بسم الله الرحمن الرحيم

<u>Enhancing Plant & Energy Efficiency Through Better Color Removal.</u>

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CHASHMA SUGAR MILLS

DERA ISMAIL KHAN

ABSTRACT

The paper presents the case study to show significant performance, improvements in sugar quality, enhancement of plant efficiency through reduction in molasses recirculation and better color removal of raw melt liquor at its initial stage. The quantum gain through improvement in energy, management and process control efficiency are also highlighted.

i) **Sugar Quality**

ii) **By making R-5, the recirculation of reject to the raw house is reduced.**

iii) **Overall consumption of Refinery Chemicals is reduced.**

iv) **By reducing wash water at Centrifugals, recirculation of sugar is reduced.**

v) **Steam saving.**

INTRODUCTION

Chashma Sugar Mills was commissioned in 1990 by HMC. The plant capacity was 3000 TCD. By continuous efforts of the team under the guidance of Engr. Abdul Qadir khan (Technical Director) the plant capacity is now 12000 TCD.

The enhancement of profit margin through production of high quality sugar with maximum process efficiency and minimum energy consumption was the prime objective during the BMR of the plant.

MATERIAL AND METHOD.

i) **Sugar Quality.**

Chashma Sugar mills -1 is situated in Low purity sugar cane area where we are facing different types of coloring matters in raw juice. HL Conti -12 DC Centrifugal machines are installed for massecuite curing. Due to low RPM i. e 1600 (Recommended by Supplier M/S HMC) and low opening area of baskets (0.42 % instead of recommended opening area 1.24 %) we were facing high color value of melt liquor i-e, 900 to 1100 IU. Phosphetation process used for color removal. Different types of decolorisers were used to improve sugar quality. The results of White refine sugar of some past years are mentioned in table-1.

Table-1

Year of Prod.	Melt Liq. IU	Polished Liq. IU	Refine Strikes	White Refine Sugar IU
2010-11	900-1100	500-600	R1,R2,R3	140,170,210
2011-12	900-1050	500-550	R1,R2,R3	132,160,202

Honorable technologists are well aware of the value of good quality sugar and its effect on plant efficiency.

There are different ways adopted by sugar technologists to improve sugar quality. As mentioned above, we have continuous centrifugal machines of low RPM and low opening area for high grade masscuite curing. It was difficult for us to achieve raw melt liquor above 97.5 purity and below 900 IU without increasing washing water which causes Extra load of molasses and over wash of A-sugar. We were worried to solve this issue without replacement of these continuous centrifugals. In season 2012-13 we started High Performance Adsorbent Decolorizer FRS W-2 on trial basis. The results were amazing, so in season 2013-14 it was used in all three sugar mills of the group. Table -2 clearly shows the improvement in strike rate as well as in IU value of white refine sugar. (Exhibit # 1a, 1b)

Table-2

Year of Prod.	Melt Liq. IU	Melt Liq. + FRSW2 IU	Polished Liq. IU	Refine Strikes	White Refine Sugar IU
2012-13 (Trial)	900-1050	700-900	450-500	R1,R2,R3	92,142,188
2013-14	900-1050	650-750	220-320	R1,R2,R3,R4,R5	49,65,90,120, 150

ii) **By making R-5, the recirculation of reject run off to the raw house is reduced.**

Data:

White Refine sugar Production = 1000 T/D

Case -1 (Without addition of FRS W-2) (Exhibit # 2a)

Average crushing rate for one month= 10564 TCD

Quantity of rejected run off = 172 T/D (Up to season 2012-13. R1, R2, R3)

Case -2 (After addition of FRS W-2) (Exhibit # 2b)

Average crushing rate for one month= 11073 TCD

Quantity of rejected run off = 87 T/D (In season 2013-14, R1,R2,R3,R4,R5)

Difference in Rejected Run off = 85 T/D

A Massecuite produced = 70.84 T/D

Curing time required @ 14 T/h = 5.0 hrs

Curing machine motor power = 90 Kw

Saving in KW for 5 hrs = 450 KW/Day

= 45000 KW/Season of 100 days

Saving of Steam @ 11Kg/KW = 495 T/Season

Saving of Bagasse @ 1.9 = 260 T/Season

iii) **Overall consumption of Refinery Chemicals is reduced.**

Data:

White Refine Sugar Production = 1000 T/D

Case -1 (Without addition of FRS W-2)

I) Decolorizer

Quantity of Decolorizer = 400 Kg / Day

@ 400 PPM Rs: = 1,80,000 /=

II) Phosphoric Acid

Quantity of Phosphoric Acid = 420 Kg / Day

@ 420 PPM Rs: = 50,400 /=

Total Rs: = 180000 + 50400 = 230400 /=

For season of 100 days Rs: = 2,30,40,000 / =

Case -2 (After Addition of FRS W-2)

I) Decolorizer

Quantity of Decolorizer = 220 Kg / Day

@ 220 PPM Rs: = 99,000 /=

II) FRS W-2

Quantity of FRS W-2 = 180 Kg / Day

@ 180 PPM Rs: = 72,000 /=

III) Phosphoric Acid

Quantity of Phosphoric Acid = 300 Kg / Day

@ 300 PPM Rs: = 36,000 /=

Total Rs: = 99000 + 72000 + 36000 = 207000 /=

For season of 100 days Rs: = 2,07,00,000 /=

Net Saving for season Rs: = 2,30,40,000–2,07,00,000= 23,40,000/=

iv) **By reducing wash water at centrifugals, recirculation of sugar is reduced.**

It is very clear for every one that maximum sugar collection from A-massecuite is based on minimum purity of A-molasses. High molasses purity will decrease the quantity of A- sugar. In addition of many other factors, quantity of wash water is also one of the major factor which effect on A-molasses purity as well as quantity and quality of A-sugar. A-sugar quantity is inversely proportional of A-molasses purity. Quantity of wash water depends on A-sugar purity/IU value. Less wash water at A-centrifugal will decrease A-sugar quality. The different observations are mentioned in Table - 3.

Table - 3

Case -1

Description	Brix	Pol	Pty	Wash water %
A-molasses	84	57.20	68.09	7.48 %

A-Sugar = 41 % (Color value of Raw Melt liquor = 800 IU)

A-Molasses = 59 %

Case -2

Description	Brix	Pol	Pty	Wash water %
A-molasses	86	57.20	66.51	5.57 %

A-Sugar = 43.5 % (Color value of Raw Melt liquor = 900 IU)

A-Molasses = 57.5 %

Case -3

Description	Brix	Pol	Pty	Wash water %

A-molasses	88	57.20	65.00	3.89 %

A-Sugar = 46 % (Color value of Raw Melt liquor = 1000 IU)

A-Molasses = 54 %

Case -3 was an ideal situation at minimum quantity of wash water we got maximum quantity of A-Sugar. Now high color value of A-sugar is a single bottle neck in this case. This problem was solved by High Performance Adsorbent FRS W-2 and we successfully achieved the results mentioned in case-3 at 600 - 700 IU value of raw melt liquor. (Exhibit # 3)

V) Steam Economy.

Case # 1

A Molasses Brix = 84°

A Molasses Purity = 68 %

Wash water % on Massecuite = 7.48 %

Quantity of A molasses = 59 % on A Massecuite

Steam Required for B Massecuite = 12.57 T/h

Case # II

A Molasses Brix = 88°

A Molasses Purity = 65 %

Wash water % on Massecuite= 3.68 %

Quantity of A molasses = 52 % on A Massecuite

Steam Required for B Massecuite = 11.55 T/h

Difference = 1.02 T/h

= 2448 T / Season of 100 days

Bagasse saving = 1288.42 T / season

(Exhibit list # 4)

RESULT AND DISCUSSION.

i) Improvement in sugar quality and strike rate from R3 to R5 achieved only due to minimize the IU value of polished liquor from 550 to 230.

ii) The reject run off quantity of R3 was comparatively higher than that of R5. By reducing the quantity of reject run off, we improved crushing rate.

iii) About 25% quantity of phosphoric acid was reduced due to the acidic nature of FRS W2 on same dosing rate of decolorizer.

iv) There was no need to use extra wash water at A centrifugals to improve the quality of raw melt liquor. We achieved good quality of raw melt liquor by the addition of high adsorbent value FRS W2 on comparatively less quantity of wash water.

v) With out addition of extra equipment in process house we gained steam saving at different stages.

CONCLUSION

By using High Performance Adsorbent Decolorizer, FRS W 2,

we achieved:

- Saving of Chemicals
- Enhancement of crushing rate
- Steam saving

Improvement in sugar quality

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SEASON 2012-13 (Exhibit # 1a)

Sr. #	Polish liqour IU	Strike R1 IU	Strike R2 IU	Strike R3 IU
1	498	99	143	198
2	505	98	149	191
3	475	94	146	195
4	481	99	151	193
5	475	92	148	194
6	448	87	138	198
7	453	88	133	190
8	484	87	136	192
9	466	93	142	198
10	441	92	137	187
11	457	89	138	189
12	452	88	146	182

13	468	94	143	186
14	441	95	150	188
15	477	87	144	178
16	462	85	142	188
17	451	94	149	187
18	438	94	152	194
19	469	88	140	194
20	473	92	139	179
21	470	93	132	175
22	462	91	135	181
23	468	95	139	189
24	455	94	142	185
25	458	97	145	182
26	453	95	143	187
27	485	94	139	184
28	478	88	138	188
29	465	87	141	188
30	468	91	140	194
Avg.	465.87	92.00	142.00	188.47

SEASON 2013-14 (Exhibit # 1b)						
Sr. #	Polish liqour IU	Strike R1 IU	Strike R2 IU	Strike R3 IU	Strike R4 IU	Strike R5 IU
1	320	48	59	93	124	162
2	324	52	57	93	127	151
3	208	55	59	87	120	152
4	302	51	64	91	119	146
5	278	48	69	93	118	149
6	261	54	64	89	120	146
7	258	52	66	94	129	141

8	234	55	68	91	124	143
9	245	52	65	87	118	148
10	220	49	61	84	124	149
11	218	45	55	82	117	151
12	209	42	58	89	121	149
13	212	39	62	90	125	148
14	234	41	60	91	117	152
15	218	49	69	87	122	152
16	204	50	64	84	121	157
17	215	53	68	86	118	153
18	203	51	72	89	114	154
19	218	48	70	90	111	151
20	232	42	72	94	117	154
21	254	43	69	92	127	148
22	281	50	71	95	125	152
23	295	53	70	87	118	146
24	212	51	69	86	121	145
25	238	48	58	84	118	151
26	221	47	65	91	124	152
27	262	48	67	97	120	153
28	268	52	62	95	120	150
29	245	51	68	94	119	151
30	251	51	69	97	115	145
Avg.	244.67	49.00	65.00	90.07	120.43	150.03

RUN OFF 3 CALCULATION (Exhibit # 2a)

Cane Crushed	11000	TCD			
	458.333	Tch			
Purity of Refine Sugar	99.900				
A-Sugar % Cane	10.500	%		A.SUGAR	Raw Melt
Tons of A-Sugar	48.125	Ton/h	BRIX %	98.000	62.000
A-Sugar of 98 Brix	48.125	T/H	POL %	95.403	61.070
Raw melt	76.069	T/H	PTY.	97.350	98.500

R1 - Massecuite					
Evaporation	21.228	T/H		R1.M	R.O1
R1 - Massecuite	54.840	T/H	BRIX %	86.000	77.000

RUN OFF 5 CALCULATION (Exhibit # 2b)

R1 - Sugar	23.896	T/H	POL %	84.366	74.467
R.O1 Molasses	30.944	T/H	PTY.	98.100	96.710
R2 - Massecuite					
Evaporation	3.868			R2.M	R.O2
R2 - Massecuite	27.076	T/H	BRIX %	88.000	78.000
R2 - Sugar	11.829	T/H	POL %	85.360	73.905
RO2 - Molasses	15.247	T/H	PTY.	97.000	94.750
R3 - Massecuite					
Evaporation	2.033			R3.M	R.O3
R3 - Massecuite	13.214	T/H	BRIX %	90.000	79.000
R3 - Sugar	6.050	T/H	POL %	85.860	72.364
RO3 - Molasses	7.164	T/H	PTY.	95.400	91.600
Refine Sugar	41.775	T/H			
Sugar % Cane	9.115	%			
Refine Masssecuite	95.130				
	20.756	%			
RO3 - Molasses	7.164	172	M.T/Day		

Cane Crushed	11000	TCD			
	458.333	Tch			
Purity of Refine Sugar	99.900				
A-Sugar % Cane	10.500	%		A.SUGAR	Raw Melt
Tons of A-Sugar	48.125	Ton/h	BRIX %	98.000	62.000
A-Sugar of 98 Brix	48.125	T/H	POL %	95.403	61.070
Raw melt	76.069	T/H	PTY.	97.350	98.500
R1 - Massecuite					
Evaporation	21.859	T/H		R1.M	R.O1
R1 - Massecuite	54.210	T/H	BRIX %	87.000	76.000
R1 - Sugar	21.684	T/H	POL %	85.347	73.644
R.O1 Molasses	32.526	T/H	PTY.	98.100	96.900
R2 - Massecuite					
Evaporation	4.751			R2.M	R.O2
R2 - Massecuite	27.775	T/H	BRIX %	89.000	77.000
R2 - Sugar	10.490	T/H	POL %	86.330	73.335
RO2 - Molasses	17.285	T/H	PTY.	97.000	95.240
R3 - Massecuite					
Evaporation	2.497			R3.M	R.O3
R3 - Massecuite	14.788	T/H	BRIX %	90.000	79.000
R3 - Sugar	5.333	T/H	POL %	86.400	74.102
RO3 - Molasses	9.455	T/H	PTY.	96.000	93.800
R4 - Massecuite					
Evaporation	1.247			R4.M	R.O4
R4 - Massecuite	8.208	T/H	BRIX %	91.000	80.000
R4 - Sugar	2.622	T/H	POL %	86.450	74.160
RO4 - Molasses	5.586	T/H	PTY.	95.000	92.700
R5 - Massecuite					
Evaporation	0.729			R5.M	R.O5
R5 - Massecuite	4.857	T/H	BRIX %	92.000	81.000

R5 - Sugar	1.236	T/H	POL %	86.572	74.617
RO5 - Molasses	3.621	T/H	PTY.	94.100	92.120
Refine Massecuite	109.838				
	23.965				
Refine Sugar	41.366	T/H			
Sugar % Cane	9.025	%			
RO 5	3.62	86.88	M.T/Day.		

A MOLASSES CALCULATION

Cane Crushed = 11000 TCD

A Massecuite % cane = 24 %

Quantity of A Massecuite = 110 T/h

A Massecuite = 110 T/h Brix = 96.00 Pol = 77.28 Pty = 80.50

Wash Water = Z 0 0 0

A Sugar = X Brix = 98.00 Pol = 96.00 Pty = 97.95

Case I:

A Heavy = Y Brix = 84.00 Pol = 57.20 Pty = 68.09

Taking over all balance

A Massecuite + Wash Water = A Sugar + A Heavy

a) Taking Brix Balance

105.60 + Z = 0.98 X + 0.84 Y

Y = 125.71 - 1.167 X

a) Taking Brix Balance

85.008 + z = 0.96 X + 0.572 Y

Y = 148.61 - 1.678 X

125.71 - 1.167 X = 148.61 - 1.678 X

X = 22.90/0.511

A Sugar = 44.81 T/h = 40.73 %

A Heavy = 125.71 – 1.167 X 44.81

= 73.42 T/h

Total = 118.23

Wash Water = 8.23 T/h = 7.48 %

Case II:

A Heavy = Y Brix = 86.00 Pol = 57.20 Pty = 66.51

a) Taking Brix Balance

105.60 + Z = 0.98 X + 0.86 Y

Y = 122.79 - 1.139 X

a) Taking Brix Balance

85.008 + z = 0.96 X + 0.572 Y

Y = 148.61 - 1.678 X

122.79 - 1.167 X = 148.61 - 1.678 X

X = 25.82 / 0.539

A Sugar = 47.90 T/h = 43.54 %

A Heavy = 122.79 – 1.139 X 47.90

= 68.23 T/h

Total = 116.13

Wash Water = 6.13 T/h = 5.57 %

Case III:

A Heavy = Y Brix = 88.00 Pol = 57.20 Pty = 65.00

a) Taking Brix Balance

105.60 + Z = 0.98 X + 0.88 Y

Y = 120 - 1.113 X

a) Taking Brix Balance

85.008 + Z	=	0.96 X	+	0.572 Y
Y	=	148.61	-	1.678 X
120 - 1.113 X	=	148.61	-	1.678 X

X = 28.61 / 0.565

A Sugar = 50.64 T/h = 46.03 %

A Heavy = 120 – 1.113 X 50.64

= 63.64 T/h

Total = 114.28

Wash Water = 4.28 T/h = 3.89 %

Steam Saving due to A Molasses (Exhibit list # 4)

Cane Crushed = 11000 TCD

Quantity of A massecuite @ 24 % = 2640 T/D

A Molasses %age on A massecuite = 59 %

Quantity of A Molasses @ 84 Brix = 1557.6 T/D

Quantity of A Molasses @ 80 Brix = 1557.6 X 84/80

= 1635.48 T/D

Evaporation = 1635.48 X 98 – 80 / 98

= 300.394 T/D

= 12.57 T/H

A Molasses %age on A massecuite = 52 %

Quantity of A Molasses @ 88 Brix = 1372.8 T/D

Quantity of A Molasses @ 80 Brix = 1372.8 X 88/80

= 1510 T/D

Evaporation = 1510 X 98 – 80 / 98

= 277.361 T/D

= 11.55 T/H

Saving of Steam = 12.57 – 11.55 = 1.02 T/h

Saving of steam/season = 2448 T/ season of 100 days

Saving of Bagasse @ 1.9 = 1288.42 T/ season of 100 days