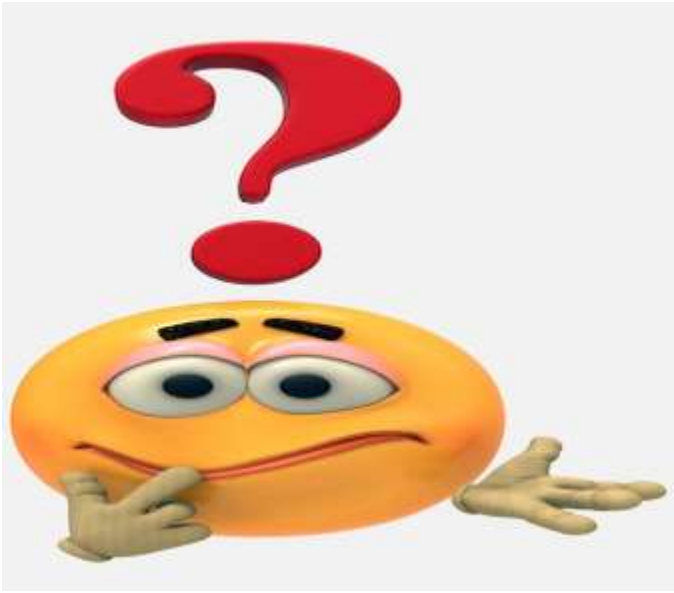
RECOMMENDATION/PROPOSAL OF NSI IN COST REDUCTION OF BIOFUEL PRODUCTION

NATIONAL SUGAR INSTITUTE
KALYANPUR, KANPUR

WHY ?

Reducing the cost of biofuel production is crucial for India

- ❖**To meet growing energy demands**
- ❖**To fulfill the commitment to sustainable development by reducing dependency on imported fossil fuels**
- ❖**To improve energy security**
- ❖**To reduce greenhouse gas emissions.**



HOW ?

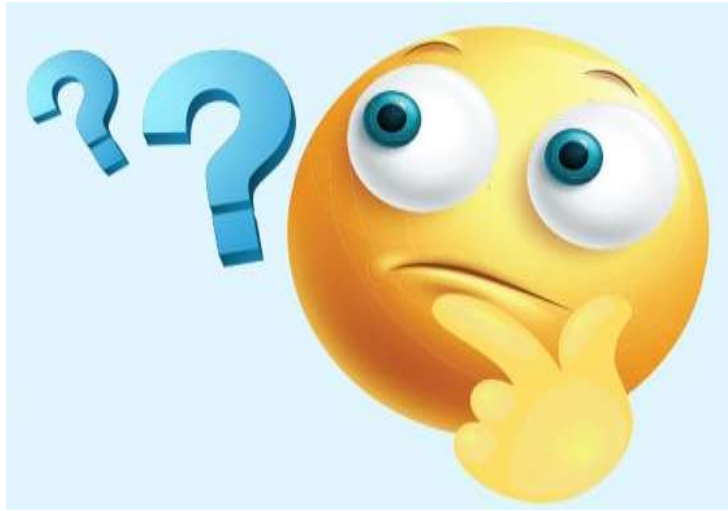
Several strategies could help to reduce the cost of biofuel production in India:

1. Switching to Smart Practice

2. Alternative Feedstock Availability

3. Value Addition from Available Sources/Biomass

4. Alternative Biofuel



1. SWITCHING TO SMART PRACTICE

The following work is being carried out at NSI, Kanpur for cost of reduction of Biofuel production by substituting the regular practice

a. Cane Syrup storage without any chemicals

b. Mixing Gasoline (Petrol) as a Denaturant in Ethanol as per Indian Standard IS 4117:2008

1.A CANE SYRUP STORAGE AT NO COST

- **Storage of syrup cane make the ethanol plant to run through out the year,**
- **Institute has taken up the syrup storage studies without adding any chemicals at institute laboratory level.**
- **The research was recognized and taken up by NSL sugars, and as per the methodology NSI proposed, syrup storage was taken up by the group at laboratory level for 1 month and now taken forward for large scale syrup storage.**
- **Storing syrup is not a problem if we maintain the pH above neutral and raise the brix to 75 + before storing.**

5000 TCD - 28.5% Syrup diversion 160 days 100 KLPD

5000 TCD 71.5% B heavy @6.5% at 310 l/t - 100 KLPD 115 days

Total working → 160 +115 = 275 days

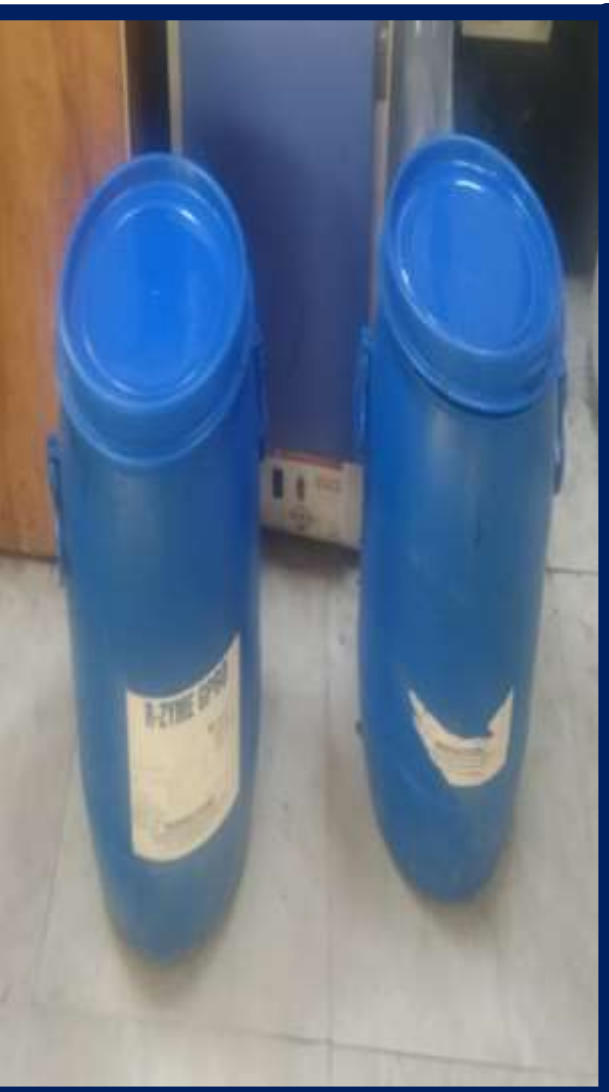
So we have to go for syrup storage to use during off season

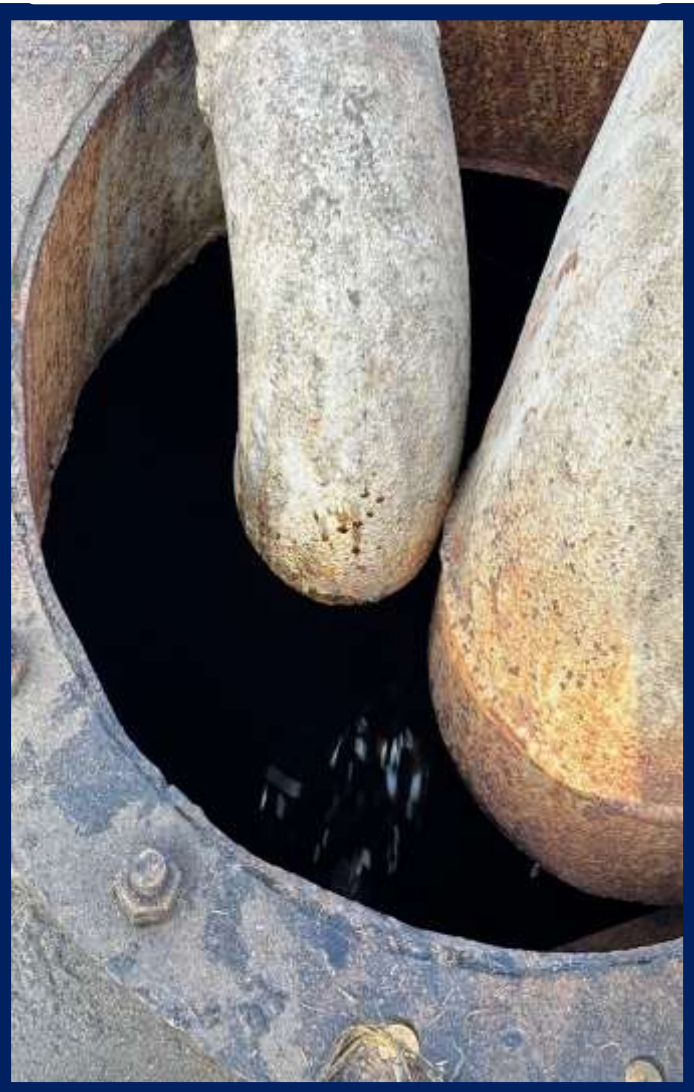
The quantity of storage shall be about 20 % (112 days)

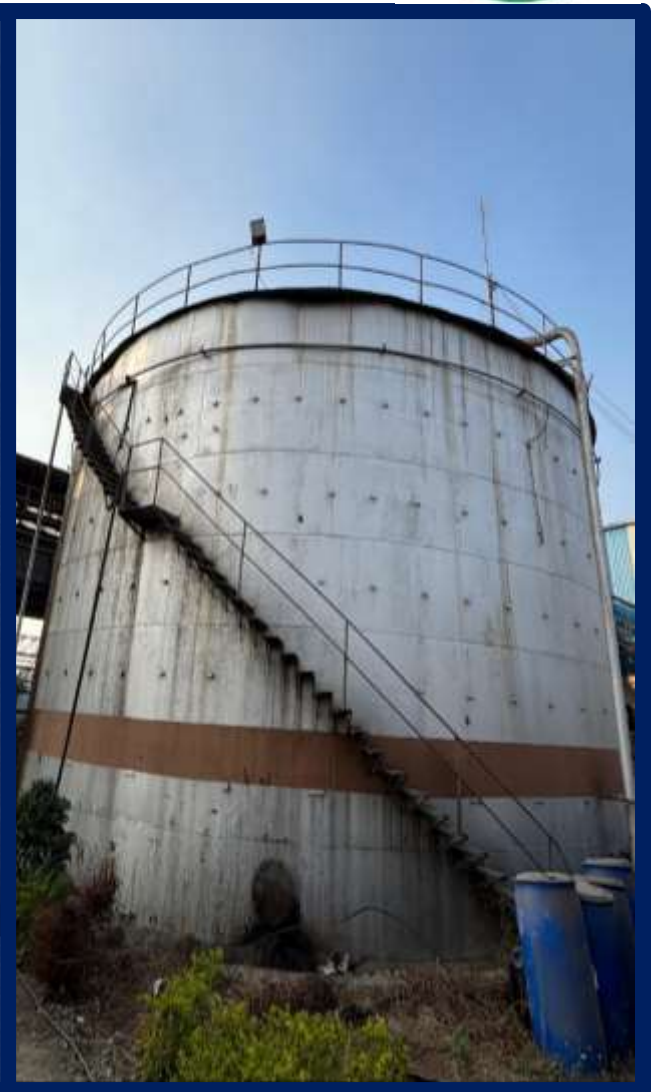
Balance 100-28.5-20 = 51.5 % as B heavy diversion and

No. of days 160+112+83=355 days

CANE SYRUP STORAGE TRIALS AT NSL







1.B DENATURANTS AT NO COST

NEED OF DENATURANTS IN ETHANOL

- To make it unfit for human consumption
- Making it undrinkable while retaining its utility
- Allowing its use in industrial & commercial purpose etc.
- Indian standard has recommended list of denaturants for the same
- IS 4117:2008 deals with the denaturants
- Along with other allowed denaturants, gasoline is one of them
- IS 2796:2008 deals exclusively about Gasoline(Petrol) as denaturant

INDIAN STANDARD 4117:2008

IS 4117 : 2008

भारतीय मानक

एलकोहल विनैचरमक — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

ALCOHOL DENATURANTS — SPECIFICATION

(Second Revision)

ICS 71.100.80

INDIAN STANDARD 4117: 2008

ANNEX A

(*Foreword*, and *Clause* 4; *Annex* B *and* E-2.6)

FORMULAE FOR DENATURED ALCOHOL

Designation	Denaturant	Amount of Denaturant for 100 Litres of Alcohol	Use (Ref to Annex)
	A — Completely Denatured Alcohol		
CD 1	Methyl alcohol + Ethyl Acetate	16.0 litre + 1.0 litre	B
CD 2	Isopropyl alcohol + Ethyl acetate	8.0 litre + 4.0 litre	B
CD 3	Acetone + Ethyl acetate	8.0 litre + 1.0 litre	B
CD 4	Methyl alcohol + Petroleum naphtha	6.5 litre + 1 litre	B
CD 5	Gasoline	2 to 5 litres	B

INDIAN STANDARD IS 2796:2008

भारतीय मानक

मोटर गैसोलीन — विशिष्टि

(चौथा पुनरीक्षण)

Indian Standard

MOTOR GASOLINE — SPECIFICATION

(Fourth Revision)

DENATURANTS ON USAGE IN INDIA

- Currently some of the chemicals are used as denaturants
- Following are prominent among them

➢ Crotonaldehyde 0.2% (Liquid form)

➢ Denatonium Benzoate 0.004%(Powder form)

➢ Brucine Sulphate with Tertiary Butyl Alcohol - 10g + 0.5 liters

PRESENT COST OF DENATURANTS USED BY DISTILLERY

Particulars	Unit	Data
Basis for costing on ethanol	Litre	100
Crotonaldehyde dose	%	0.2
Strength of protonaldehyde	%	85
Required Crotonaldehyde for 100 litre	Litre	0.24
Cost @ rupees 150 per litre	Rs/100 litre	35.29
Cost per litre	Rs/litre	0.3529
Deanatonium benzoate dose	Gm/100 litre	4
Cost @ rate rupees 1650 per kg	Rs /100litre	6.600
Cost per litre	Rs/Litre	0.066
Total cost per litre	Rs/Litre	0.419

WHY GASOLINE AS DENATURANT?

Cost Efficiency

- Using gasoline as a denaturant eliminates the need of purchasing separate specialized denaturants, offering immediate cost savings as gasoline usage may not require additional storage or transportation for denaturation purposes.

Compliance with IS 4117:2008

- By mixing gasoline with alcohol, the resulting product will remain in compliance with the regulatory guidelines for denatured Ethanol as IS standard allows the use of gasoline as a denaturant.

Environmental Considerations

- ✓Proper use and control of the mixture can minimize the environmental impact compared to using non-renewable or highly toxic denaturants.
- Most of the denaturants which are in use till now may affect the petrol based engines in longer term.

Safety and Handling

- Gasoline is already handled by industry professionals who are familiar with its properties and safety protocols.

UPSMA – STUDY PROJECT

- Standardization of procedure Involved
- Employees training strategy
- Establishment of protocols to manage the associated risk
- Supply chain management
- NSI will give presentation to MoPNG, OMCs, UP and other state excise authorities about the technical findings for implementation.

2. ALTERNATIVE FEEDSTOCK

Alternative feedstock for integrated distilleries with very minor modifications are possible with the

A. Sweet sorghum crushing

B. Muddy Juice Diversion

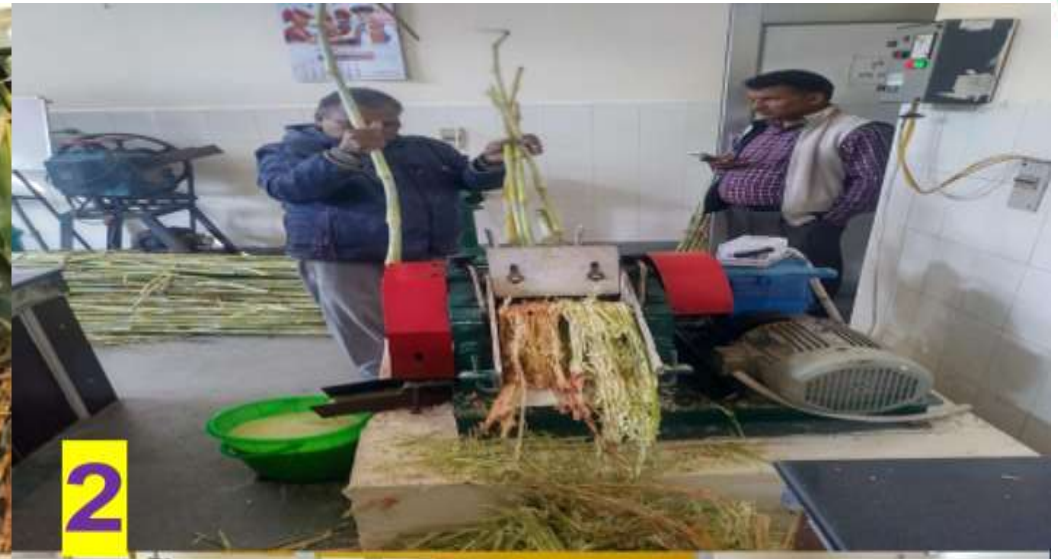
Experimental studies are completed by NSI, Kanpur both at laboratory level and mini factory scale level.

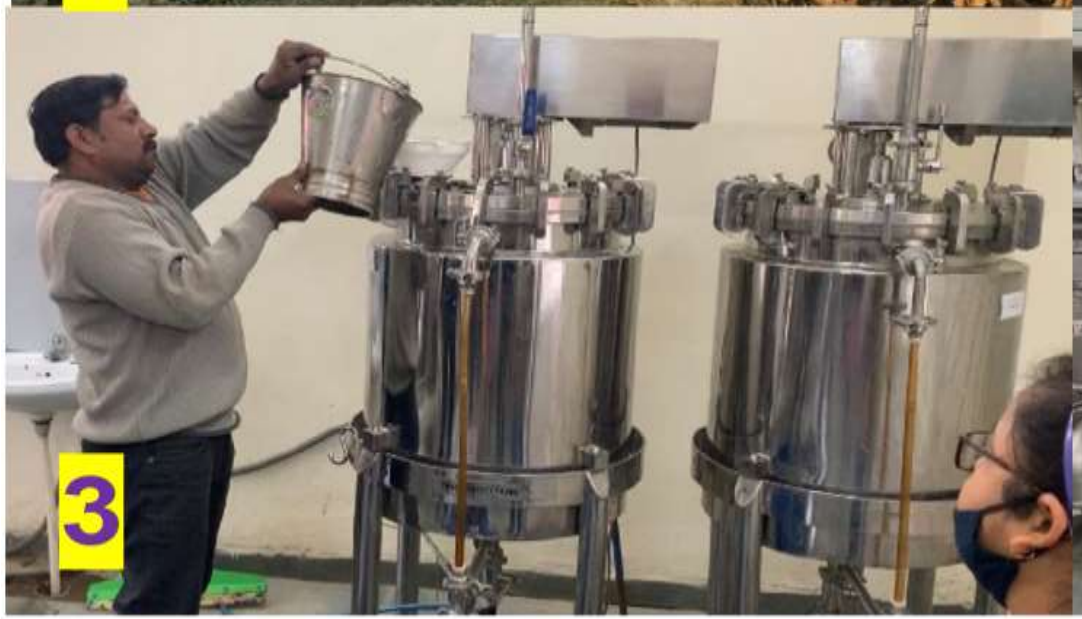
2.A.SWEET SORGHUM FOR BIOETHANOL

- **Sweet sorghum (Sorghum bicolor L. Moench), a sugar crop with wider adaptation and high potential for bioenergy and ethanol production is expected to meet food, feed, fodder, fuel and fibre demands.**
- **It produces high biomass *(50-80 t/ha)* and alcohol *(1500-2800 l/ha)* and multiple income opportunities exist with this crop.**
- **Some sweet sorghum lines attain juice yields of about *65%* (with lab crusher) of total plant biomass, containing from *15% soluble fermentable sugars* which are composed mainly of sucrose (70–80%), fructose and glucose.**
- **Due to its short growing period *(3-4 months)*, it could be cultivated and supplied during the lean period of sugarcane crushing thus extending the crushing period before and after sugarcane crushing and stretch the sugar mill operation.**
- **The major advantage with this crop is that no CapEx is required when used in a sugar mill system as same machinery can be used for crushing and fermentation.**

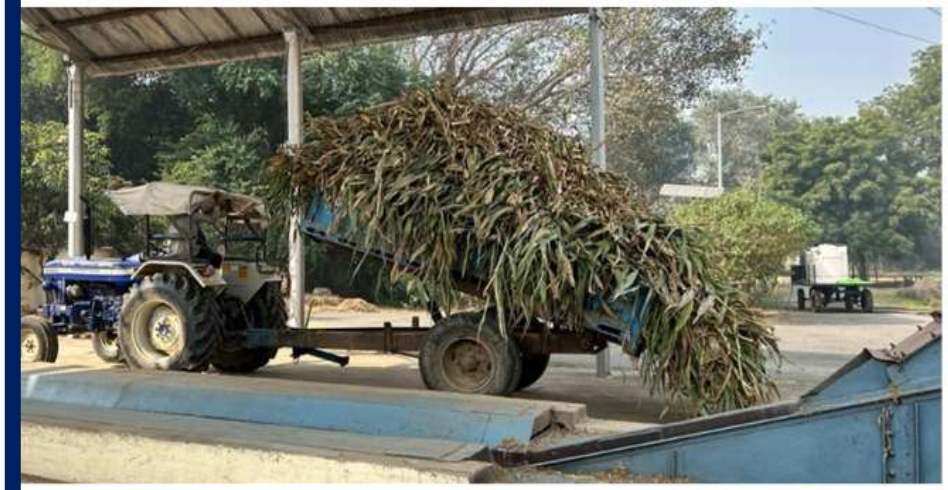
- **It will help farmers to fetch additional income and provide an opportunity for better utilization of industrial facilities during sugarcane off-season thus extending the crushing period before and after sugarcane crushing and stretch the sugar mill operation.**
- **In order to promote bioethanol production from alternate feed stocks so as to cope up with the mandatory blending of ethanol in petrol, *National Sugar Institute, Kanpur and ICAR-IIMR, Hyderabad* joined hands for working together to promote Sweet Sorghum for bioethanol production over a *five-year period (2020-2025).***
- **Very recently carried out the *Factory trials* of sweet sorghum along with *Advanta, Hyderabad* by growing sweet sorghum at NSI farm for around *10 acres* and crushed at *100 TCD sugar factory, ESF at NSI* and studied for ethanol production.**
- **Also the sweet sorghum syrup of 77 Brix was made and was under study for storage of syrup for ethanol production.**
- **NSI going to take up a *project with BPCL* to study the sweet sorghum for ethanol at 2 sugar factories – one at Karnataka *(Jamkhandi Sugars Ltd)* and one at Maharashtra *(Shreenath Mhaskoba Sakhar Karkhana Ltd.)***

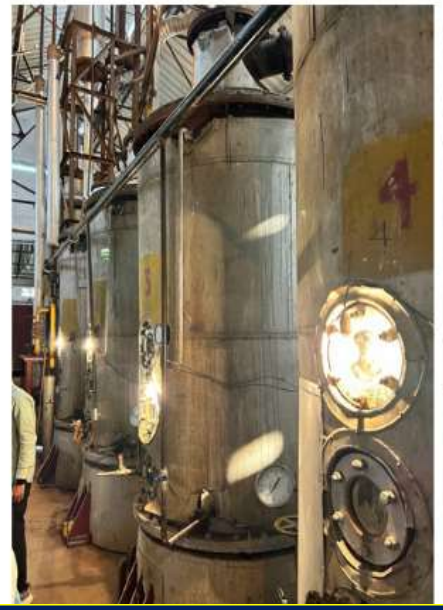
SWEET SORGHUM TRIALS AT NSI, KANPUR WITH IIMR, HYDERABAD

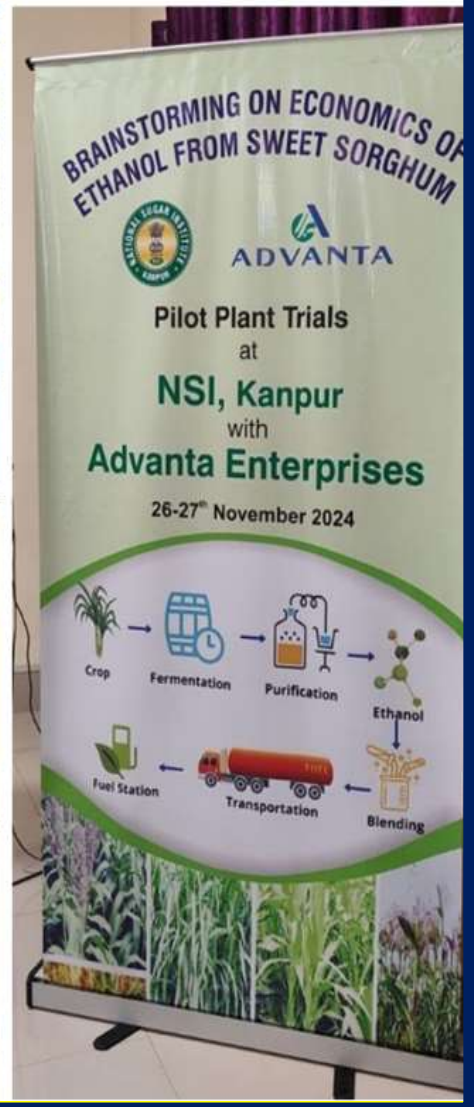




SWEET SORGHUM TRIALS AT NSI, KANPUR WITH ADVANTA, HYDERABAD







VALUE OF SWEET SORGHUM

- **Sweet sorghum is a promising dry land biofuel feedstock that addresses**

Food Vs Fuel issue favorably.

- **Crop consumes 1/3rd the requirement for sugarcane. Water requirement is much lower compared to rice and maize also.**
- **Can be crushed with the existing sugarcane machinery in the factory with little modification.**
- **No CapEx**
- **Farmer's income is more than doubled.**
- **Industry profit is also much higher than rice and maize**
- **Overall, the good thing is that there is no burden on the Govt. exchequer.**
- **There is no air pollution due to burning of trash (Parali burning)**
- **Enhance Energy security, ecological and economical sustainability and livelihood development.**

2.B.MUDDY JUICE FOR ETHANOL

- At present sugar factories opt Rotary vacuum filter/ decanter for recovering the sugar in muddy juice.
- After separation of coagulated suspended particle as filter cake, the filtrate juice is recirculated and combined with Mixed Juice at mixed juice tank or at absorption tower of juice reaction tank.
- This filtrate juice has brix content in the range of 9.00 to 12.00 percent on juice& accounts almost 15-20% of the volume of juice processed.
- The recycling of filtrate juice represents an extra 12-15% mud solids loading on the clarifier, as a result reducing its effective capacity. Also, the filtered muddy juice recycling leads to significant increase in turbidity, complexed calcium ion formation, phosphate, proteins and polysaccharides in juice that impact on

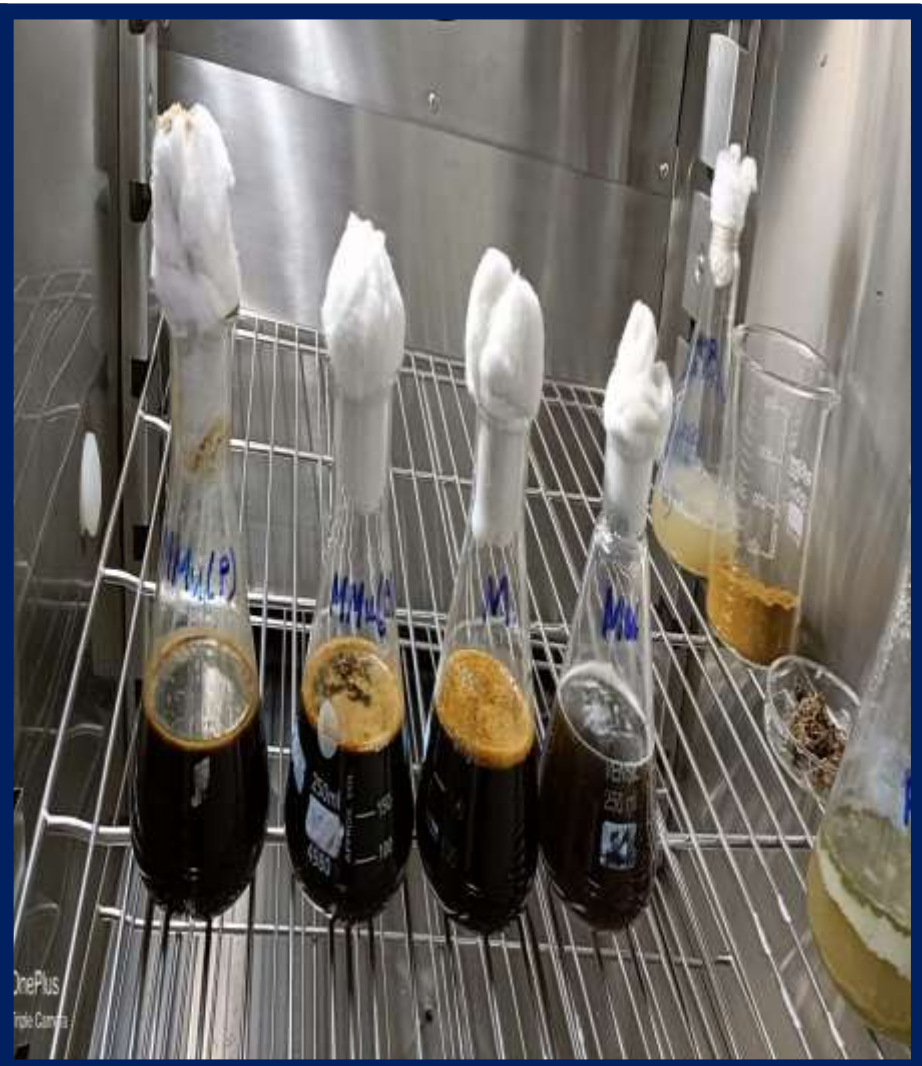
1. Evaporator - Scale formation
2. Sugar - Color reduction
3. Molasses - Exhaustion.

NSI carried out trials at NSI laboratory and also factory trials at Uttam Sugar Mills and Nirani Sugars.

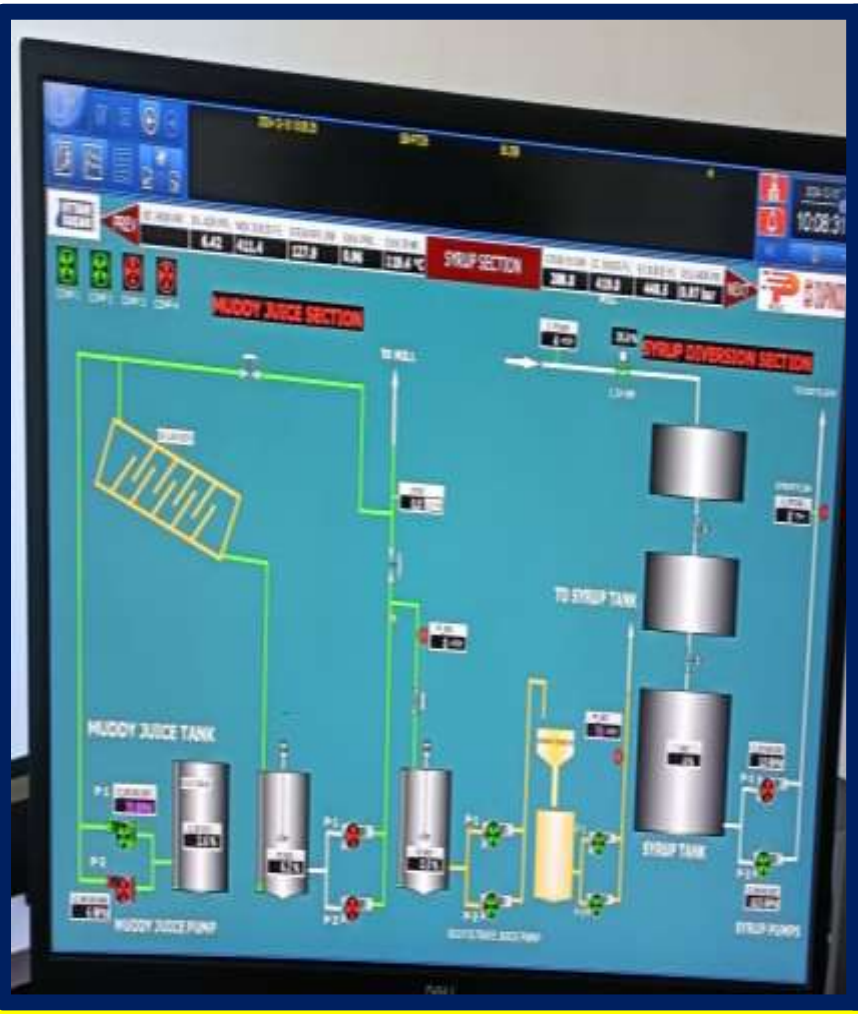
VALUE OF MUDDY JUICE FOR ETHANOL DIVERSION

- Sugar ICUMSA will be improved
- Steam consumption will be reduced
- Power consumption will be reduced
- Manpower will be reduced
- Bagasse saving will be increased
- Water consumption will be reduced at RVF
- Minimise the ground water extraction
- To enhance the Boiling house capacity approx..15% of sugar plant without any investment
- To increase the production of Ethanol.

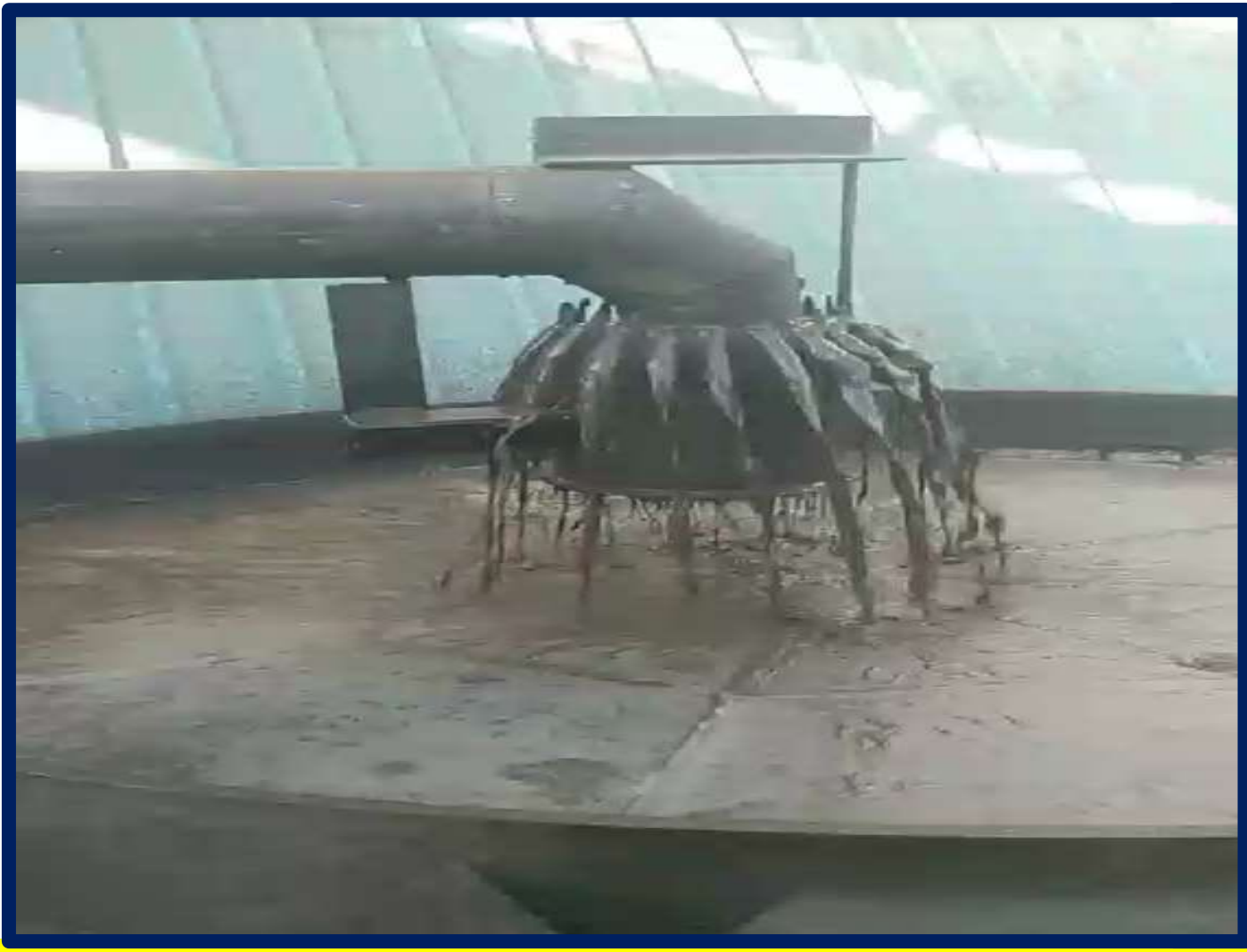
MUDDY JUICE TRIALS AT NSI



MUDDY JUICE TRIALS AT UTTAM SUGARS



MUDDY JUICE TRIALS AT NIRANI SUGARS



3. VALUE ADDITION FROM AVAILABLE SOURCES/BIOMASS

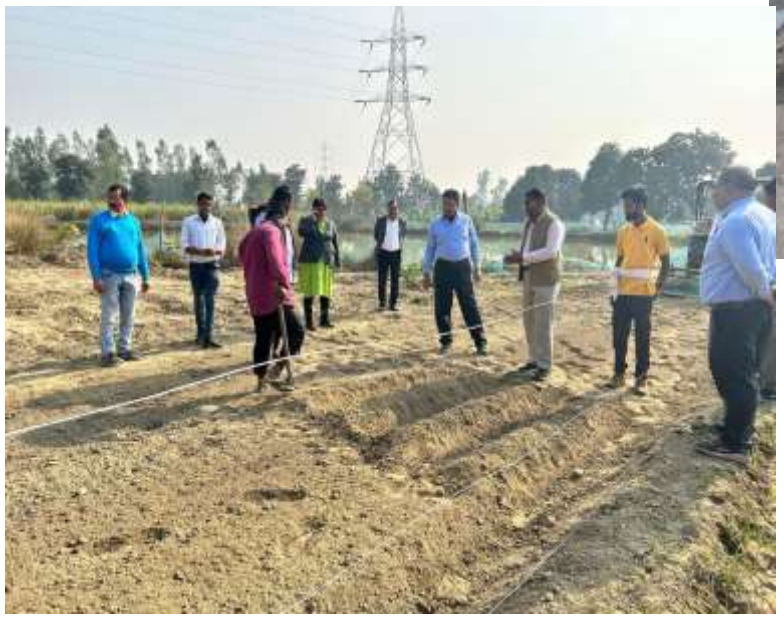
NSI striving towards establishing a pilot plant for producing value added products like lignin, cellulose, hemicellulose from sugarcane bagasse, sweet sorghum bagasse and other biomasses (For what already laboratory level studies are completed at NSI)

4. ALTERNATIVE BIOFUEL AND SOLUTIONS

NSI has proposed a CBG project under Center of Excellence for Biofuels (along with IIT, Kanpur) with following objectives

- **To standardize a method for CBG production from alternative raw material available at sugar factories viz cane leaf tops, colony domestic waste and spent wash.**
- **To standardize a method for CBG production from *sugar beet pulp: Sugar Beet is sown in 5 sugar factories of Uttar Pradesh in the month of November 2024, by NSI, Kanpur in collaboration with IISR, Lucknow.* The initiation is taken to show case the potential of sugar beet in terms of crop yield and ethanol production to the farmers. After harvesting the Sugar beet juice will be used for ethanol production and the left over sugar beet pulp may be utilized for CBG production.**
- **To study the effectiveness of biogas production from alternative raw material in different combinations with and without press mud.**
- **To develop the solution for handling and curing of LOM &FOM**

SUGAR BEET TRIALS AT 5 SUGAR FACTORIES AT UP



CONCLUSION

1.Implementation of Advanced Technology with Efficient Energy Management

2.Government Support and Policies

3.Public-Private Partnerships

Thank You