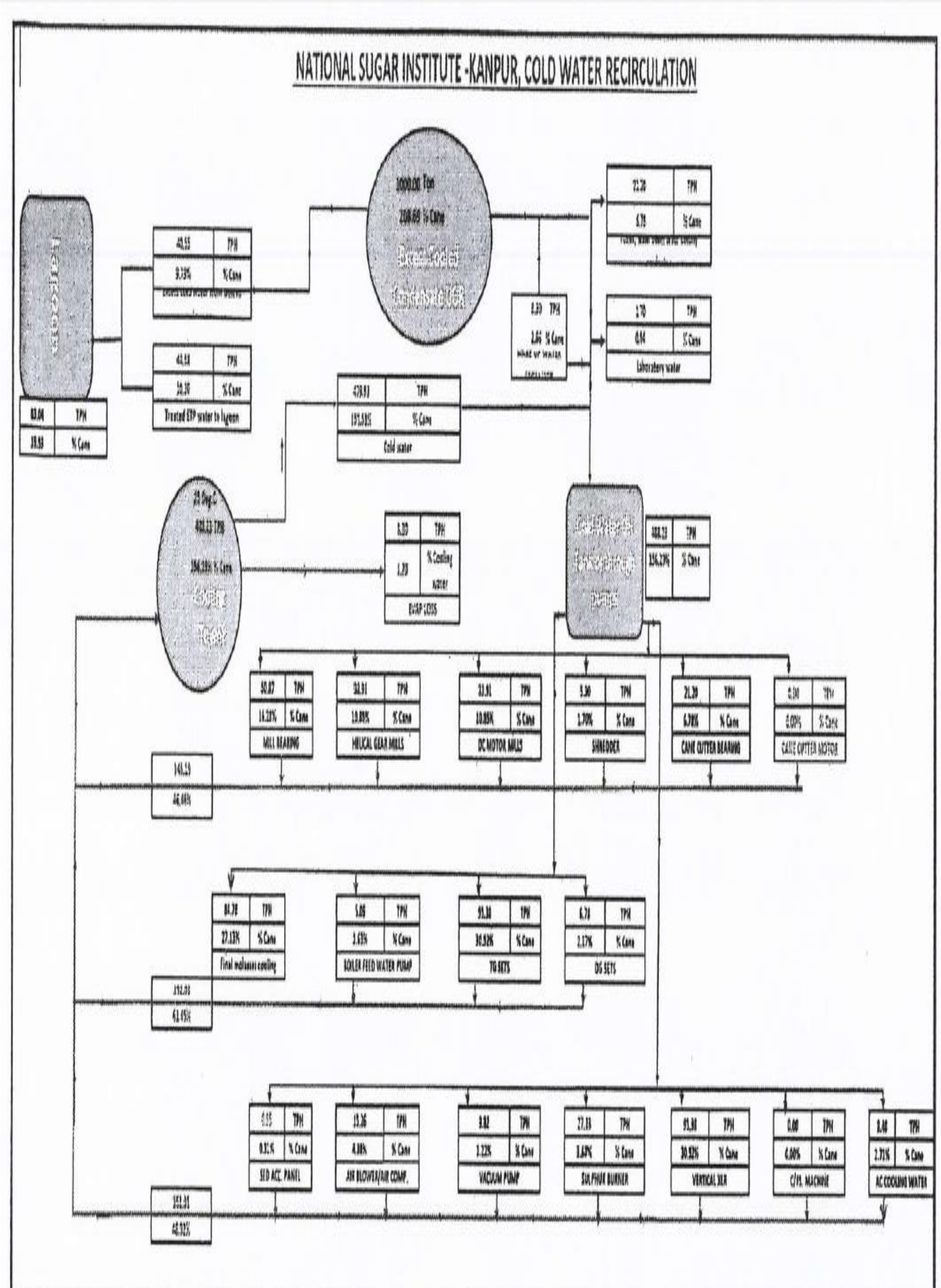
Annexure-III



Three Massecuite Boiling Scheme



Annexure-IV


NATIONAL SUGAR INSTITUTE -KANPUR, COLD WATER RECIRCULATION
TPH
% Cane
Treated ETP water to lagoon
Cold water
Laboratory water
% Cooling water
EVAP LOSS
MILL BEARING
HELICAL GEAR MILLS
DC MOTOR MILLS
SHREDDER
CANE CUTTER BEARING
CANE CUTTER MOTOR
Final molasses cooling
BOILER FEED WATER PUMP
TG SETS
DG SETS
SED ACC. PANEL
AIR BLOWER/AIR COMP.
VACUUM PUMP
SULPHUR BURNER
VERTICAL XLR
C/FS. MACHINE
AC COOLING WATER