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FERMENTATION OF HIGH SUCROSE FEED SUCH AS SECONDARY JUICE AND BH-MOLASSES : SOLUTIONS

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ABSTRACT

This paper reports some observations regarding the potential production levels of ethanol from various feedstocks available in a sugar factory. The methods for calculating the yields of ethanol from sugar factory sources are investigated and a preferred method is described which could be used as a standard for comparing ethanol yields. The potential feedstocks available to a sugar factory for the production of ethanol include raw sugar, Cmolasses (final molasses), Bmolasses, A molasses,evaporator supply juice (ESJ), secondary express juice and bagasse.

INTRODUCTION

C-Molasses based ethanol fermentation is a well established process. Distillers are already achieving 88-91 % FE and 240±15 Lt/Ton recovery of ethanol with spent wash generation of 7-8 Lt/Lt of ethanol. Alternative feed stocks like BH-Molasses, Secondary Juice as Syrup (~45 °Brix) has higher sucrose content in feed as compare to C-Molasses. Using these alternative feed stocks, Distillers can achieve enhanced recovery with less generation of spent wash and energy consumption. Storage & processing of alternative feed stocks can also be a challenging task due to higher sucrose content (recoverable) and total reducing sugar. The most commonly used feedstock for the production of ethanol in the cane sugar industry is final molasses. The five season mean for final molasses production is close to 1.1 million tonnes and corresponds to a final molasses production rate of 2.84 molasses%cane. The levels of fermentable sugar in final molasses for the whole of industry for the five-year period are not known since the analyses for the fermentable sugar levels are not routinely undertaken. It is assumed that the level of fermentable sugars in final molasses is approximately 45% based on anecdotal evidence. If all the available final molasses is fermented, the maximum potential production of ethanol from final molasses is in the order of about 280 million litres per year (based on the five year average from 1996 to 2000). The maximum production of ethanol (100%) from final molasses ranges from 220 million litres per year (1996 data) to 300 million litres per year. The potential production of ethanol from A molasses is approximately 1560 million litres per year. This calculation assumes that all A molasses is diverted to ethanol production, the level of fermentable sugars in A molasses is 60%, and the A molasses production rate is 12% on cane for the nominated five year period. Likewise the potential production of ethanol from B molasses is 680 million litres per year (assumes all B molasses is diverted to ethanol production, the level of fermentable sugars in B molasses is 52%, and the B molasses production rate is 6% on cane)

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Feed Stock Comparison

The potential production of ethanol from evaporator supply juice (or clarified juice) is similar to the sum of the ethanol production derived both from raw sugar and from final molasses and is approximately 3400 million litres per year. The main advantage of this feed source is that the costs for raw sugar manufacture are avoided. However, the production of ethanol is limited to the crushing season, unless some ESJ is concentrated and stored as liquor. condary express juice

In this option, first express juice (FEJ) from the milling train is forwarded to the factory for raw sugar production and secondary express juice (SEJ) together with final molasses feeds the distillery. The production of ethanol from secondary express juice from the milling train is seen as desirable because SEJ contains higher levels of impurities and these impurities are sent directly to the distillery and may reduce some processing costs for the sugar factory. Increased levels of maceration are possible in this mode of operation and can increase the extraction of both sucrose and reducing sugars in the SEJ feed to the distillery. It is possible to split the juice from the milling train to optimise the purity and sugar levels in the two juice streams (viz. the feed to the sugar factory can comprise the juice from mill nos. 1 and 2 and the juice feed to the distillery is from the other mills). SRI has undertaken simulations in this regard and the outputs are site specific.

Final molasses	280
B molasses	680
A molasses	1560
Raw sugar	3100
ESJ	3400
SEJ and final molasses from FEJ	750
Bagasse	290

S.N0.	Parameters	Sec Juice	Sec Juice Syrup	B Molasses	C Molasses
1	Total Solids, % w/w.	7-9	42 - 45	70 - 72	76 - 82
2	Fermentable Sugars, % w/w	6.3 – 7.0	31 – 32	55 - 60	44 - 48
3	Sucrose	5- 5.5	27-29	39-42	26- 28
4	Glucose	1.2-1.5	4 - 5	16- 18	18- 20
5	Total settlea-blesl%w/w	----	0.5 Max	0.5 Max	3
6	Titrable volatile acidity, ppm	300 Min	1200 Max	2500 Max	3000 - 5000
7	FAN	150 – 300	800 Min	1500 Min	1500 Max
8	Butyric Acid content, ppm	----	150 Max	150 Max	150 Max
9	Total Viable count, cfu/ gm	10000 Min	1200 Max	1000 Max	1000 Min

Suitable Solution for High Sucrose Feed Fermentation

Generally yeast produce invertosucrase enzyme to hydrolyze sucrose in to glucose and fructose.

High sucrose feed trigger yeast for higher invertosucrase enzyme production resulting increased metabolic stress for yeast.

To obtain required level of sucrase enzyme production yeast needed excessive nutrients & essential mineral and vitamins.

Due to higher metabolic stress yeasts productivity decreases and simultaneously undesired contaminants grows fast and produce undesired byproducts, which also creates further chemical stress on yeast.

In term to reduce such metabolic & chemical stress, we developed a booster "combination of enzyme and antimicrobial agents" to reduce the invertosucrase production and parallelly control contaminations resulting higher ethanol yield.

This process also requires high sugar tolerant dry yeast and technical support to optimize process conditions for maximum outcomes and minimum losses.

How to Choose Suitable Solutions?

Considerable Parameters	Cane juice	Syrup	B-Molasses	C-Molasses
Volatile acids	1500 - 2500	2000 - 4000	3000 - 5000	5000 - 7500
Microbial Contamination	High	Low	Low	Moderate
Chemical stress	Low	Low	Moderate	High
Osmotic Stress	Low	High	High	Moderate
Yeast inhibitors	Low	Low	Moderate	High
Fermentation efficiency	Low*	High	High	Moderate
Waste water generation per Lt. of ethanol	Very High	Mod-erate (1-2)	Low (4-5)	Moderate (7-8)
Waste water recycling possi-bility	No	No	High	Moderate
Waste water treatment ex-penses	Mod-erate	Moder-ate	Low	High
Energy/power consumption	High	Moder-ate	Low	Moderate
Transport from one place to another	Prob-lem-atic	Only at high brix > 45	Easy	Easy
Storage possi-bility	Prob-lem-atic	Only at high brix > 45	Difficult	Easy

Case Study on BH-Molasses – Maharashtra Region

Challenges Faced during B-Heavy Molasses Fermentation

- High Sulphur content
- High Osmotic & metabolic stress
- Unsuitability issue of basic yeast culture

- PF operation unsuitability due to excessive osmotic pressure
- Filling pattern requires optimization to reduce stress on yeast performance

Trouble-shooting Activities Conducted

- Shifted operation from culture yeast to Dry yeast completely
- Changed PF pattern “Say no to cut PF” (Previously using 3-4 PF cut on C-Molasses)
- Changed the feeding pattern of fermenter to reduce osmotic stress and enhancing the viability of yeast.
- Firstly added few molasses quantity to achieve 1.050 gravity followed by PF transfer with 4 hr retention.
- Once yeast activated and reaction starts then immediately start addition of molasses in next 12-14 hrs.

Case Study on BH-Molasses – Maharashtra Region

Lab Analysis Data						
DATE	TRS	BRIX	UFS	FS	Sludge %	VFA
23/2/19	57.0	85.0	4.2	52.8	11.9	3600.0
24/2/19	56.1	85.0	4.2	51.9		
27/2/19	56.3	84.0	4.2	52.1	12.0	
1/3/19	56.3	85.0	4.2	52.1		3660.0

Case Study Outcomes

Increase in Alcohol % :- 11.712-11.042 =0.67 on average basis.

Decrease in R.S.% :- 1.81-1.078 = 0.73 % On average basis.

Improvement in Fermentation efficiency from 85 % to 90 %

Gain in Recovery per ton of molasses 314.9-298.3 = 16.6 liter/ ton of molasses

Case Study on BH-Molasses – Production Data

Actual Per day production on using existing product				
Date	Wash Distilled	Molasses/ Day	Production/ Day	Recovery /Ton
18/2/19	562464	219.953	63789	290.053
19/2/19	562347	216.218	62752	290.226
20/2/19	517824	201.35	58699	291.527
21/2/19	446400	179.306	52032	290.185
22/2/19	544608	219.023	64181	293.033
				291.00
Actual Per day production on using ENZYPRO MV6				
Date	Wash Distilled	Molasses/ Day	Production/ Day	Recovery /Ton
23/2/19& 24/2/19	1035648	424.855	125354	295.051
25/2/19	571392	215.009	63860	297.011
26/2/19	562464	210.45	62931	299.031
27/2/19	374976	155.443	46633	300.001
28/2/19	354855	151.826	45862	302.069
1/3/19	535680	221.32	67971	307.116
2/3/19& 3/3/19	1160640	438.569	137369	313.227
				301.93

CONCLUSION

On using ENZYPRO MV6 we get an increase in recovery 10.93per ton of molasses.

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