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Water Management for 5000 TCD Plant with B-heavy Molasses Diversion

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ABSTRACT

As the significance of water intake is increased, it has become inevitable to see the valuable option to this aspect. Usage of excess condensate only has become the remedy. In this paper, excess condensate for a 5000 TCD plant where Bh is diverted to ethanol, and water balance is also derived. Efforts were made to explain about water management with respect to boiler feed water management and effects of poor quality of water were also explained.

Keywords: Water balance, zero water intake, B-heavy molasses diversion.

INTRODUCTION

Now a days, the role of water management has become inevitable. There is a need to reduce or to stop the taking the water from sources. Simultaneously, there is a need to feed the good quality of water to the boilers, as almost all the boilers in sugar factories are switched over to high pressure. For high pressure boilers, water quality has become as sensitive issue. which needs higher attention on water management.

Usually, the boiler is fed with the hot water and cold water. Hot water is nothing but the condensate water derived from the 1st body of evaporator body. Most of the times, it may not be required for treatment. The cold water after necessary and required treatment, will be fed to the boiler.

When there is hot water sufficient, then there is no need of taking cold water (raw water) from sources. Though we use all the exhaust to the first body of evaporator, the condensate of this first body will not be sufficient to meet the requirement of water for boilers. It will be inevitable to take water from other sources such as RO plant, DM plant, etc., as there would be venting, blowdown, drain loss, etc which attracts water for boilers.

Generally, the condensate would be excess which can be used so that raw water from sources can be avoided. Main requirement of this aspect is to know quantity of excess condensate on par with requirement and the quality of water to be maintained as per the boiler specified requirement.

MATERIALS AND METHODS

We have considered a factory of 5000 TCD which diverts all B-heavy molasses to the ethanol plant. It is a usual practice to calculate the steam requirement for juice heaters, evaporators and pans which will give the condensate. Details were as under:

1.	Plant capacity	5000 (for 22 hours)
2.	Juice % cane	102
3.	Filterates % cane	13.5
4.	A-Massecuite % cane	23
5.	B-Massecuite % cane	9
6.	MJ Brix	14.5
7.	Syrup Brix	60

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8.	Exhaust pressure	1 Kg/Sq.Cm
9.	Last Body Vacuum	25” vacuum
10.	Evaporator system	Quintple
11.	A and B pans	Batch pans

Vapour bleeding pattern was as under:

1.	RJ 1st Heating	Evap. Last Body Vapour Tubular (30 – 48)
2.	RJ 2nd Heating	By Condensate Water (48 – 62)
3.	RJ 3rd Heating	Evap. 3rd Body Vapour tubular (62 – 75)
4.	SJ 1st Heating	Evap. 2nd Body Vapour tubular (72 – 88)
5.	SJ 2nd Heating	Evap 2nd Body Vapour DCH (88 – 102)
6.	CJ 1st Heating	Evap 1st Body Vapour Tubular (95 - 105)
7.	CJ 2nd Heating	Evap 1st Body Vapour DCH (105 – 112)
8.	Pan Washing	Evap 2nd Body Vapour
9.	Others	Evap 1st Body Vapour
10.	Centrifugals	Evap 1st Body Vapour
11.	A-Boiling	Evap 2nd Body Vapour
12.	B-Boiling	Evap 2nd Body Vapour

RESULTS AND DISCUSSION

Based on the above bleeding system and the data, condensate generation was recorded as:

	Source		Condensate Qty in Tons/Hr
1.	RJ 1st Heater	;	7.360
2.	RJ 3rd Heater	:	5.580
3.	SJ 1st Heater	:	8.100
4.	CJ 1st Heater	:	4.530
5.	Evap. 1st Body	:	76.190
6.	Evap 2nd Body	:	67.750
7.	Evap. 3rd Body	:	17.240
8.	Evap. 4th Body	:	11.670
9.	Evap. 5th Body	:	11.670
10.	A-Pans	:	21.560
11.	B-Pans	:	9.200
	Total	:	240.850

Out of this total condensate;

1.	Exhaust condensate	:	76.190
2.	Vapour condensate	:	164.660

Therefore, the condensate generation was 240.850 tons/Hr. Hot water consumption at various points was as follows:

Hot water consumption

1.	Boilers	:	76.19
2.	Mill Maceration @30 %age	:	68.18
3.	Vac. Filters	:	10.23
4.	Milk of Lime Preparation	:	7.27
5.	Pans Movement water	:	1.14
6.	Centrifugal washing	:	6.82
7.	Miscellaneous	:	2.27
8.	Exhaust Desuperheating	:	3.11
9.	Drain Loss	:	1.14
10.	Melter	:	5.12
	Total	:	181.47

Therefore, the excess condensate available was 240.850 – 181.47 = 59.38 tons/hr

This quantity shall be cooled and reutilized instead of cold water. For this purpose, it shall be treated.

Now the cold water consumption shall be:

1.	Mill Bearings Cooling	:	45.45
2.	Turbine Cooling	:	11.36
3.	Fibrizor Bearing Cooling	:	11.36
4.	Pumps Glands Cooling	:	22.73

5.	Massecuite Cooling	:	34.09
6.	Total for Recirculation	:	124.19
8.	Loss %age due to Circulation	:	1.00
9.	Loss due to Circulation	:	1.24

Spray Pond

10.	Vapour to Condensers	:	37.95
11.	Cold Water to Condensers	:	1897.33
12.	Water to Spray Pond	:	1935.28
13.	Spray Loss %age	:	2.00
14.	Spray Loss Quantity	:	38.70
15.	Spray Pond OverFlow	:	0.00
16.	Spray Pond Make Up	:	0.75

Total cold water requirement was 1.24 + 0.75= 1.99 Tons/Hr. This quantity can be used from the excess condensate after it's treatment.

Now we possessed about 60 tons of excess condensate which was required for treatment. Boiler capacity was 80 tons/hr. It gets condensate from 1st body 76.19 tons. Remaining quantity of 3.81 tons shall be taken from DM/RO water to meet it's requirement.

Now the water treatment plays a major role to use it for DM plant / RO plant.

If we utilize this excess condensate, we need not take water from sources. During water treatment methods, primarily, the excess condensate shall be cooled to atmospheric temperature. Then it is to be treated.

For treatment of excess condensate, there are two ways: One is biological treatment and another one is ion exchange method. Biological treatment can be done in condensate polishing unit (CPU).

After the treatment of excess condensate it shall be further treated in DM plant / RO plant according to characteristics of the water, then only such water can be used for boilers. CPU outlet water cannot be directly taken as boiler feed water.

If we utilize the excess condensate we can achieve zero intake water from sources. For this zero intake, we shall make small efforts which are as follows:

Reducing the losses at various stages:

Losses due to recirculation. It is an universal practice that the bearing cooling water is recirculated. But even in this case also, there would be certain loss of water which shall be compensated by the cold water from reservoir. To reduce this, there are certain material like as gel which can be used for bearing cooling which replaces the water cooling.

At sulphur burner station, spray pond/injection water shall be used for cooling the gas.

At baby condenser, the water to be used for creation of vacuum for vacuum filters shall be injection water only.

Running the pumps, fans at cooling tower more than required will render the water loss through the evaporation which attracts make up water at cooling tower from cold water reservoir. Hence additional pumps/fans running shall be avoided.

Efficient use of vents and drains at various stages:

Blow down vent vapour can be condensed by utilizing it's heat by means of heat exchangers to heat the dm water. This water shall be treated through the water treatment system.

Exhaust lines/vapour lines drain vapour can be utilized to heat the maceration water, water for centrifugals, hot air blowers,etc. When the heat is recovered, additional steam thereby water requirement can be reduced correspondingly.

Evaporator pressure vessels vent vapours can be utilized through the vapour line to pans.

Evaporator vaccum vessels vapour going through the noxious gas can be utilized through any heat exchanger. So far it is not in practice in sugar industry except in one or two factories. (they are using the same for molasses conditioning). We shall make a thought of it for better use.

Condensate pressure vessel vent vapour can be utilized as flash vapour to the evaporators or for molasses conditioning.

The water being derived through the water treatment system such as back wash, rinsing,etc from the softeners, filters, RO plant, mixed bed, DM plant, etc., shall be treated and sent to the cold water reservoir.

Boiler operating conditions: When the temperature of live steam is less than it's designed temperature, the specific steam consumption at prime movers will be increased which attracts not only water requirement but also the fuel requirement.

Efficient running of condensate pumps: It is universal practice to drain out the condensate water, when the pumps fail to lift the water, in order to run the plant in stead of stopping. Hence it is highly essential to see that no condensate pump should fail to work.

Efficient running of liquid i.e, juice and molasses pumps: It is inevitable to get over flow of the juice or molasses, when the pump gets failed to lift the material. After the problem is solved, usually the staff of the factory does the cleaning the floor by means of water. Hence, it is necessary to see that the pump should not fail to work.

Efficient use of process techniques: Using syrup for seed melting, using molasses for magma mixing, avoiding false grain formation in pan boiling, less washings in centrifugals, etc are general methods which are already in practice. Otherwise these attracts water and steam in the process.

Recirculation of sugars shall be avoided either from the internal process or from the godown which attracts not only water but also sugar loss.

Water management can be considered :

Efficient use of excess condensate to avoid water intake from sources

Treatment of water

External Treatment

Internal Treatment

At the same time we should know about the problems that we have to face , if the quality of water is poor.

Usually the problems being faced with water are Scaling, corrosion, sludge, priming, foaming and caustic embrittlement

All the above problems are faced due to non maintenance of water properly either in the boiler or before entering into the boiler. We define the boiler feed water as a mixture / combination of makeup water and return condensate.

We shall have to give make up water to substantiate the water requirement for generating the steam at its capacity, since there will be certain loss of water due to blow down, venting and leakages.

The return condensates also, though less compared to raw water, will have impurities.

The above problems being faced are due to impurities available in the water.

The following are analytical parameters that are to be checked frequently to maintain the quality of water.

Total hardness (Ca hardness, Mg hardness)

Total alkalinity (P-Alkalinity, M-Alkalinity, OH Alkalinity)

Chlorides

Sulphates

Dissolved oxygen

Total dissolved solids

Phosphates

Total suspended solids in mg/Lit

Total organic carbon in mg/Lit

Biological oxygen demand in mg/Lit

Chemical oxygen demand in mg/Lit

Turbidity

Total silica

Impurities	**Effect**
Calcium Carbonate	Soft scale
Calcium BiCarbonate	Soft scale, CO_2
Calcium Sulphate	Hard Scale
Calcium Chloride	Corrosion
Magnesiumm Carbonate	Soft scale

Magnesium bicarbonate	Scale and corrosion
Magnesium sulphate	Corrosion
Sodium chloride	Electrolysis
Sodium carbonate	Alkalinity
Sodium bicarbonate	Priming and foaming
Sodium hydroxide	Alkalinity, embrittlement
Sodium sulphate	Alkalinity
Silicon dioxide	Hard scale

CONCLUSION

In the water management, both water quantity and quality are important. Requirement of water quantity can be met by means of excess condensate and preventing the losses of water. The quality of water can be achieved by treatment of water according to the characteristics of water available for feeding to Boilers.

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