

Enthalpy balance for the evaporators

Notes :

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Summary :

3.30		Total Vent from evaporators
185.00	MT/Hr	Exhaust in # 1
0.00	MT/Hr	Exhaust at other stations
185.00	MT/Hr	Total Exhaust
42.05	%	Steam% Actual exhaust estimated
40.00	%	Actual Steam % Cane Targeted
-2.05	%	Difference between actual vs theoretical

Result **O.K.**

	E.R	Installed	No of	E.R.	Calculated	E.R.
	MT/Hr	Area m^2	Bodies	(Kg/m^2/Hr)	Area m^2	(Kg/m^2/Hr)
# 1	175.96	7200	2	12.22	5950.08	29.57
# 2	158.86	6800	2	11.68	5863.77	27.09
# 3	41.02	3200	2	6.41	3345.26	12.26
# 4	31.66	2000	1	15.83	1524.10	20.77
# 5	30.18	1700	1	17.76	886.76	34.04

1			
In		Out	
<b>Heat entering</b>		<b>Heat Leaving</b>	
<b>Steam / Vapour In</b>		<b>Vapour Out</b>	
Temperature, oC	120.20	Temperature, C	112.70
Latent heat, Kcal	525.89	Latent heat, Kcal	530.87
Quantity, MT/Hr	185.00		
		<b>A Vent Out</b>	
<b>Flash from condensate In</b>		Quantity, MT/Hr	1.80
Temperature, oC	120.20	Total heat in Vent, Kcal	1,162.96
Latent heat, Kcal	525.89		
Quantity, MT/Hr	0	<b>B Heat lost</b>	
		Heat loss % Total Heat admitted	1.50
		Heat loss, Kcal	2,628.24
		<b>C Condensate</b>	
		Quantity, MT/Hr	183.20
		Temperature, C	117.20
		Total heat in Condensate, Kcal	21,471.04
		<b>D Vapour bleeding :</b>	
		Quantity, MT/Hr	17.73
		Total heat in Vapour bled, Kcal	11,411.37
		<b>Total ( A+B+C+D ), Kcal</b>	36,673.61
		<b>Heat remaining in, Kcal</b>	
		<b>( Juice &amp; Vapour to next body )</b>	1,38,542.71
		<b>Vapour to next body</b>	
		Quantity, MT/Hr	158.23
		Total heat in Vapour, Kcal	101830.135
		<b>Total Evaporation, MT/Hr</b>	175.96
<b>Juice In</b>		<b>Juice Out</b>	
Quantity, MT/Hr	538.42	Assumed Brix out	16.88
Brix	11.36	Calculated Actual Brix out	16.88
Temperature, C	111.00	Quantity, MT/Hr	362.47
		Specific heat of juice out	0.89871559
		Temperature, C	112.70
		Total heat in Juice, Kcal	36,712.57
<b>Total Heat In, Kcal</b>	1,75,216	<b>Total Heat Out, Kcal</b>	1,75,216

2		2	
<i>In</i>		<i>Out</i>	
<b>Heat entering</b>		<b>Heat Leaving</b>	
<b>Steam / Vapour In</b>		<b>Vapour Out</b>	
Temperature, oC	112.7	Temperature, C	103.8
Latent heat, Kcal	530.9	Latent heat, Kcal	536.6
Quantity, MT/Hr	158.2		
		<b>A Vent Out</b>	
<b>Flash from condensate In</b>		Quantity, MT/Hr	1.0
Temperature, oC	112.7	Total heat in Vent, Kcal	643.6
Latent heat, Kcal	530.9		
Quantity, MT/Hr	0.8	<b>B Heat lost</b>	
		Heat loss % Total Heat admitted	1.5
<b>Total Vapour In, MT/Hr</b>	159.0	Heat loss, Kcal	2,085.6
		<b>C Condensate</b>	
		Quantity, MT/Hr	158.0
		Temperature, C	109.1
		Total heat in Condensate, Kcal	17,243.7
		<b>D Vapour bleeding :</b>	
		Quantity, MT/Hr	121.4
		Total heat in Vapour bled, Kcal	77,766.2
		<b>Total ( A+B+C+D ), Kcal</b>	97,739.1
		<b>Heat remaining in, Kcal</b>	
		( Juice & Vapour to next body)	41,299.2
		<b>Vapour to next body</b>	
		Quantity, MT/Hr	37.4
		Total heat in Vapour, Kcal	23,975.5
		<b>Total Evaporation, MT/Hr</b>	158.9
<b>Juice In</b>		<b>Juice Out</b>	
Quantity, MT/Hr	362.5	Assumed Brix out	30.1
Brix	16.9	Calculated Actual Brix out	30.1
Temperature, C	112.7	Quantity, MT/Hr	203.6
		Specific heat of juice out	0.8
		Temperature, C	103.8
		Total heat in Juice, Kcal	17,323.7
<b>Total Heat In, Kcal</b>	1,39,038	<b>Total Heat Out, Kcal</b>	1,39,038

3		3	
<i>In</i>		<i>Out</i>	
<b>Heat entering</b>		<b>Heat Leaving</b>	
<b>Steam / Vapour In</b>		<b>Vapour Out</b>	
Temperature, oC	103.8	Temperature, C	96.6
Latent heat, Kcal	536.6	Latent heat, Kcal	541.2
Quantity, MT/Hr	37.4		
		<b>A Vent Out</b>	
<b>Flash from condensate In</b>		Quantity, MT/Hr	0.3
Temperature, oC	103.8	Total heat in Vent, Kcal	192.1
Latent heat, Kcal	536.6		
Quantity, MT/Hr	3.0	<b>B Heat lost</b>	
		Heat loss % Total Heat admitted	1.5
<b>Total Vapour In, MT/Hr</b>	40.4	Heat loss, Kcal	648.2
		<b>C Condensate</b>	
		Quantity, MT/Hr	40.1
		Temperature, C	100.9
		Total heat in Condensate, Kcal	4,049.5
		<b>D Vapour bleeding :</b>	
		Quantity, MT/Hr	13.7
		Total heat in Vapour bled, Kcal	8,764.2
		<b>Total ( A+B+C+D ), Kcal</b>	13,654.0
		<b>Heat remaining in, Kcal</b>	
		( Juice & Vapour to next body)	29,560.2
		<b>Vapour to next body</b>	
		Quantity, MT/Hr	27.3
		Total heat in Vapour, Kcal	17,400.9
		<b>Total Evaporation, MT/Hr</b>	41.0
<b>Juice In</b>		<b>Juice Out</b>	
Quantity, MT/Hr	203.6	Assumed Brix out	37.6
Brix	30.1	Calculated Actual Brix out	37.6
Temperature, C	103.8	Quantity, MT/Hr	162.6
		Specific heat of juice out	0.8
		Temperature, C	96.6
		Total heat in Juice, Kcal	12,159.3
<b>Total Heat In, Kcal</b>	43,214	<b>Total Heat Out, Kcal</b>	43,214

4			
<i>In</i>		<i>Out</i>	
Heat entering		Heat Leaving	
<b>Steam / Vapour In</b>		<b>Vapour Out</b>	
Temperature, oC	96.6	Temperature, C	83.8
Latent heat, Kcal	541.2	Latent heat, Kcal	549.2
Quantity, MT/Hr	27.3		
		<b>A Vent Out</b>	
<b>Flash from condensate In</b>		Quantity, MT/Hr	0.1
Temperature, oC	96.6	Total heat in Vent, Kcal	63.8
Latent heat, Kcal	541.2		
Quantity, MT/Hr	2.0	<b>B Heat lost</b>	
		Heat loss % Total Heat admitted	1.5
<b>Total Vapour In, MT/Hr</b>	29.2	Heat loss, Kcal	144.9
		<b>C Condensate</b>	
		Quantity, MT/Hr	29.1
		Temperature, C	91.5
		Total heat in Condensate, Kcal	2,665.7
		<b>D Vapour bleeding :</b>	
		Quantity, MT/Hr	15.5
		Total heat in Vapour bled, Kcal	9,802.0
		<b>Total ( A+B+C+D ), Kcal</b>	12,676.4
		<b>Heat remaining in, Kcal</b>	
		( Juice & Vapour to next body)	18,132.9
		<b>Vapour to next body</b>	
		Quantity, MT/Hr	16.2
		Total heat in Vapour, Kcal	10,237.9
		<b>Total Evaporation, MT/Hr</b>	31.7
<b>Juice In</b>		<b>Juice Out</b>	
Quantity, MT/Hr	162.6	Assumed Brix out	46.7
Brix	37.6	Calculated Actual Brix out	46.7
Temperature, C	96.6	Quantity, MT/Hr	130.9
		Specific heat of juice out	0.7
		Temperature, C	83.8
		Total heat in Juice, Kcal	7,894.9
<b>Total Heat In, Kcal</b>	30,809	<b>Total Heat Out, Kcal</b>	30,809

5			
<i>In</i>		<i>Out</i>	
Heat entering		Heat Leaving	
<b>Steam / Vapour In</b>		<b>Vapour Out</b>	
Temperature, oC	83.8	Temperature, C	55.0
Latent heat, Kcal	549.2	Latent heat, Kcal	566.3
Quantity, MT/Hr	16.2		
		<b>A Vent Out</b>	
<b>Flash from condensate In</b>		Quantity, MT/Hr	0.1
Temperature, oC	83.8	Total heat in Vent, Kcal	63.3
Latent heat, Kcal	549.2		
Quantity, MT/Hr	9.8	<b>B Heat lost</b>	
		Heat loss % Total Heat admitted	1.5
<b>Total Vapour In, MT/Hr</b>	26.0	Heat loss, Kcal	125.7
		<b>C Condensate</b>	
		Quantity, MT/Hr	25.9
		Temperature, C	72.3
		Total heat in Condensate, Kcal	1,870.0
		<b>D Vapour bleeding :</b>	
		Quantity, MT/Hr	15.2
		Total heat in Vapour bled, Kcal	9,423.7
		<b>Total ( A+B+C+D ), Kcal</b>	11,482.7
		<b>Heat remaining in, Kcal</b>	
		( Juice & Vapour to next body)	12,851.3
		<b>Vapour to next body</b>	
		Quantity, MT/Hr	15.0
		Total heat in Vapour, Kcal	9,329.7
		<b>Total Evaporation, MT/Hr</b>	30.2
<b>Juice In</b>		<b>Juice Out</b>	
Quantity, MT/Hr	130.9	Assumed Brix out	60.7
Brix	46.7	Calculated Actual Brix out	60.7
Temperature, C	83.8	Quantity, MT/Hr	100.7
		Specific heat of juice out	0.6
		Temperature, C	55.0
		Total heat in Juice, Kcal	3,521.5
<b>Total Heat In, Kcal</b>	24,334	<b>Total Heat Out, Kcal</b>	24,334

Sugar Mill Calculations Resource Page



Condensate management									
Juice Heaters			DC = 0 ; Tubular=	Flow Temp.		Flow Temp.			
Exhaust	Flow	oC	MT/Hr	oC	<b>Vacuum Pans by # 1 Body</b>				
Mixed juice	0.00	0.00	1.00	0.0	0.0	0.0	0.0	0.0	0.0
Sulphited juice	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
Clear juice	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
Melt heating	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
Syrup heating	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
				<b>0.0</b>	<b>0.0</b>				
# 1	Flow	oC	MT/Hr	oC	<b>Vacuum Pans by # 2 Body</b>				
Mixed juice	0.00	0.00	1.00	0.0	0.0	0.0	0.0	0.0	0.0
Sulphited juice	2.36	107.96	1.00	2.4	108.0				
Clear juice	9.10	110.02	0.00	0.0	0.0				
Melt heating	0.00	0.00	1.00	0.0	0.0				
Syrup heating	0.00	0.00	1.00	0.0	0.0				
				<b>2.4</b>	<b>108.0</b>				
# 2	Flow	oC	MT/Hr	oC	<b>Vacuum Pans by # 3 Body</b>				
Mixed juice	0.00	0.00	0	0.0	0.0				
Sulphited juice	8.41	100.50	1	8.4	100.5				
Clear juice	5.35	101.48	0	0.0	0.0				
Melt heating	0.00	0.00	1	0.0	0.0				
Syrup heating	0.00	0.00	1	0.0	0.0				
				<b>8.4</b>	<b>100.5</b>				
# 3	Flow	oC	MT/Hr	oC	<b>Vacuum Pans by # 4 Body</b>				
Mixed juice	0.00	0.00	1	0.0	0.0				
Sulphited juice	13.73	91.18	1	13.7	91.2				
Clear juice	0.00	0.00	1	0.0	0.0				
Melt heating	0.00	0.00	1	0.0	0.0				
Syrup heating	0.00	0.00	1	0.0	0.0				
				<b>13.7</b>	<b>91.2</b>				
# 4	Flow	oC	MT/Hr	oC	<b>Vacuum Pans by # 5 Body</b>				
Mixed juice	9.56	76.84	1	9.6	76.8				
Sulphited juice	0.00	0.00	0	0.0	0.0				
Clear juice	0.00	0.00	1	0.0	0.0				
Melt heating	0.00	0.00	1	0.0	0.0				
Syrup heating	2.48	77.86	0	0.0	0.0				
				<b>9.6</b>	<b>76.8</b>				
# 5	Flow	oC	MT/Hr	oC	<b>Vacuum Pans by # 5 Body</b>				
Mixed juice	15.15	48.66	1	15.2	48.7				
Sulphited juice	0.00	0.00	0	0.0	0.0				
Clear juice	0.00	0.00	0	0.0	0.0				
Melt heating	0.00	0.00	0	0.0	0.0				
Syrup heating	0.00	0.00	0	0.0	0.0				
				<b>15.2</b>	<b>48.7</b>				
Temp. Pan vapours	65.00		<b>Melt Concentrator</b>						
Evaporators	Flow	Temp.	MT/Hr	oC					
	MT/Hr	oC	Exhaust						
# 1	183.2	117.2	# 1						
# 2	158.0	109.1	# 2						
# 3	40.1	100.9	# 3						
# 4	29.1	91.5	# 4						
# 5	25.9	72.3	# 5						

Condensate Flashing Calculations						
		Flow In		Flow Out		
		Quantity	Temp.	Quantity	Temp.	
		MT/Hr	oC	MT/Hr	oC	
Exhaust	# 1 Body Condensate	183.20	117.20			
Condensate						
PHE	Exhaust Condensate	183.20	117.20	<b>183.20</b>	<b>100.00</b>	
<b>Plate Type Heat Exchanger</b>						
	From Cigar Out Chamber	91.37	83.01	<b>91.37</b>	<b>117.50</b>	
Super Heated Wash Water System						
SHWW % Cane	1.41	%Cane				
Temperature, C	117.50	oC				
Quantity	6.20	MT/Hr				
Compartment		Flow In		Flash Vapour	Flow Out	
		Quantity	Temp.		Quantity	Temp.
		MT/Hr	oC		MT/Hr	oC
<b>1</b>	From PHE	85.2	117.5	Flash MT/Hr		
				0.77		
				oC Flash		
				113		
				Latent heat		
		85.2	117.5	530.87	<b>84.4</b>	<b>113</b>
<b>2</b>	From 1st Chamber	84.4	112.7	Flash MT/Hr		
	# 2 Body Condensate	158.0	109.1	2.99		
	# 1 Vapour Heaters	2.4	108.0	oC Flash		
		0.0	0.0	104		
				Latent heat		
		244.7	110.4	536.65	<b>241.8</b>	<b>104</b>
<b>3</b>	From 2nd Chamber	241.8	103.8	Flash MT/Hr		
	# 3 Body Condensate	40.1	100.9	1.96		
	# 2 Vapour Heaters Condensate	8.4	100.5	oC Flash		
	# 2 Vapour Pan Condensate	106.6	88.3	97		
				Latent heat		
		396.9	99.3	541.22	<b>394.9</b>	<b>97</b>
<b>4</b>	From 3rd Chamber	394.9	96.6	Flash MT/Hr		
	# 4 Body Condensate	29.1	91.5	9.80		
	# 3 Vapour Heaters Condensate	13.7	91.2	oC Flash		
	# 3 Vapour Pan Condensate	0.0	0.0	84		
				Latent heat		
		437.8	96.1	549.16	<b>428.0</b>	<b>84</b>
<b>Out</b>	From 4th Chamber	428.0	83.8			
	# 5 Body Condensate	25.9	72.3			
	# 4 Vapour Heaters Condensate	9.6	76.8			
	# 4 Vapour Pan Condensate	0.0	0.0			
		463.4	83.0		<b>463.4</b>	<b>83</b>

**Condensate Heaters**

	Quantity MT/Hr	Temp. oC
Total Hot water available after flashing	463.43	83.01
Hot water towards PHE	91.37	83.01
<b>Total water remaining</b>	<b>372.06</b>	<b>83.01</b>

<b>Condensate heater 1 ( Outlet temp. of hot fluid is unknown )</b>			
	Quantity MT/Hr	Temp. oC	Brix
Raw juice inlet	506.00	48.30	12.22
Raw juice outlet	506.00	60.80	12.22
Hot water inlet	372.06	66.39	
Hot water outlet	372.06	44.27	
Heat in Juice	22647.87 A		
Heat in juice out	28509.12 B		
loss	5 %		

<b>Condensate heater 2 ( Outlet temp. of hot fluid is unknown )</b>			
	Quantity MT/Hr	Temp. oC	Brix
Sulphited juice inlet	585.20	71.20	12.22
Sulphited juice outlet	585.20	76.20	12.22
Hot water inlet	372.06	83.01	
Hot water outlet	372.06	66.39	
Heat in Juice	38611.27 A		
Heat in juice out	41322.74 B		
loss	5 %		

	Quantity MT/Hr	Temp. oC
Water from SJ condensate heater	372.06	66.39
Water from RJ condensate heater	372.06	44.27
# 5 Vapour Heaters Condensate	15.15	48.66
Water available in Pan Overhead Tank	387.21	44.44