CASE STUDY OF DECANTER OPEARTION AT

LOKMANGAL MAULI INDUSTRIES LTD.

Chaitanya S. Joshi[1], Ajay K. Mahajan[2] and Arvind E. Giramkar[3]

ABSTRACT

Lokmangal Mauli Industries Ltd. Lohara M.S. is a new 5000 TCD greenfield sugar plant having 30 MW capacity cogeneration unit, incorporating latest and proven technologies. One such modern technology was identified for the treatment of muddy juice instead of going into conventional RVF technology. The choice obviously as short listed and as finalized was adaptation of "decanter technology", already being well proven elsewhere. The aim behind presenting this paper is to share practical experience of decanter operation over a period of full crushing season.

KEYWORDS

Decanter, RVF**,** muddy juice, flocculent, centrate, compact packed volume (CPV)

INTRODUCTION

Lokmangal Mauli Industries Ltd., Lohara is a third successive sugar complex of Lokmangal Group – Solapur. This new sugar plant adapting double sulphitation process having initial capacity of 5000 TCD, expandable to 7500 TCD was successfully commissioned in the season 2013-2014. During the first trial season itself factory has crushed 492365 Tons of cane producing 48009 Tons of sugar and exporting 4,65,00,000 KWH of electric power to state grid.

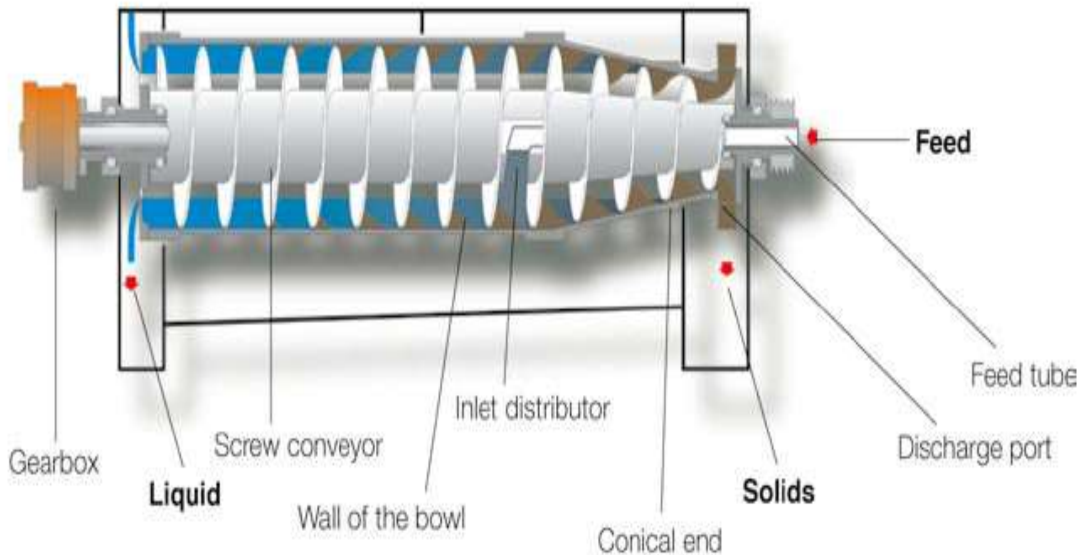
Principle of working

Solid liquid separation is carried out in a bowl fitted with inside screw conveyor. The muddy juice i.e. feed enters in to the decanter through a stationary tube. The bowl rotates at high speed and due to the high G force solids being higher in density get separated from the low density liquid. The screw conveyor inside the bowl conveys these separated solids towards the solids outlet of decanter. The liquid is also discharged from outlet port located at other end.

---

1. Director, 2. General Manager, 3. Dy. General Manager (Projects)
Suviron Equipments Pvt. Ltd. Ahmednagar,
Phone no.: 0214-2778711 Email: contact@suviron.com

Cut view of sugar Dec 400 decanter machine

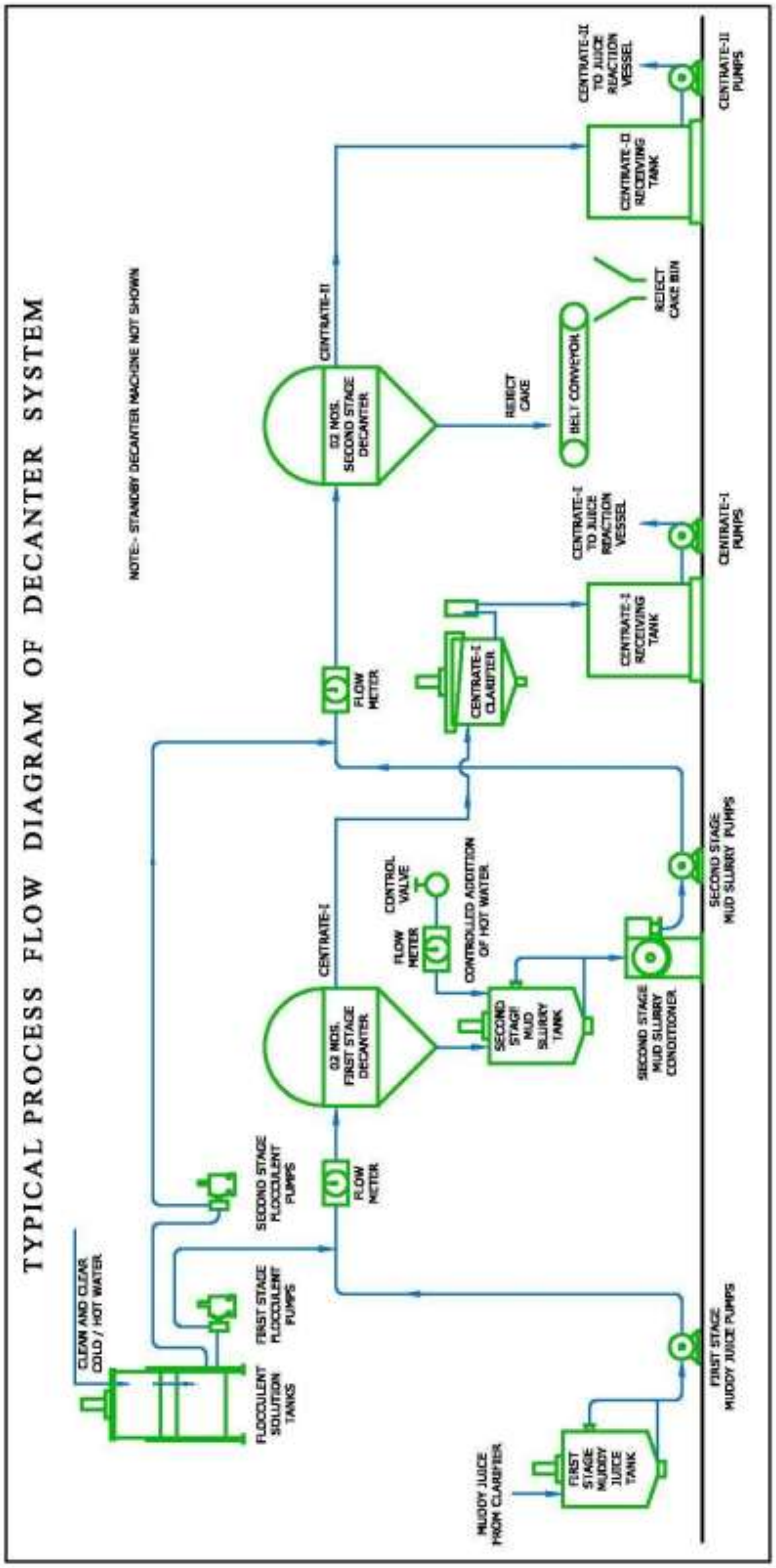


Decanter station as viewed from reject cake bin

List of equipments forming total decanter system

The total decanter station comprises of following major equipments

Sr. no.	Name of equipment	Quantity
1	1st stage Mud receiving tank	01 No.
2	1st Stage muddy juice transfer pumps with drive mounted on base frame.	03 Nos.
3	Polymer preparation and storage tank	02 Nos.
4	Polymer dosing pumps with drive mounted on common base frame.	08 Nos.
5	1st stage Decanter machine Model - Sugar Dec 400	02 Nos.
6	2nd stage Mud receiving tank	01 No.
7	2nd Stage mud slurry conditioner	01 No.
8	2nd Stage mud slurry transfer pumps with drive mounted on base frame.	03 Nos.
9	2nd stage Decanter machine Model - Sugar Dec 400	02 Nos.
10	Centrate I flotation clarifier	01 No
11	Centrate I receiving tank	01 No
12	Centrate I transfer pump with drive mounted on common base frame.	02 Nos.
13	Centrate II receiving tank	01 No.
14	Centrate II transfer pump with drive mounted on common base frame.	02 Nos.
15	1st stage muddy juice and 2nd Stage mud slurry transfer pumps with drive mounted on common base frame for standby decanter machine	02 Nos.
16	Polymer dosing pumps with drive mounted on common base frame for standby decanter machine	02 Nos.
17	Decanter machine – Common standby for both the stages Model - Sugar Dec 400	01 No.
18	Process automation and electricals	1 set
19	Cake conveying system	01 No.
20	Reject cake bin	01 No.


TYPICAL PROCESS FLOW DIAGRAM OF DECANTER SYSTEM
CLEAN AND CLEAR COLD / HOT WATER
NOTE:- STANDBY DECANTER MACHINE NOT SHOWN
FLOCCULENT SOLUTION TANKS
FIRST STAGE FLOCCULENT PUMPS
SECOND STAGE FLOCCULENT PUMPS
FLOW METER
02 NOS. FIRST STAGE DECANTER
CENTRATE-I
FLOW METER
CONTROL VALVE
CONTROLLED ADDITION OF HOT WATER
SECOND STAGE MUD SLURRY TANK
MUDDY JUICE FROM CLARIFIER
FIRST STAGE MUDDY JUICE TANK
SECOND STAGE MUD SLURRY CONDITIONER
FIRST STAGE MUDDY JUICE PUMPS
SECOND STAGE MUD SLURRY PUMPS
FLOW METER
CENTRATE-I CLARIFIER
02 NOS. SECOND STAGE DECANTER
CENTRATE-II
REJECT CAKE
BELT CONVEYOR
REJECT CAKE BIN
CENTRATE-I RECEIVING TANK
CENTRATE-I TO JUICE REACTION VESSEL
CENTRATE-I PUMPS
CENTRATE-II RECEIVING TANK
CENTRATE-II TO JUICE REACTION VESSEL
CENTRATE-II PUMPS

DATA COLLECTED DURING CRUSHING SEASON – 2013-14

METHODS USED FOR ANALYSIS

Method GS7 – 13 - For cane fibre in juice, Mud and Reject / Filter cake by filtration method

Method GS7 – 7 - For Pol of Reject / Filter cake by Polarimetry

Method GS7 – 11 - For mud solids in juice, Mud and Reject / Filter cake by a Gravimetric method

Method GS7 – 9 - For Moisture in Reject / Filter cake by Oven Drying
Lab centrifuge used for analyzing Compact Packed Volume (CPV) for 3 minutes at 3000 rpm.

Solid and Fiber Analysis

Sr. no.	Sample Name	% of fiber	% of w/w solids	Vol/Vol % solids (CPV)
01	Mixed juice	0.17	0.71	7.4
02	Sulphited juice	0.16	0.65	7.2
03	Muddy juice 1	2.18	8.7	58
04	Muddy juice 2	1.98	7.1	48
05	Centrate 1 at 12 to 14 Deg. Brix, and 80 to 82 purity	0.02	0.31	2.3
06	Centrate 2 at 3 to 4 Deg. Brix, and 60 to 65 purity	0.01	0.18	3.1
07	Clarified centrate	Below detectable level	Below detectable level	0.40
08	Scum from Centrate I clarifier	0.1	5.4	55

Results

Sr. no.	Description	Unit	Value
01	Pol % reject cake	%	1.3 to 1.5
02	Moisture % reject cake	%	67 to 70
03	Suspended / insoluble solid removal efficiency across decanter station	%	93 to 94
04	Reject cake % cane	%	1.8 to1.9

DISCUSSION

A) First stage operation

Clarifier underflow i.e. muddy juice from conventional 4-4-4 clarifier is taken to first stage muddy juice receiving tank provided with stirrer to properly mix the muddy juice from all 4 compartments of conventional 4-4-4 clarifier.

Separate pump with VFD is provided to transfer this preconditioned muddy juice to first stage Decanter centrifuge.

Muddy juice which is going to first stage is measured by a magnetic flow meter and indicated by transmitter installed in the feed line of each machine. At muddy juice entry of decanter machine polymer solution addition connection is provided. The “Anionic” grade polymer is used for improved solid liquid separation at decanter centrifuge.

The decanter machine rotates at 3250 rpm with “G” force more than 2650 G. Machine has one inlet for muddy juice feed together with online addition of polymer solution and has two outlets viz. one for liquid outlet, termed as ‘centrate’ and another one is for solid discharge i.e. cake.

The conveyor of the decanter rotates at slightly lesser speed (17 to 20 rpm) than that of the bowl which allows compacting of accumulated solids towards conical end, eventually pushing the solids from discharge ports in the form of mud cake.

The centrate-I which is coming out from first stage decanter operation before clarification is having brix and purity equivalent to mixed juice and has dry insoluble solids, 0.31 % which are half the solids content in mixed juice. This centrate contains good amount of air is then fed to Centrate I flotation clarifier. The clear centrate coming out from centrate clarifier with negligible solids content is then collected at centrate I receiving tank and pumped to juice reaction vessel. Scum generated in flotation clarifier was sent to 1st stage muddy juice tank.

B) Second stage operation

Cake solids discharged from first stage decanter is mixed with hot water in second stage mud slurry preparation tank provided with mechanical stirrer for proper mixing of mud solids with added hot water. For control and proportionate addition of hot water control valve and magnetic flow mater is provided in hot water pipeline. Mud conditioner is provided at the outlet of second stage mud slurry dilution tank for further conditioning of mud slurry. By using progressive cavity pump this conditioned mixture of mud slurry is pumped to second stage decanter machines. Magnetic flow meter is installed in the feed line for each machine.

The reject cake from second stage decanter is having pol % in the range of 1.3 to 1.5 % and moisture content in the range of 67 to 70 %.

Centrate generated in second stage operation is having brix of 3 to 5 and purity 60 to 65 is collected in centrate-II receiving tank and two nos. centrifugal pumps are provided to transfer centrate normally to juice reaction vessel and only as an alternative arrangement piping is provided for recycling the same for mill imbibition which was seldom used.

C) Quantity of bagasse saved

1) Theoretical approach:

   Reference:
   Cane Sugar Engineering By: Peter Rain, Page no 251, reproduced below

   For better filtration of mud, quantity of bagasse added in mud, is 0.5 to 0.7 tons of **dry fiber** per 100 mt of cane.

   Let us consider a average value i.e 0.6 tons of dry fiber per 100 mt of cane.

   Moisture % mill discharged bagasse = 48 % i.e. 52 % dry fiber

   Required dry fibre is 0.6 MT / 100 MT of cane Crushing.
   In terms of required mill discharged bagasse = (0.6 / 52) x 100 = 1.15 MT per 100 MT of cane.

   From above reference quantity of bagasse %
   cane required to be added at mud mixer of R.V.F. = 1.15 %

   Therefore bagasse % cane saved
   after adapting decanter technology = 1.15 %

2) By inferential method

   a. Data collected
      1. Reject cake % cane : 1.9
      2. Moisture % reject cake : 70
      3. Moisture % bagasse at last mill : 48

   b. Data collected at a factory where only R.V.F. is installed in the nearby factories located in the same region
      1. Moisture % filter cake at R.V.F. : 70
      2. Filter cake % cane : 3.6

Reduction in cake % cane

1. Cake % cane using R.V.F. alone = 3.6
2. Cake % cane using decanter alone = 1.9

   Therefore reduction in cake % cane = 1.7

Calculations:

The reduction in cake % cane of 1.7 at same moisture level of 70 % as observed after applying decanter technology represents the quantity of bagasse % cane added at mud mixer of R.V.F.

Actual bagasse saved having moisture content, say @ 48% can be worked out as below

$$= \text{Reduction in cake \% cane} \times \frac{\text{Moisture \% bagasse}}{\text{Moisture \% cake}}$$

$$= 1.7 \times \frac{48}{70}$$

= 1.16 % cane is actual bagasse saved.

3) By dry solid method

Above results of baggase saving are further substantiated by dry solid method as per following calculations

1. Total dry solids including dry fiber % cane when RVF is used is calculated below,
   = (Dry matter % filter cake x Filter cake % cane)/ 100
   = 30x3.6/100
   = 1.08 %

2. Total dry solids including dry fiber % cane when decanter is used is calculated below
   = (Dry matter % reject cake x Reject cake % cane)/ 100
   = 30x1.9/100
   = 0.57 %

3. Reduction of dry matter in cake
   % cane after adapting decanter system = 1.08% – 0.57%
   = 0.51%

   From above it is observed that the reduction of dry matter in cake % cane after adapting decanter is due to non addition of baggase which indicates that 0.51 % is the dry matter % cane saved. Considering moisture content of baggase at the last mill is 48 % i.e dry matter of 52 % then the baggase saving achieved is worked out as below,

   $$= \frac{\text{Reduction in dry matter \% cane}}{\text{Dry matter \% baggase}} \times 100$$

   = 0.51/52x100

   = 0.98 % is the baggase saving

   Conclusion:

   Therefore it could be concluded that after installing decanter in place of R.V.F. the bagasse saving that could be practically achieved is **1.0 % cane**.

D) Sugar extraction across decanter system

Muddy juice % cane = 9%

Dry suspended solid % muddy juice = 8.7%

Dry suspended solids in muddy juice % cane = (9 x 8.7) / 100
= 0.78 %

Juice content in muddy juice = 100 – 8.7
= 91.3 %

Total juice content in muddy juice % cane = (91.3 x 9) / 100
= 8.217 %

Total dissolve solids (brix) in centrate I = 15 %

Purity of centrate I which is liquid extracted from muddy juice without any dilution	= 84 %
Total dissolve solids in muddy juice % cane	= (8.217x15)/100 = 1.23 %
Total sugar in muddy juice % cane entering to decanter system	= (1.23x84)/100 **= 1.033 % cane**
Reject cake % cane	= 1.9
Pol % reject cake	= 1.5
Sugar loss in reject cake % cane	=(1.5 x 1.9) / 100 = 0.0285 % cane

Sugar extraction % across decanter system =

$$\frac{\text{Sugar recovered at decanter station \% cane}}{\text{Sugar entering at decanter station \% cane}} \times 100$$

$$= \frac{1.033 - 0.0285}{1.033} \times 100$$

$$= \frac{1.0045}{1.033} \times 100$$

= 97.24 %

E) Factors affecting suspended / insoluble solid separation efficiency

a) Flow rate to decanter machine
If decanter is operated above the rated capacity affected suspended / insoluble solid separation efficiency.
b) Proportionate quantity of ‘Anionic’ grade polymer solution.
c) Quality of polymer used to enhance the flocculation.
d) Differential speed of bowl and conveyor of decanter.
e) Pond depth of liquid inside the bowl of decanter.
f) Concentration of dissolve solids in muddy juice / mud slurry.
g) Temperature of muddy juice / mud slurry
h) Water used for polymer preparation

F) Factors affecting moisture content of final reject cake

a) Rated flow rate to decanter
b) Quantity of polymer solution
c) Differential speed of bowl and conveyor of decanter.
d) Pond depth of liquid inside the bowl of decanter.
e) Concentration of dissolve solids in muddy juice / mud slurry.

G) Factors Influencing pol % Reject cake

a) Pol % cane
b) Use of settling polymer at juice clarifier
c) Type of juice clarification
d) Type of clarifier used for juice clarification i.e. SRTC / 4-4-4 conventional clarifier
e) Quantity and quality of dilution water used
f) Quantity of bagasse present in muddy juice

CONCLUSION

Sugar extraction 97 to 98 % as well as solid removal efficiency 95 to 96 % across decanter station is much higher in comparison with RVF.

From foregoing discussion it is concluded that the new decanter technology certainly has an edge over RVF in all respect and that in near future more and more sugar factories would contemplate to adapt decanter technology.

<u>Future plans for plant expansion to 7500 TCD</u>

Only one more decanter of model Sugar dec 400 with BCC capable of handling 1500 to 1600 kg of dry solids per hour shall be added this year to present decanter station and accordingly configuration of existing 5 nos. decanters of model Sugar Dec 400 will be modified to suite total decanter station for expanded plant capacity of 7500 TCD

ACKNOWLEDGEMENT

Authors express their grateful thanks to Honorable Shri Dadasaheb Deshmukhji, Honorable Chairman Shri Maheshji S. Deshmukh, Shri Ravindra Patil, Managing Director and Shri Mohan Pise, Technical Director of Lokmangal Mauli Industries Ltd. for their kind permission to publish this paper. Authors are also thankful to technical staff of Lokmangal Mauli Industries Ltd. for their kind cooperation during successful commissioning of decanter system.

REFERENCES

1. M.D.Narute, P.S.Yelpale, R.V. Dani, R.N. Bhosale and A.K.Jagtap (2012) Comparative study of Decanter system and Rotary vacuum filter at M/s. Vitthalrao Shinde SSK Ltd. – Convention of SISTA

2. Wagh A. (2011) “Operation Of Decanter During Two Seasons”- A Case Study,10th Joint Convention Of STAI And DSTA, Page 103-109.