DECANTER TECHNOLOGY APPLICATION IN INDIAN SUGAR INDUSTRY
- A NATIONAL PERSPECTIVE -

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Abstract:

Ever increasing number of the decanter installations in Indian Sugar Industry with continued additions year over year; the modest beginning being from the year 2009 is a positive indicator of the steady but firm acceptance of this modern and proven technology by sugar industry to replace the old and obsolete RVF technology.

It is further interesting to note that even those old factories which had originally provided RVF at their plant have now opted to replace the existing RVF which still have balance working life, by decanter; and many more are contemplating.

This paper relates to the developmental work taken over a period of last 6 years to reduce the solid loading on decanter resulting into sustainable growth of this technology. A national perspective of decanter technology application if implemented in all Indian sugar factories is also discussed with statistics.

Key word:
Decanter, RVF**,** ICUMSA Methods, Co-gen power,

Analytical method used for data collection:

Method GS7 – 7	The Determination of the Pol content of Filter cake and Reject Cake
Method GS7 – 9	The Determination of Moisture content of filter cake and Reject cake by Oven Drying
Method GS7 – 11	The Determination of the mud solids in juice, clarifier underflow muddy juice, Filter cake and Reject cake by Gravimetric method
Method GS7 – 13 (1994)	The Determination of the mud solids in juice, clarifier underflow muddy juice, Filter cake and Reject cake by filtration method

Introduction:
The table below shows the list of decanter installations at various sugar factories together with respective cogeneration plant capacity.

Suviron EquipmentsPvt.Ltd., G-120, MIDC, Ahmednagar 414111 Maharashtra, India

Sr. No.	Name of sugar factory, Co-gen power plant capacity	Project category	Year and **No. of Decanters**	Cane crushing capacity – TCD
1	Gangakhed Sugar And Energy Limited, **30 MW**	New greenfield (NO R.V.F.)	2009 **4** Nos.	6000, expanded to 7500 in 2015
2	Hemarus Industries Ltd., (Group company of Olam Agro India Ltd.), **20 MW**	New greenfield (NO R.V.F.)	2010 **3** Nos.	3500
3	VitthalraoShinde SSK Ltd. Madha, **28 MW**	11 years old plant replacing all existing R.V.F.s	2011 **4** Nos.	6000
4	Shree ChhatrapatiShahu SSK Ltd., Kagal, **22 MW**	32 years old plant replacing all existing R.V.F.s	2012 **3** Nos.	2500, expandable to 5500
5	LokmangalMauli Industries Ltd., (Unit No. 3) **33 MW**	New greenfield (NO R.V.F.)	2013 **6** Nos.	5000, expanded to 7500 in 2014
6	Athani Sugars Limited, Athani, **24 MW**	Expansion	2014 **5** Nos.	7500
7	Daund Sugar Limited (Through ISGEC Heavy Engineering Limited) **18 MW**	Expansion, replacing all R.V.F.s	2014 **5** Nos.	6000
8	SaiPriya Sugars Limited Nirani Group, **35 MW**	New greenfield (NO R.V.F.)	2015 **7** Nos.	10000 Under installation
9	Agro Olmos,**Peru Export project** (Through ISGEC Heavy Engineering Limited)	Expansion	2015 **5** Nos.	5500 Under installation
10	Lokmangal Sugar Ethanol and Energy Pvt. Ltd., **28 MW**	Expansion, replacing all R.V.F.s	2015 **5** Nos.	7500
11	Agroaurora S.A.C., **Peru Export project** (Through ISGEC Heavy Engineering Limited)	Expansion	2016 **5** Nos.	5500 Under installation
Total No. of Decanters			**52 Nos.**	

Decanter technology allows saving of bagasse @1% cane which itself is a major motivation to opt for the decanter application so as to increase the sustainability and profitability of existing co-gen power plant. Bagasse saving @ 1% cane is confirmed as per calculation and supported by well-known reference at page No. 251 of Handbook of cane sugar engineering by Peter Rein and which is further reconfirmed by actual data collection at sugar factory.

In addition to this major advantage there are other multiple advantages which all put together results into a forever recurring gain of ₹. 50/- per ton of cane crushed. This is evident from the cost economics worked out which are discussed at a table below.

Cost economics of Decanter system operation over RVF** confirming forever net profit of ₹ 50 per ton cane

Commercial benefits are calculated based on following considerations,

1.0	**Particulars**	**Rotary Vacuum Filter**	**Decanter System**
1.1	Pol % Cake	1.6	1.6
1.2	Cake % cane	3.8	1.9*
* 1.4% with 2-stage R.J.S. and 1.0% with hot raw juice R.J.S. application			
1.3	Pol-loss through cake % cane	0.061	0.030
2.0	Sugar Price		₹30000 per Ton
3.0	Electric power Tariff		₹5.69 per kWh
4.0	Specific steam consumption of power house turbine		5.5 Ton per mW
5.0	Steam generation per ton of bagasse		2.5 Ton
6.0	Price of polymer		₹275 per Kg.

Rotary Vacuum Filter	Decanter System	Per Ton Cane	
		Profit	Loss
1. Additional revenue by direct bagasse saving @ 1 % cane *			
At Rotary Vacuum Filter 1.0% cane of sieved fine bagasse is required to work as filtering media to achieve optimum results.	Bagasse not at all required.	This will result in net bagasse saving @ 1% cane i.e. 0.01 tons per ton cane which will raise 0.025 tons of steam to generate 4.54 kWh of electric power as per following calculations :	
		₹ 25.83	

1) Steam generation ratio at bagasse fired boiler = 2.5 steam per ton of bagasse burnt.
2) Specific steam consumption of power house turbine = 5.5 Ton of steam per mW. At prevailing tariff of ₹. 5.69 perkWh, the additional electric power generated results into extra revenue of ₹. 25.83 per ton cane

Rotary Vacuum Filter	Decanter System	Per Ton Cane	
		Profit	Loss
2. Additional sugar recovered due to reduced sugar loss through cake			
The sugar loss % cane through filter cake is works out as 0.061 % cane.	The sugar loss % cane through reject cake works out as 0.030% cane.	The reduction in sugar loss shall be 0.031 (0.061 – 0.030) % cane. Considering sugar price ₹ 30000 per Ton the gain per ton cane works out as 0.031 / 100 =0.00031 x ₹ 30000 = ₹ 9.3	
		₹ 9.3	
3. Electrical energy saved due to reduced power requirement			
Since the time of introduction of RVF in Indian sugar industry in late sixties no data is available in respect of actual energy consumed at RVF. It is therefore fair to consider a industry accepted power consumption ratio as 0.71 kWh/Ton of Cane; supported by various references.	It is observed at M/s. ChhatrapatiShahu SSK, Kagal that by using fully automatic decanter with BCC and operating the same at its full capacity with respect to solid handling, the power consumption ratio is found as 0.4 kWh/Ton of Cane	The reduction of power consumption ratio by 0.31 kWh/Ton Cane results into net saving on account of reduced power consumption as = ₹ 5.69 x 0.31 = ₹ 1.77	
		₹ 1.77	

<table>
<tr><td colspan="4">4. Additional revenue by sending Centrate II for mill imbibition</td></tr>
<tr><td>In case of Rotary Vacuum Filter both the filtrates i.e. heavy filtrate and light filtrate are combined and sent to juice reaction vessel for further treatment. So the total quantity of filtrate normally 15% cane is recycled back to the process.</td><td>In case of decanter system muddy juice de-sugarization takes place in two stages, hence the centrate resulted from first stage operation i.e. Centrate I (approximate 7% cane) is sent to juice reaction vessel and the centrate resulted from second stage operation i.e. Centrate II (approximate 8% cane) is recycled back to mills for mill imbibition ofcourse having no any adverse effect on pol% bagasse. Hence the fresh water load for mill imbibition can be reduced by 8%.</td><td colspan="2">Considering quintuple effect evaporator station,Steam saving % cane shall be :
= 8 ÷ 5
= 1.6 % cane,
= 0.016 ton of steam per Ton of Cane
Additional electricity generated
= (0.016 ÷ 5.5) x 1000
= 2.91kWh
Additional revenue generated
= 2.91 x 5.69
= ₹. 16.56 per Ton of Cane
₹ 16.56</td></tr>
<tr><td colspan="4">As per data collected at various installations over a period of last 6 years including a case of 4 nos x 2 roller mills allowing only 4 compressions, while at the rest there are 8 or 10 compressions using 4 or 5 nos. three roller mills no any adverse effect on pol% bagasse was observed after recycling Centrate II for mill imbibition.</td></tr>
<tr><td colspan="4">5. Chemical requirement</td></tr>
<tr><td colspan="2">Not required for Rotary Vacuum Filter.</td><td>Chemical requirement will be approximately 0.010 Kgs per ton cane, maximum.</td><td>Additional cost on account of chemical requirement @ 0.01 kgs/ton cane at the unit rate of ₹. 275/- per Kg. works out as,
₹ 2.75</td></tr>
<tr><td colspan="2">TOTAL PROFIT / LOSS PER TON OF CANE</td><td>₹53.46</td><td>₹ 2.75</td></tr>
<tr><td colspan="2">NET FINANCIAL GAIN PER TON OF CANE</td><td colspan="2">₹ 50.71</td></tr>
<tr><td colspan="2">FOREVER NET FINANCIAL GAIN PER 10 LAKHS TON OF CANE</td><td colspan="2">₹5.07 Cr.*</td></tr>
<tr><td colspan="2">FOREVER NET FINANCIAL GAIN PER MILLION TON OF CANE</td><td colspan="2">USD 780,000*</td></tr>
</table>

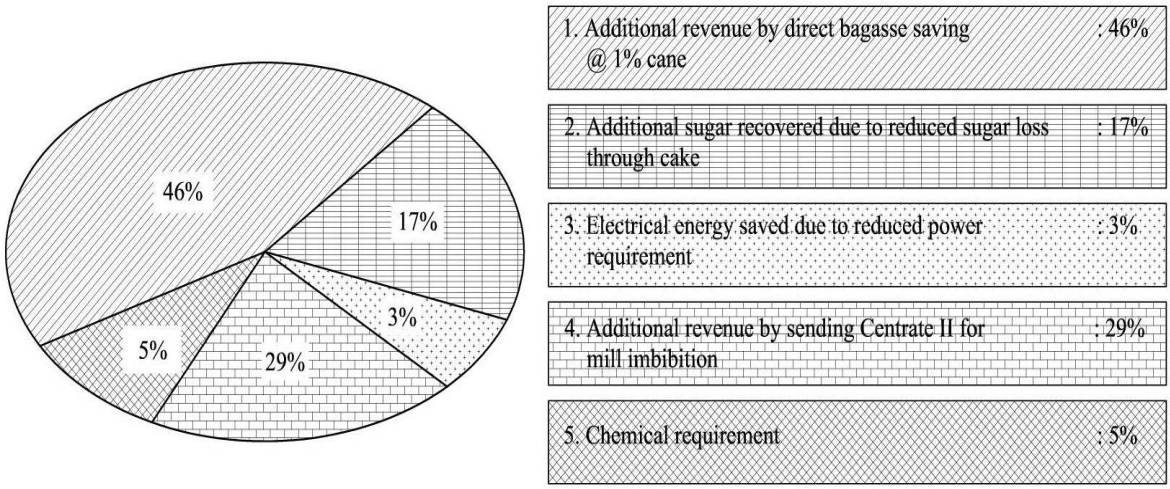
* As per currency exchange rate of USD 1 = INR (₹) 65

** Updated subsequent to successful continuous recycling of Centrate II to mill imbibition throughout the two crushing seasons at M/s. Daund Sugar Ltd.

* In addition to profit as quantified above there are other direct and indirect benefits like reduction in cake transportation cost, very high solid removal efficiency of more than 92%, thereby lesser recirculation of mud solids, less colour value of recycled centrate than that of filtrate returns, higher purity of combined centrate than combined heavy and light filtrate returns and reduction in viscosity etc.

The graphical presentation of the cost economics as shown below gives a quick presentation.

Graphical presentation of % profit / loss account



Data collection:

Detailed analysis was conducted at decanter installations of **8** sugar factories with respect to various operating parameters and following table shows average of the analytical results for the period ranging from 1 to 6 crushing season; as per the year of installation of individual decanter system at respective sugar factories.

Sr. No.	Name of Factory	% Fibre Solids in muddy juice	% Mud Solids in muddy juice	Muddy juice % cane	Pol % reject cake	Moisture of reject cake	Solid removal efficiency
1	Gangakhed Sugars before 2nd RJS operation	2.26	8.38	8 - 9	1.4 - 1.6	67 to 70	92 to 93
	Gangakhed Sugars after 2nd RJS operation	1.80	7.50	5.5 – 6.5	1.3 - 1.5	67 to 70	93 to 94
2	Hemarus	2.14	8.24	8 - 9	1.4 - 1.6	68 to 71	94 to 95
3	VithalraoShinde	1.457	5.65	9 - 11	1.4 - 1.5	68 to 70	93 to 94
4	Shree ChhatrapatiShahu	1.74	5.44	10 - 12	1.4 - 1.7	67 to 70	95 to 96
5	LokmangalMauli	1.98	7.10	11 - 13	1.3 - 1.5	67 to 70	91 to 94
6	Athani Sugars	1.64	7.88	9 - 10	1.4 - 1.8	68 to 72	92 to 93
7	Daund Sugar	1.85	7.8	9 - 10	1.2 - 1.6	67 to 70	92 to 94
8	Lokmangal, Bhandarkavathe	1.96	7.23	9 - 11	1.4 - 1.7	68 to 72	93 to 95

Recent Developments:

Latest commercial scale developmental work carried out at sugar factories has practically proved the supplementary and complimentary effect of these new systems on the operation of existing decanter station.

A) **2-stage Rotary Juice Screening System**

Data collected at one such installation at M/s. Gangakhed Sugar And Energy Ltd., Gangakhed, Dist:Parbhani during current crushing season.

Sr. No.	Product	Value in %	Value
01	Fibre content of 1st stage screened juice	0.14 to 0.17	1400 to 1700 PPM
02	Fibre content of 2nd stage screened juice	0.05 to 0.06	500 to 600 PPM
03	Muddy juice % cane before installation of 2nd stage RJS	Avg. 8.5	--
04	Muddy juice % cane after installation of 2nd stage RJS	Avg. 6.0	i.e. Reduction by ≈ 30 %
05	Reject cake % cane before installation of 2nd stage RJS	2	--
06	Reject cake % cane after installation of 2nd stage RJS	1.4	i.e. Reduction by 30 %

B) Hot Raw Juice - Rotary Juice Screen

This was done at M/s. Sonhira SSK Limited, Wangi, Tal:Kadegaon, Dist:Sangli where the decanter system proposal to replace the existing RVF is on the table.

Referring to the effect of actual reduction in fibre solid content of mixed juice and by advantages of getting further reduction of fibre solid content of mixed juice at Hot Raw Juice Rotary Screen it can be safely concluded that this will result into much lower fibre solid loading on decanter which eventually will result into capacity and / or efficiency enhancement of decanter station.

Fibre solid content of hot screened mixed juice : 81 PPM
as observed at M/s. Sonhira SSK Ltd.

Subsequent to substantial reduction of fibre solid contents in the hot screened mixed juice and same by reflecting on the fibre content in muddy juice it is anticipated that muddy juice % cane will get reduced to the extent of 4 – 5, a major achievement.

A national perspective:

Quite recently, as per the major policy revision more and more thrust is being given on 'Non-conventional source of energy' like solar power with a national program of putting 100 Giga watt solar power plants all across India.

It is therefore felt that sugar industry as well can contribute towards this to the extent possible by adopting decanter technology.

Potential for additional co-gen power generation in India by applying decanter technology as national drive :

Base :

a)	Cane crushed per year	: 300 Million tons
b)	Crop days	: Average 150 days
c)	Electric power terriff	: ₹. 6,000 per mWh
d)	Specific steam consumption power house turbine	: 5.5 Ton per mW
e)	Steam generation per ton of bagasse	: 2.5 Tons
f)	Annual bagasse saved @1% Cane	: 3.0 Million tons

Annual additional co-gen power generated :

a)	Per hour	: 378 mWh
b)	Per day	: 9072 mWh
c)	Per season of 150 crop days	: 1.36 Million mWh

Therefore potential of additional revenue generation : ₹. 8160 Million

Realizing the great potential that exists to produce additional renewable source of power by using bagasse saved @ 1% cane by adopting decanter technology we request and appeal to our apex Association of Sugar Technologists to suitably take up this novel idea to various related government ministries like Renewal Source of Energy, Food Ministry, Industrial Ministry to motivate the sugar factories by allowing soft loan facilities like those currently being provided for co-gen power plants and to include decanter station as an integral part of co-gen power plants; new upcoming as well as for those factories where co-gen power plants are already installed.

Conclusion :

High potential exists to generate additional co-gen power plants adjacent to sugar factories by application of decanter technology by achieving recurring financial gain of ₹. 8160 Million every year just by saving of bagasse @ 1% cane.

The total net saving when worked out in the terms of ₹. 50/- per tons of cane including as resulted from bagasse saving works out as ₹. 15000 Million.

ACKNOWLEDGEMENT

Authors express their grateful thanks to management of all **8** sugar factories for their kind cooperation extended for collection of data.