

SHARKARA

VOLUME-49, NO .02

APRIL-JUNE, 2018



NATIONAL SUGAR INSTITUTE
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IT CONTAINS.....

CONTENTS	PAGE
MESSAGE FROM DIRECTOR	03
OUR RESEARCH AREAS	04 - 08
OUR PROVISIONS	09 - 15
OUR ADVISORY	16 - 18
RESEARCH ARTICLE	19 - 30
HAPPENINGS IN THE SUGAR INDUSTRY	31 - 36
ABSTRACTS	37 - 45

FROM DIRECTOR'S DESK.....



The sugar production in the country is all set to be the highest ever & is expected to be around 32 million tonnes during the current sugar season 2017-18.

The prices of sugar which went lower, again shown stabilization & firmer as a result of policy interventions by the Central Government with regard to minimum selling price of sugar, creation of buffer stock & monthly release mechanism. The differential pricing policy for ethanol is also going to help the sugar industry looking to the preliminary estimates for sugar production during the next crushing season 2018-19. Indian sugar industry needs a long term policy, a road map, for increasing its revenues through other sources rather remaining heavily dependent upon sugar. An out of box thinking shall be required to address the issue.

I wish sugar business to remain sweet.

(Narendra Mohan)
Director

➤ OUR RESEARCH AREAS:

The Institute is actively involved in the collaborative endeavors with the sugar and allied industries for developing innovative techniques and technologies for improving the overall profitability of the sugar industry.

➤ RESEARCH:

The Institute during the period took up R&D work on the following:

1. Utilization of Potash Rich ash for production of valuable bio fertilizer – Boiler ash from Incineration Boilers installed in molasses based distilleries can be used as carrier for making bio-fertilizer. The work has been taken up so as to work out different formulation & testing them at field level.



2. Alcohol fermentation by immobilized yeast cells – The study was taken up with a view to use the same yeast for many cycles in fermentation & thereby saving yeast. Since the concentration of yeast is high in immobilized beads there is great reduction in fermentation time. Trial was carried out using immobilized yeast cells on Glass bead and concentration of 20:12(ratio g), produced very good results upto 9 cycles and the performance was observed to be more or less consistent with Fermentation Efficiency of around 90%.

3. Press Mud to Bio CNG- With an aim to utilize the press mud for production of Bio-CNG, different combinations of press mud, farm yard manure and spent wash were initially tried on laboratory scale. A new set was started at pilot plant scale and it was observed that the production of biogas using a mixture of Press mud & cow dung in the ratio 80:20 improved a lot after about 25 days and there has been continuous production since then. Percentage of methane & other gases is continuously being monitored to assess the quantity of Bio-gas.



4. Studies on clarification of cane juice with bagasse derived bio char – The study has been taken up with an aim to utilize the bagasse fly ash in combination with bio char to check its clarification efficiency on cane juice and other sugar liquors. Characterization of fly ash surface area has been taken up.



5. Studies on synthesis of glycosidic surfactants using by-product resources of sugar industry – Studies have been further taken up so as to enhance the yield of bagasse derived polypentosides based surfactant along with reduction in purification steps involved thereof. The detailed study of Mass and NMR spectra of the surfactant synthesised from sugarcane trash has been done. Further, a proto type formulation of eco-friendly liquid detergent from sugarcane trash derived surface active agent has been carried out. Its properties such as pH, surface tension, foam ability & stability, cleaning action via reflectance measurement are under evaluation.

6. Studies on Production/isolation of C5-Sugar Alcohol/Sugar using by-product resources of sugar industry- The studies aim basically at deriving a low calorie sweetener from bagasse for which an up to date literature survey on the topic has been completed. The isolation and identification of products formed during the optimization of the reaction conditions for the synthesis of xylitol from bagasse are under process. The isolation and identification of products formed during the optimization of the reaction conditions for the synthesis of xylitol from bagasse has been completed. A fresh batch of reaction has been put to access xylitol from sugarcane trash and isolation and identification of the products formed in the reaction mixture is under process.



7. Studies on pot efficient synthesis of alkyl levulinates (Als) using sugarcane bagasse derived cellulose – Biomass conversion into useful chemicals, materials and fuels emerged as a promising alternative toward replacing the current production of most of these commodities and specialty products from petroleum feedstocks. Alkyl levulinate (AL), is as useful as a levulinic acid derivative in many fields, such as medicines, solvent, organic chemistry, fragrance and furthermore it can be directly used as additives for gasoline and diesel, due to its excellent performances, such as high lubricity, flashpoint stability, non-toxic and better flow properties under cold condition. Based on such potential, direct production of alkyl levulinate (AL) from sugarcane bagasse in a catalytic cascade reaction will be evaluated following bio-refinery concept.

8. Improvement in Sugar Quality by clarification of intermediate boiling house products- In order to improve sugar quality laboratory experiments were conducted in two commercial sugar factories carrying out physico-chemical clarification of intermediate process liquors. Analysis work of samples collected from different factories has been completed. Research paper has been sent for publication in proceeding of Annual Convention of STAI to be held in August 2018 at Indore.



9. Settling test at inclined surface.- Analytical data as a result of experiment conducted on a prototype at The Experimental Sugar Factory revealed that the turbidity and colour reduction to be around 35% & 20% respectively from raw juice to clear juice during the trial of SSRT clarifier. Further experiments shall be taken up from the inferences drawn.



➤ **RESEARCH PAPERS/ POSTER / PRESENTED / PUBLISHED/ SENT FOR PUBLICATION:**

1. **“Effluent Generation & Treatment in Indian Sugar Industry-An Overview”** by Mahendra Yadav, J.P. Srivastava & Narendra Mohan, presented during national seminar organized by National Sugar Institute & S. Nijalingappa Sugar Institute on 27th April, 2018 at Belagavi, Karnataka.
2. **“Treatment of Sugar Factory Effluent by Electro Coagulation Process to Meet CPCB requirements”** by Vimlesh Mishra, Amresh Pratap, Mahendra Yadav & Narendra Mohan, presented during National Seminar organized by National Sugar Institute & S. Nijalingappa Sugar Institute on 27th April, 2018 at Belagavi, Karnataka.
3. **“Ethanol Production Opportunities & Challenges”** by Narendra Mohan, presented during All India Seminar organized by All India Distillers Association (AIDA) at New Delhi on 26-27th April 2018.
4. **“Sustainability of Indian Sugar Industry –Cost Effective Sugar Production & Beyond”** by Narendra Mohan, during the Annual Business Meet organized by M/s EID Parry at Bangalore, on 20th April 2018.
5. **“Isolation of Yeast Strain from Spoilt Sugarcane Juice”** by Vinitanjali Banerjee, Santosh Kumar & Narendra Mohan sent for publication in the proceedings of 76th Annual Convention of The Sugar Technologist’s Association of India to be held from 20th -22nd August 2018 at Indore.
6. **“Development of an Effluent Treatment Process for Plantation White Sugar Factories to meet CPCB Requirements”** by Neelam Dixit, Amresh Pratap & Narendra Mohan sent for publication in the proceedings of 6th Annual Symposium of Bhartiya Sugar, to be held at Kolhapur on 14-15th July 2018.
7. **“Multi-Level Inverter based Topologies for Sugar Mill Drive Applications”** by Anoop Kumar Kanaujia, Sanjiv Kumar & D. Swain sent for publication in the proceedings of 76th Annual Convention of The Sugar Technologist’s Association of India to be held from 20th -22nd August 2018 at Indore.
8. **“Sugarcane Price Determination in India-Need for a Hybrid Formula”** by Narendra Mohan, D.Swain & Priyanka Singh sent for publication in the proceedings of 76th Annual Convention of The Sugar Technologist’s Association of India to be held from 20th -22nd August 2018 at Indore.
9. **“A Study on Working of Vertical Continuous Pan for Raw Masecuite Boiling”** by Narendra Mohan, Ashutosh Bajpai and Subhash Chandra sent for publication in 76th Annual

Convention of The Sugar Technologist's Association of India to be held from 20th -22nd August 2018 at Indore.

10. "Valorization of Sugarcane trash as a Potential Raw Material in Formulation of Eco-Friendly Liquid Detergent" by Narendra Mohan, Vishnu P. Srivastava and Anushka Agarwal sent of publication in the proceedings of 64th Annual Convention of The Deccan Sugar Technologists Association to be held on 28-29th July 2018 at Gandhinagar, Gujarat.

11. "Treatment of Sugar Factory Effluent by a Novel Process" by Amresh P. Singh, Mahendra kr. Yadav and Narendra Mohan sent for publication in 48th Annual Convention of SISSTA to be held in Aug 2018.

12. "Ethanol Production: Opportunities & Challenges" by Narendra Mohan sent for publication in the proceedings of 6th Annual Symposium of Bhartiya Sugar, to be held at Kolhapur on 14-15th July 2018.

➤ OUR PROVISIONS:

➤ SEMINAR & WORKSHOP ORGANIZED:

1. National Seminar on the important topic of "Modern Technologies for Reducing Effluent Generation in Sugar Processing/Distilleries and Further Treatment to Meet CPCB Norms" was organized by the institute jointly with S. Nijalingappa Sugar Institute at Belagavi on 27th April 2018. Two papers were presented on the related topic by the up-coming Sugar Technologist's of the institute.



2. Director, National Sugar Institute attended "Annual Business Meet" organized by M/s EID Parry at Bangalore on 20th April 2018. During the meet, he delivered a lecture on "Sustainability of Indian Sugar Industry –Cost Effective Sugar Production & Beyond".

3. Director, National Sugar Institute attended two days seminar organized by All India Distiller's Association (AIDA), New Delhi on 26-27th April 2018, wherein he emphasized upon use of alternate feed stocks for alcohol production to meet requirement of various sectors & make EB10 a success.



4. National Workshop on "Sugar Industry in Northern India-Road Map for Crushing Season 2019-20" organized at the institute on 26th June 2018 wherein brainstorming on cane price fixation mechanism, diversification, value addition, sugarcane varietal balance, branding of Indian Sugars and on environmental issues were carried out.



➤ EXTENSION LECTURES :

Under the Aegis of Scientific Society of Council of Student's Activities expert lectures were delivered by many eminent Scientists & Technologists.

1. Shri S.P. Tripathi (Technical Consultant) delivered a lecture on "Standard Practices for Clarification House in Plantation White Sugar Factories" for the benefit of faculty and students on 12th April, 2018.



2. Dr. (Mrs.) Priyanka Singh, Scientific officer UP Council of Sugarcane Research delivered a lecture on "Managing Maturity & Post-Harvest Deterioration" on 13th April, 2018.



3. Dr. M. B. Londhe, Technical Director, M/s Rahi Techno Services, Pune delivered a lecture on "Pan Boiling and Sugar Quality" on 09th May, 2018.



➤ **SOLAR SUGARCANE SEED TREATMENT UNIT DEVELOPED:**

Shri Subhash Chandra Sharma, Commissioner, Kanpur Range released "Solar Sugarcane Seed Treatment Unit" developed by the institute. The unit has been based on "Hot Water Treatment" of Sugarcane Seed.



➤ **SEMINAR ROOM INAUGURATED:**

A newly constructed hi-tech Seminar room having a seating capacity for 50 persons was inaugurated by the Commissioner, Kanpur range.



➤ **DISTINGUISHED VISITORS:**

1. Shri Anil Kumar Shukla, Executive Vice President, North Indian Sugarcane & Sugar Technologists Association (NISSTA), Lucknow.

2. Shri Atul Kr. Agrawal, General Manager (Production), Triveni Engineering & Industries Ltd., Sabitgarh, U.P.
3. Shri S.S. Singh, Vice President, Wave Industries Pvt. Ltd., Aligarh, U.P.
4. Shri Deepak Gupta, Secretary General, UPSMA, Lucknow, U.P.
5. Shri Dr. M.B. Londhe, Technical Director, Rahi Techno Services, Pune.
6. Shri G.K. Thakur, Director-Policy (Sugar & By-Products), ISMA, New Delhi.

➤ BUREAU OF SUGAR STANDARDS:

The Institute on behalf of Bureau of Indian Standards prepares and issues Sugar Standard Grades to the entire Sugar Industry of the country for every sugar season. These Sugar Standard Grades are issued to facilitate quality control and to protect the interest of the common consumers. On the basis of these grades, sugar factories mark their produce accordingly.

On the basis of the approved Standards, Bureau of Sugar Standards Grades distribution commenced from 3rd October, 2017. During the period, October 2017-June 2018, 1496 nos. samples were sold to sugar factory and other users.

Price schedule for the sugar season 2017-18:

1	Sugar Standard Grades to be issued	L-31, L-30, M31, M-30, S-31, S-30 & SS-31
2	Set of New Sugar Standard Grades containing 7 grades +3 empty glass bottles + 3 Velvet Cork in packing case	Rs.10000/= each set
3	Single Sugar Standard Grade	Rs.1260/= each
4	Empty Sugar Standard Glass Bottle	Rs.200/= each
5	Packing case	Rs.430/= each
6	Velvet Cork	Rs.50/= each
7	Postal expenses, forwarding charges, if any	Extra on actual basis
8	Demand Draft to be sent	In favour of Director, National Sugar Institute , payable at Kanpur
9	Delivery of Sugar Standard Grades	Monday to Friday (10.00 AM to 5.00 PM)
10	Taxes	GST extra as applicable @18%.

➤ हिन्दी कार्यशाला:

सरकारी कामकाज में राजभाषा के रूप में हिन्दी के प्रति जागरूकता लाने तथा उसके उत्तरोत्तर विकास हेतु संस्थान में 04 जून 2018 को हिन्दी कार्यशाला का आयोजन किया गया जिसमें संस्थान, के निदेशक ने सभी विभागाध्यक्षों को निदेशित किया कि सभी अपने अधीनस्थ कर्मचारियों को हिन्दी में कार्य करने को प्रेरित करें जिससे कि राजभाषा विभाग के निर्देश का पालन सुनिश्चित किया जा सके। इस कार्यशाला में नव नियुक्त अधिकारियों व कर्मचारियों को राजभाषा में कार्य करने हेतु सरकारी दिशा निर्देशों से भी अवगत कराया गया।



➤ INTERNATIONAL YOGA DAY:

4th National Yoga Day celebrated at the Institute on 21st June, 2018. Staff of the institute performed various Yoga exercised under the watchful eyes of a Yoga teacher.



➤ WORLD ENVIRONMENT DAY:

Under the aegis of Council of Students' Activities, Institute's Scientific Society celebrated World



Environment Day -PARIVESH on the theme "Beat Plastic Pollution" students actively participated in poster, slogan & other competitions. Dr. Sushil Solomon, Vice-Chancellor, CSA University, Kanpur graced the occasion.

➤ ENTRANCE EXAMINATION:

Entrance Examination – 2018 for admission to various courses during academic season 2018-19 was conducted at six centers across the country on 10th June 2018. A new PG Diploma course in Quality Control & Environment Science” is being introduced from the academic session 2018-19.



➤ OUR ADVISORY:

Besides conducting teaching and training programmes, carrying out research in relevant field, another main function of the institute is:

1. To function as a “Think-tank” to sugar and allied industry for proposing modernization and trouble free functioning of the process on advisory basis / through Extension Services.
2. To formulate strategies and promotes measures for expansion of capacities, energy conservation, co-product utilization etc. for sugar and allied industries.
3. To assist Govt. of India through technical contribution in policy formulation and control of Sugar Industry.

➤ CONSULTANCY SERVICES:

During the period April-June, 2018 consultancy services were provided to the following:

1.	M/s NABARD Consultancy Services Pvt. Ltd., Lucknow, U.P.
2.	M/s State Vigilance Bureau, Rohtak, Haryana.
3.	M/s Dhampur Sugar Mills Ltd., Mansurpur, Distt-Muzaffarnagar, U.P.
4.	M/s Mawana Sugars Works, Mawana, Distt- Meerut, U.P.
5.	M/s Triveni Engineering & Industries Ltd., Kurdwara, Distt-Moradabad, U.P.
6.	M/s The Kisan Sahkari Chini Mills Ltd., Gajraula, Hasanpur, Distt- Amroha, U.P.
7.	M/s The Nandi Sahkari Sakkare Karkhane Niyamit, Krishnanagar, Distt- Vijayapur, K.N
8.	M/s Avadh Sugar & Energy Ltd., Hargaon, Distt- Sitapur, U.P.
9.	M/s DSM Sugar Meerganj unit of Dhampur Sugar Mills Ltd., Bareilly, U.P.
10.	M/s Sadguru Sri Sri Sakhar Kharkhana Ltd., Unit-02, Pune, Maharashtra.
11.	M/s Dalmia Bharat Sugar & Industries Ltd., Unit- Jawaharpur, Distt- Sitapur, U.P.
12.	M/s Gularia Chini Mills Ltd., Distt- Lakhimpur-Kheri, U.P.
13.	M/s Kumbhi Chini Mills Ltd., Distt- Lakhimpur-Kheri, U.P.
14.	M/s U.P. State Sugar Corporation, Mohiddinpur, Distt- Meerut, U.P.
15.	M/s Balrampur Chini Mills Ltd., Balrampur, Distt- Balrampur, U.P.
16.	M/s Panipat Cooperative Sugar Mills Ltd., Panipat, Haryana.
17.	M/s Rauzagaon Chini Mills Ltd., Rauzagaon, Distt- Faizabad, U.P.
18.	M/s Nirani Sugar Mills Ltd., Distt- Bagalkot.

19.	M/s Dalmia Bharat Sugar Industries Ltd., Nigohi, Distt- Sahajahanpur, U.P.
20.	M/s Dalmia Bharat Sugar Industries Ltd., Ramgarh, Distt- Sitapur, U.P.
21.	M/s Balrampur Chini Mills Ltd., Unit Haidergarh, Distt.- Barabanki U.P.
22.	M/s Uttam Sugar Mills Ltd., Lilbberheri, Distt.- Haridwar U.K.
23.	M/s Harinagar Sugar Mills Ltd., Harinagar, West Champaran, Bihar.
24.	M/s The Haryana Co-operative Sugar Mills Ltd., Bhali Anandpur, Rohtak.
25.	M/s Triveni Engineering & Industries Ltd., Alco-Chemical complex Bhikki- Bilaspur, Muzzaffarnagar, U.P.
26.	M/s Central Distillery & Breweries Kankerhera, Meerut Cantt., Meerut, U.P.
27.	M/s Triveni Engineering & Industries Ltd., Sugar Unit – Sabitgarh Distt.- Bulandshahr U.P.
28.	M/s Kisan Shakari Chini Mills Ltd., Najibabad, Bijnor, U.P
29.	M/s DSCL Sugar Loni, Hardoi, Shahabad, U.P.
30.	M/s Kisan Shakari Chini Mills Ltd., Powayan, Shahjahanpur, U.P

➤ ANALYTICAL SERVICES:

The institute now has a Centralized NABL Accredited Analytical Laboratory to carryout analysis of sugar, molasses, alcohol and other related products as ICUMSA and other standards protocol. During the period, analytical services were rendered to following:

1.	M/s The Kisan Sahkari Chini Mills Ltd., Unit-Tilhar, Distt-Shahjhanpur, U.P.
2.	M/s Uttam Sugar Mills Ltd., Khaikheri, Distt-Muzaffarnagar, U.P.
3.	M/s The Palwal Co-operative Sugar Mills Ltd., Palwal, Haryana.
4.	M/s Kisan Sahkari Chini Mills Ltd., Sampurna Nagar, Distt-Lakhimpur-Kheri, U.P.
5.	M/s Seksaria Biswan Sugar Factory Ltd., Biswan, Distt-Sitapur, U.P.
6.	M/s The Kisan Sahkari Chini Mills Ltd., Puranpur, Distt-Pilibhit, U.P.
7.	M/s Ministry of Micro, Small & Medium Enterprises (MSME), Kanpur, U.P.
8.	M/s The Kisan Sahkari Chini Mills Ltd., Mahmoodabad, Distt-Sitapur, U.P.
9.	M/s AGT Foods India Pvt., Ltd., Bhandup, Mumbai, Maharashtra.
10.	M/s The Kisan Sahkari Chini Mills Ltd., Bilaspur, Distt- Rampur, U.P.

11.	M/s Sahakari Khand Udyog Mandal Ltd., Gandevi, Bilimora, Distt- Navsari, Gujarat.
12.	M/s Sarjoo Sahkari Chini Mills Ltd., Belrayan, Kheri, U.P.
13.	M/s Ramala Sahkari Chini Mills Ltd., Ramala, Distt- Bagpat, U.P.
14.	M/s The Kisan Sahkari Chini Mills Ltd., Nanauta, Distt- Saharanpur, U.P.
15.	M/s Kisan Sahkari Chini Mills Ltd., Punwaya, Distt- Shahjahanpur, U.P.
16.	M/s The Kisan Sahkari Chini Mills Ltd., Anoopshahr, Distt- Bulandshahr, U.P.
17.	M/s The Kisan Sahkari Chini Mills Ltd., Badaun, U.P.
18.	M/s Bisalpur Kisan Sahkari Chini Mills Ltd., Bisalpur, Distt- Pilibhit, U.P.
19.	M/s Shri Ganesh Khand Udyog Sahkari Mandli Ltd., Vataria, Distt- Bharuch, Gujarat.
20.	M/s Uttam Sugar Mills Ltd., Unit Libberheri, Roorkee, Uttarkhand.

➤ RESEARCH ARTICLE:

“SUGAR DUST EXPLOSION – A CASE STUDY, PREVENTION & PROTECTION”

by

Sanjay Chauhan & Jitendra Singh

National Sugar Institute, Kanpur, India

ABSTRACT

Sugar professionals are well aware that the sugar dust formation starts from pan, increases in crystallizers, centrifugal machines and finally while handling it through mechanical means of conveyance. Sugar dust is hygroscopic in nature and if hardened then it is difficult to remove it. It may be deposited on pipelines, structures, building sheds, electrical cables, bus bars and starters, etc. Apart from creating environmental issues, presence of sugar dust may create explosion hazards. Therefore, it is important to minimize the sugar dust formation by adopting the available resources like installation of effective dust collection system for its removal. If sugar dust increases beyond a certain level i.e. Minimum Explosion Concentration (MEC) and the temperature becomes more than the minimum ignition temperature, then explosions occurs. Since sugar dust is suspended in the air, it interacts with oxygen more easily than when it is settled on the surface. Thus, the entire process is fueled by oxygen in indoor space. For an explosion to take place there must be sufficient oxygen present to support combustion and also an ignition source of sufficient temperature (350°C) and energy to ignite the dust cloud ⁽¹⁾. The first explosion is called the primary explosion and the force created by a primary explosion can unsettle even more sugar dust, causing a secondary explosion. As a result of this explosion there is loss of wealth and leads to human casualty.

KEY WORDS:

Sugar dust collector, sugar bin, bucket elevator, grader, deflagration index.

INTRODUCTION:

The major causes of dust formation is mechanical abrasion, however, some of the possible causes for dust formation in sugar industries are given as ⁽²⁾:

1. Due to false grain formation in pan, if the secondary crop of grains is formed during pan boiling it would tend to grow during remaining boiling cycle and also in the crystallizers and appear in the final product as fine dust.
2. Due to fracture of the large crystals by the excessive gravity forces exerted in centrifugal machine.
3. By plough action in centrifugal machine during scrapping of sugar from basket some of the crystals are broken/fractured which thereby causes dust formation.
4. Due to rubbing of sugar crystals in massecuite between pump's rotor and casing.
5. Due to breakage of sugar crystals during lifting of sugar through bucket elevators.
6. Due to falling of sugar in empty sugar bins from height.

Dust formation due to any of the above mentioned reasons will create unhealthy atmosphere, loss of sugar in the form of dust and if the sugar density increases beyond the limit i.e. minimum explosive concentration (MEC) then it may cause fire accident in sugar house. Any fire accident in sugar house may cause loss of sugar, machineries, building and may also lead to human casualty. Therefore it is necessary to make provisions for sugar dust removal from the sugar house so that the sugar dust is not deposited on structures, sheds, pipelines and other electrical/ mechanical equipments.

Any organic material can burn, but Sugar ($C_{12}H_{22}O_{11}$) being highly inflammable, an explosion might take place especially in the case of volatile dust of sugar. Sugar dust particles are smaller and lighter in weight and may get deposited in the form of small sugar heaps on pipe lines, structures and machineries, etc. Due to any reason if fire occurs in the sugar house then these sugar dust particles start to burn in suspended form and continuously increase like a chain reaction.

A fine grain of sugar dust can generate up to 100 psi pressure in enclosed process equipment within 100 millisecond. Due to this fast reaction fire explosion may take place and this is responsible for human, material and property loss. To avoid such incidences, proper ventilation should be provided in drier house and dust collection system should be in working condition.

CAUSES OF DUST EXPLOSION IN DRIER HOUSE:

Initially sugar factories were installed with smaller crushing capacity and with time the crushing capacity of sugar factories increased, but the drier house in most of the factories was not expanded as per the requirement of enlarged crushing capacity. This may

be a cause of sugar dust accumulation in drier house on structures, machineries & equipment. Due to small capacity of the drier house, sugar dust density increases up to a certain level and may cause sugar dust explosion. Factors pertinent to the explosiveness of sugar dust are as follows:

1. Mikus and Budicek ^[3] quote a range of values for the minimum explosible concentration of sugar dust: from 6 to 19 g/m³ (depending on particle size), with an average of 10 g/m³. Other authors quote rather higher levels: Morden ^[4] refers to 40 g/m³, while Hugot ^[5] quotes 60 g/m³ for 0.1 mm particles, ranging down to 7 g/m³ for the finest dust. Dust levels in sugar house are normally well below these levels, but the limit may be exceeded, due to explosion which will propagate by lifting dust from surfaces.
2. Estimates of minimum ignition temperature vary from 330 to 480°C ^[4], which means that ignition is unlikely to come from ordinary equipment surfaces in a sugar factory.
3. Sugar dust is categorized as explosion class ST 1 (weak to moderate explosion), with a pressure rise rate of between 59 and 172 bar m/s ^[4].
4. The maximum explosion pressure for sugar is approximately 9 bar ^[4]. However, in interconnected vessels, the propagation of an explosion from one to the other can cause some pre compression of the dust cloud and therefore enhancement of the explosion pressure, to a value well above 9 bar. The measures aim at avoiding the creation of a dust cloud or an ignition source.

As per NFPA, sugar dust particles size may be 420 microns to be volatile. If dust particle size is less than this then these will be found in suspension forms. The entire process is fueled by the oxygen present in the room, and since the dust is suspended in the air, it interacts with the oxygen more easily.

The size of the sugar dust particle is important. The minimum explosive concentration (MEC) means when sugar dust density reaches more than 20 gram /m³ for particle size smaller than 100 microns. For dust explosion, temperature is also important, which is 380°C known as minimum ignition temperature (MIT). Humidity lowers the ignition sensitivity of organic materials. If humidity increases then the possibility of explosion decreases. Most of the explosion takes place when humidity is minimum i.e. in winter season ^[6].

Spark emergence in drier house may be due to one of the following reason:

1. Welding & cutting work in drier house.
2. Electrical spark or short circuiting.
3. Temperature rise of bearing in any covered conveyor.

4. Any sparks generated due to friction of metal surfaces.
5. Grinding work in drier house.

Due to any of the above reasons, if spark emerged, the chain reaction would start by the first ignited sugar particle which would create a lot of energy as a result of which successive chain reaction would start. This would occur faster than flame burning and may cause explosion. As we know that the sugar dust in suspended form is more inflammable than the heap dust. This first explosion is called the primary explosion and this primary explosion thrust to other suspension sugar dust particles for secondary explosion. These two explosions may occur in succession and second explosion is more powerful. This may be a cause for damage of building structures, sheds, machineries and equipment, etc.

COMBUSTIBLE DUST CHARACTERISTICS:

Combustible dust hazard studies, including sugar dust, divided combustible dusts into three classes based on ignitability and relative burn rates:

1. Class I – Dusts that ignites and propagates flame readily, the source of heat required for ignition being comparatively small.
2. Class II – Dusts that are readily ignited, and which for the propagation of flame; require a heat source of large size or high temperature.
3. Class III – Dusts that does not appear to be capable of propagating flame.

The National Fire Protection Association (NFPA) defines a combustible dust as any “finely divided solid material regardless of particle size and that presents a fire or explosion hazard when dispersed and ignited in air”, Standardized test procedures used to experimentally determine important properties of a combustible dust are listed in table [7].

Measured properties of combustible dusts

Property	Definition	Test Method	Application
K_{st}	Dust deflagration index	ASTM E 1226	Measures the relative explosion severity compared to other dusts
P_{max}	Maximum explosion overpressure generated in the test chamber	ASTM E 1226	Used to design enclosures and predict the severity of the consequence

(dP/dt)_{max}	Maximum rate of pressure rise	ASTM E 1226	Predicts the violence of an explosion; used to calculate Kst
MIE	Minimum ignition Energy	ASTM E 2019	Predicts the ease and likelihood of ignition of a dispersed dust cloud
MEC	Minimum explosive concentration	ASTM E 1515	Measures the minimum amount of dust, dispersed in air, required to spread an explosion. Analogous to the lower flammability limit (LFL) for gas/air mixtures

The deflagration index, Kst, is used to estimate the relative explosion severity of the dust being examined. To determine Kst, dust samples of known particle size, moisture content, and concentration are ignited in a standard 20-liter test apparatus. The test chamber pressure as a function of time is recorded for successively increasing sample concentration. The value of Kst is calculated using the equation:

$$Kst = (dP/dt)_{max} \times [\text{Test chamber volume}]^{1/3}$$

The higher the value of Kst a dust explosion can be more energetic. Combustible dust is assigned one of three hazard classes, ST1, ST2, ST3, based on the deflagration index determined from the test results

Combustible dust hazard classes

Hazard Class	Kst (bar m/s)	Characteristic
ST 1	200	Weak explosion
ST 2	201-300	Strong explosion
ST 3	300	Very strong explosion

Test results of Cornstarch & Sugar are given as under

Material	Moisture Content (wt.%)	Mean Particle Size (µm)	P _{max} [bar]	Kst [bar m/s]	MEC [g/m ³]	MIE [mJ]
Cornstarch	11.5	10	8.5	189	105	10 < MIE < 30

Powdered Sugar	0.5	23	7.5	139	95	10 < MIE < 30
Granulated Sugar (as received)	0.1	Not determined	5.2	35	115	MIE > 1000
Granulated Sugar (sieved to < 500µm)	0.1	286	6.0	56	115	MIE > 1000

From the above table it can be seen that mean particle size of the powdered sugar is representative of dust that would result from processing granulated sugar. Furthermore, the samples of granulated and powdered sugar were typically of the spilled sugar that had accumulated around equipment in the work area. In the test chamber, these samples generated significant overpressures of 5.2 bar (76.4 psig) and 7.5 bar (110.2 psig), respectively. A primary event fueled by airborne sugar dust would most likely be soft and ignite sugar that had accumulated on the floor or equipment, causing secondary and tertiary dust explosions.

MAJOR INCIDENCE OF DUST EXPLOSION:

- (i) Imperial sugar company Georgia on dated 7th Feb 2008 faced a huge explosion and fire incidence. This explosion in sugar house occurred due to massive accumulation of sugar dust in all over the packaging building. As a result of this explosion, damage of the building, structure and also lead to human causality and life threatening burns. It was given in investigation report of U.S. Chemical Safety and Hazards investigation board that the steel belt conveyor which was not covered initially, it was covered some year before the explosion and there were no provision of removable of sugar dust from inside the covered belt conveyor. Due to this sugar dust concentration became the more than MEC and caused for fire explosion.

Garden city and Port Wentworth fire department personnel were on the site within 10 minutes after the first explosion. They confirmed that there was a lot of smoke, heat, dust & debris thrown around the fully burning building. The emergency and rescue team immediately started the rescue operation. The major fire in the building was extinguished the next day while silo's fire continued to smoke for 7 days.

It was also observed by the investigating team that before two weeks of February incidence a small explosion in dry dust collector on the roof of the packing building damaged the dust collector. The dust collector had not been into service at

the time of incidence. It might be the cause for dust accumulation in sugar house and packaging area as a result of which explosion took place.

- (ii) M/S L.H. Sugar factory is located near Tanakpur road in Pilibhit (U.P.), initially its capacity was 300 TCD in year 1910 and in 2006-07 its capacity increased to 10000TCD and at present its capacity is 11000 TCD. The factory is produces direct white sugar by Double Sulphitation Process.

Sugar dust explosion occurred in L. H. Sugar factory Ltd. Pilibhit on dated 3rd December 2016. On the request of factory management, authors have visited the factory on dated 15th December 2016, to investigate the reason for such historical incident that occurred for the first time in India and also to give suggestions for necessary corrective actions

1. Minimizing the sugar dust formation
2. To control the dust density in sugar drier house.
3. To minimize chances of ignition in drier house so that sugar dust explosion can be controlled in future.

Since visit was much after the occurrence of such incident. It was not possible to observe the actual condition of explosion. As reported by the factory staff, the explosion in drier house and subsequent collapse of sugar bin and adjacent wall etc. occurred on 3rd December 2016 at around 4.40 PM.

At that time about 15 workers, both regular and contractual were working at the affected site i.e. drier house. As reported by the factory management and the workers also, first an explosion sound was heard with fire from top side of sugar house and thereafter collapse of sugar bin and its structure took place resulting into death of three workers and injuries to other three workers. The photographs (fig-2) of the site taken after the incident give an idea about the intensity of explosion and magnitude of the incident.

As per the records made available to the team, the factory on 1st and 2nd December 2016 crushed @ around 10,000 TCD bagging approx. 11,000 quintals of sugar. On 3rd December 2016, the crushing and bagging rates were reported to be almost similar at the time of explosion.

The factory has got 10 nos. fully automatic flat bottoms centrifugal, 02 nos. of 750 kg/charge, 05 nos. of 1250 kg/charge and 03 nos. of 1750 kg/charge capacity each. The factory has 1800 and 1500 mm wide hoppers. For grading, the factory has 04 nos. Multi-deck type Sugar Graders along with a sugar bin of 3000 quintals capacity. The hoppers are

equipped with hot and cold air blowing arrangement for cooling and conditioning of the sugar prior to bagging.

It was brought to the notice of the authors that at the time of incident, the bin was about 40% filled, thus, containing approx. 1200 quintals of sugar. Besides this, about 90-100 bags of 50 kg each were available at the site on conveyors or kept after filling.

The actual reason of incident was unknown but it was observed by authors that the area of drier house was short w.r.t the crushing capacity of 11000 TCD. Since the factory has expanded its capacity many times in phases due to which the layout became more congested as compared to modern sugar plant of same capacity. As a result of this sugar dust concentration became very high and dust particles accumulated on the structures, bins, sheds and electrical panels and cables. It appeared that there were some sparks generated from the top side of building shed, which may have been generated by electrical connection, etc. there-by causing primary dust explosion. This is responsible to start the chain reaction and form the shape of flame. This flame propagates and creates environment for second explosion to take place with huge amount of fire, heat and dust. As a result of this, damage of structure of sugar bins and building columns occurred. The factory personnel including safety and security staff immediately took the rescue operation and informed the local police and fire brigade. The rescue team with all their best efforts tried to control human and property losses [8].

During the visit of the factory following data were also taken to analyze the impact of dust explosion in the working of the factory apart from the above damages/losses.

Working Results of L.H. Sugar Factories Ltd, Pilibhit Before & After Dust Explosion

Sl. No.	Date	Cane Crushed in Qtls	Estimated Recovery	Sugar bags(Qtls)	Bagged Recovery	Stoppage%	Crushing Speed	Mill Stoppage
1.	01/12/2016	102800	10.35	11050	10.75		102800	
2.	02/12/2016	102700	10.40	10900	10.61		102700	
3.	03/12/2016	D M R was not Prepared due to dust explosion						
4.	04/12/2016	18700	10.25	No bagging		70.83	64114	17 hrs
5.	05/12/2016	59500	10.40	No bagging		Crushing at reduced rates	59500	

6.	06/12/2016	60500	10.45	No bagging		do	60500	
7.	07/12/2016	61900	10.47	No bagging		do	61900	
8.	08/12/2016	64900	10.49	No bagging		do	64900	
9.	09/12/2016	66000	10.50	7050	10.68	do	66000	
10.	10/12/2016	68800	10.50	7100	10.32	do	68800	
11.	11/12/2016	70000	10.50	7300	10.43	do	70000	
12.	12/12/2016	70200	10.50	6950	9.90	do	70200	
13.	13/12/2016	70000	10.50	7000	10.00	do	70000	

From above data it can be seen that before explosion crushing rate was more than 10000 TCD and after explosion crushing was stopped and there after crushing was reduced @ 70% for more than 10 days due to huge damages in sugar house.

Following suggestions were given to management of the factory.

1. Adequate steps should be taken to minimize sugar dust formation during pan boiling, crystallizers and centrifugal operation.
2. Factory should go for modernization of sugar drying and cooling system, e.g. fluidized bed drying & cooling system along with effective dust collection system.
3. During installation of modern equipments in sugar house, its area may also be increased to the extent possible.

PREVENTION & PROTECTION:

Combustible dust can be ignited by any electrical spark, static discharge, hot surface, open flame by cutting welding and hot surface due to friction or spark induced by metal contact wear. Therefore following steps should be followed by factory for prevention and protection during operation:

1. Sugar dust formation should be as minimum as possible by adopting the methods as discussed earlier.

2. Dust collection system should be properly designed and worked efficiently. The fan of dust collection system should create the desired static pressure and able to carry out the sugar dust, so that environment of drier house should be dust free.
3. Providing dust extraction system at all conveying transfer points and filling points by means of hoods over the transfer points.
4. Using correct lighting installations for explosive environments in dusty areas.
5. Avoid overloading of electrical cables and its circuits. Electrical joints in cables should be avoided in the drier house, if there is any joint, it should be properly covered & shield.
6. Before start of any welding & cutting work in drier house make a practice of cleaning the work place, so that work place should be dust free.
7. Inform safety officer of the factory before start of any welding & cutting work. There should be hydrant points near the drier house and safety staff should be ready with fire extinguishers and firefighting pipes connected with hydrant points.
8. Motors should be properly covered & its connection box should be protected from dust. Make practice to use suitably enclosed fuse boxes and switches.
9. Conveyer in drier house should not be fully covered, if any conveyer is covered then there should be provision for periodic cleaning of dust & checking of conveyer's mechanical parts. So that any abnormalities in moving/rotating parts can be identified timely.
10. Ensuring that a layer of dust is not allowed to build up in ducts, building sheds & structures, silos and electrical panel etc. There should be arrangements for timely & effective cleaning of dust and good housekeeping.
11. The drier house & its area should be properly ventilated to fulfill the requirement of factory production capacity.
12. There should be provision for training of their employee for operation, housekeeping and safety measures during operation of the factory.

CONCLUSION:

On the basis of above study it was concluded that the formation of sugar dust should be as minimum as possible so that it can be controlled up to a certain level. If sugar dust is formed then, there should be provision for removing it by installation of well-designed dust collection system. If any mechanical work is to be urgently required in drier house, then it should be done with proper safety measures. For electrical case of the terminal, armored

wiring, remote switchgear and totally enclosed motor are used in factory to minimize the risk of emergent spark.

If factory expansion takes place then simultaneously the area of drier house should also be expanded to fulfill the requirement as per modern drier house. This would help in keeping the dust concentration in drier house within limit and sugar dust to be kept below the MEC (minimum explosive concentration) i.e. 20 gram/m³. It is necessary to avoid any fire incidence & dust explosion in drier house. If it occurred then there will be loss of wealth and would lead to casualty of manpower.

ACKNOWLEDGEMENT

We are extremely grateful to Mr. Narendra Mohan, Director, National Sugar Institute, Kanpur, for giving needful guidance & encouragement for writing this paper and also thankful to the management of M/S L.H. Sugar factories Ltd., Pilibhit for extending cooperation during visit of the factory.

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Photographs of dust explosion at Imperial Sugar Company, Georgia on 7th Feb 2008.
Fig – 1



Photographs of M/S L.H. Sugar Factories Ltd. Pilibhit after sugar dust explosion on 3rd Dec 2016.

Fig -2

➤ HAPPENINGS IN THE SUGAR INDUSTRY:

Sugar export norms relaxed: 1 million tonnes outflow likely by September.

The Centre issued a notification on Tuesday relaxing sugar exports norms. Sugar exports were subject to a subsidy of Rs 55 per tonne of sugar cane payable to cane farmers. However, in the earlier notification, the ministry of consumer affairs had linked the compliance of all past conditions by mills to avail subsidy on exports.

Sugar Industry to govt: Enforce sugar exports, raise selling price.

As the cash-strapped sugar industry scrambles to deal with low sugar prices and over supply, it has urged the Centre to increase export targets steeply and enforce it.

P.M. to interact with sugarcane growers.

Prime Minister Narendra Modi will tomorrow interact with about 150 sugarcane farmers from major producing states to discuss the various initiatives taken by the government recently for helping sugar mills clear the cane arrears of around Rs 20,000 crore.

Sugar price: Lobby wants higher MSP for UP sugar.

Sugar industry representatives have not only urged the government to increase the minimum selling price of the commodity but also sought a Rs 2 per kg higher price in Uttar Pradesh than in Maharashtra.

Uganda – 2017/18 sugar output to rise by 17%.

Uganda's sugar output may climb 17% this year to 428,000 tonnes with three top producers expected to boost production.

China unwilling to reduce duty on sugar imports from Brazil.

Brazil has proposed that China introduce a quota for imports of Brazilian sugar that would face a 50% levy to solve a trade dispute between both countries but China is resisting the plan.

Bailout or not, the sugar industry's boom-bust cycle will continue to crush Indian farmers.

About 25 years ago, in 1993, I first attempted to make sense of India's sugar industry. The so-called license raj was being dismantled in bits and pieces at that time and everyone thought the sugar industry would be among the beneficiaries.

Cauvery basin farmers to get water for paddy, sugarcane.

Chief Minister H.D. Kumaraswamy said on Thursday that he has instructed the Irrigation Department to release water to the canals of the Cauvery basin so that the farmers can take up agricultural activities on time.

Indian sugar output likely to hit record next season as farmers stay sweet on cane.

India's sugar output is likely to scale record highs in the next marketing season, with farmers choosing to plant the crop despite falling prices and around 200 billion rupees (\$2.96 billion) in delayed payments from mills for the current harvest.

Mozambique -New €30.4mln sugar factory planned.

Governor of Mozambique's Maputo province Raimundo Diomba says a €30.4-million sugar factory will be commissioned in the region before the end of April, according to local press reports.

Cameroon – Local Sugar Company pleads to the government to act against smuggling.

The local sugar company Sosucam has told the government to act resolutely against smuggling which is hitting its business and may subsequently result in bankruptcy and factory closure, according to local press reports.

Chad – Local sugar producer struggling from smuggling.

The local sugar company Compagnie Sucriere du Tchad (CST), Sugar Company of Chad (CST) is facing problems selling its output in the local market due to competition with smuggled sugar according to its assistant general manager, Emmanuel Castel.

EU – Sugar companies face market reality as low prices drive down profits.

European Union sugar companies exposed to the volatility of the market place post the abolition of production quotas last October, are now fighting to survive in a fiercely competitive world market with prices and profits plunging.

Maha: Sugar production in state at record high, but prices in retail market refuse to decrease.

Maharashtra's cane crushing season of 2017-18 has almost come to an end with the production crossing 107 lakh metric tonnes (MT), the highest ever in the history of the state, said top officials of the Maharashtra sugar commissionerate.

FIR against Sangli sugar factory as farmers claim firm took loans in their names.

The economic offences wing (EOW) of the Sangli police on May 24 registered an FIR against Sadguru Sri Sri co-operative sugar factory at Atpadi in Sangli district on various charges of cheating and other sections of the Indian Penal Code (IPC).

Sugar export contracts fail to take off over price difference.

Export contracts that were signed by sugar mills in Maharashtra, Karnataka and Gujarat have apparently turned out to be non-starters, thanks to the difference in the existing sugar prices and rates at the time of signing contracts.

Govt. may announce Rs 7,000cr. bailout package to sugar mills as sugarcane arrears mount.

Concerned over mounting cane arrears of more than Rs 22,000 crore, the government is likely to announce a bailout package of over Rs 7,000 crore to ensure cash-starved mills clear dues to farmers at the earliest.

Sugar declines on bumper stock, weak demand.

Sugar prices registered a decline of Rs 60 per quintal at the wholesale market in the national capital today following abundant availability of stock on relentless arrivals from mills due to record output along with muted demand from stockist and bulk consumers.

Sugar Prices May Fall More If Government Doesn't Intervene, Says ISMA.

Sugar prices can fall further if the government fails to intervene after the output rose to a record when prices are already down due to global oversupply.

Paswan asks states to ensure mills clear cane arrears to farmers.

States should issue strict directions to sugar mills to clear their dues to sugarcane farmers and consider taking action against defaulting factory owners, Food Minister Ram Vilas Paswan said today while expressing concern over rising arrears which have reached Rs 15,000 crore.

Three sugar mills to function soon: UP govt.

Two sugar mills each in Piparaich and Munderwa of Eastern Uttar Pradesh will become functional soon while Manjhola Sugar mill be run on PPP model in the time to come, this was announced by Uttar Pradesh government.

Ethiopia buying sugar again – issues tenders for 200,000T.

In mid-May, the state-owned Ethiopian Sugar Corporation (ESC) issued an international tender for 200,000 tonnes of sugar to address persistent shortages according to USDA. Bids are due June 19 and delivery of shipments is expected between September and November.

Thailand – 0.5 mln t sugar diverted from exports to ethanol production.

Amidst swelling global surplus and falling prices, Thailand, the world's second biggest sugar exporter after Brazil, has decided to cut its exports of raw sugar by at least 500,000 tons this year.

Cameroon – Government suspends sugar imports to save a local producer.

The Cameroonian government announced on 2nd May the suspension of sugar imports following SOSUCAM's (Société Sucrière du Cameroun) complaints that it was on the verge of stopping production at its factory as it could not sell its output in the domestic market.

Brazil – Millers cancel export contracts as futures hit 10-year low.

With sugar futures now at the lowest level in 10 years on the New York Exchange, top sugar producers in Brazil are cancelling export contracts of at least 400,000 tonnes.

Tanzania – Government moves to protect the sugar sector.

The Tanzanian government recently announced that it will stop issuing new permits for sugar imports effective June, to support local millers.

Sugar exports: Mills yet to start sugar exports, await perks.

Despite government making it mandatory for sugar mills to export 2 million tonne sugar in 2017-18 marketing year as per the quota allocated to individual mills, India has not started sugar export due to lack of export parity.

Sugarcane production: Bitter harvest awaits sugar.

Sugar production this year (2017-18) is expected to touch 30 million tons, an all-time high. With such a record production, comes a host of problems—the most important one being non-payment of “cane dues” to farmers. The government can ill afford to ignore this crisis of plenty.

CBI takes over probe in Rs 1,179 crore UP sugar mill ‘scam’.

Former Uttar Pradesh chief minister Mayawati may find herself in choppy waters with the CBI taking over the probe into the alleged disinvestment of 21 state-owned sugar mills in 2010-11, which caused a loss of Rs 1,179 crore to the state government.

Paswan assures support to ailing sugar industry.

The Central government on Saturday reiterated its commitment to support the struggling sugar industry, which is facing depressed market sentiments and a crash in sugar prices. Union Minister for Consumer Affairs, Food and Public Distribution Ram Vilas Paswan said the government will ensure liquidity, financial assistance and support in sugar exports.

Haryana: Yamunanagar mill stops payment to cane farmers.

The Saraswati Sugar Mill, Yamunanagar, one of the largest sugar mills of India, has stopped making payments for cane to farmers due to a financial crisis. The mill authorities took the decision recently and informed the Cane Commissioner, Haryana.

Sugarcane's toxic waste can turn into a boon for farmers.

Sugarcane molasses-based distilleries in India are not only water guzzlers but purge a highly toxic residue— spent-wash or vinasse. This unusually viscous dark brown coloured pungent liquid after recovery of alcohol.

Brazil sugar mills are coming to a grinding halt and India is to blame.

Record sugar production in India and Thailand is weighing heavily on millers in Brazil, the world's top producer. As many as nine mills may not process sugar cane in 2018-19 due to financial problems, joining a group of about 80 that have stopped production since 2008.

Sugar exports yet to start despite sops to farmers.

Sugar exports have not started even after New Delhi gave cane farmers a Rs 1,540-crore financial assistance package, seeking to flush out last year's surplus stock in the world's biggest consumer market of the natural sweetener.

Centre to work on incentives for sugar mills to help pay farmers: Gadkari.

In the next week to 10 days, the central government is expected to finalise a second lot of incentives to help cash-strapped sugar mills clear cane payment arrears to farmers, said Road Transport Minister Nitin Gadkari.

Food Ministry moves Cabinet note on sugar buffer stock, minimum ex-mill price.

The Ministry Consumer Affairs, Food and Public Distribution has moved a draft Cabinet note on creating a sugar buffer stock of three million tonnes and fixing a minimum ex-mill price to help cash-starved millers clear cane arrears which have surged to about Rs 22,000 crore.

Why ganna is still the first choice for farmers, despite mounting dues.

Why are farmers growing sugarcane, even as arrears payable to them by mills in the current 2017-18 season has crossed Rs 23,000 crore? The answer is simple: It is one of the few crops today that's still profitable to grow.

Thailand – Kaset Phol Sugar to build a new US\$335 mln refinery.

Mitsui & Co. and Mitsui Sugar which jointly operate the Kaset Phol Sugar (KSP) mill are investing JPY37 billion (US\$335.4 mln) for the construction of new sugar refinery and warehouse.

Russia – 2018/19 beet acreage drops by 4% as sugar price falls.

Sugar beet acreage for the 2018/19 season is 3.9% lower than the previous year at 1.13 million hectares due to low sugar prices.

Duo UK supplies mailing bags produced from cane ethanol to retailers.

Polythene bag manufacturer Duo UK has become the first UK-based manufacturer to produce mailing bags using Green PE, a thermoplastic resin made entirely from sugarcane ethanol.

South Africa – Cane growers protest against cheap imports, demand increased tariffs.

Some 2000 cane growers led by the South African Sugar Association (SASA) and the SA Farmers Development Association (SAFDA) on 26th June protested in Pretoria demanding that tariffs on sugar imports be increased in order to protect the local sugarcane industry from cheap imports.

India – 2018/19 cane acreage in Maharashtra to increase by 25%.

Cane acreage in Maharashtra, India's second-largest sugar producing state, is expected to increase by 25% in the next crushing season beginning October 1st.

Mexico – Competition regulator investigates antitrust activity in the sugar market.

For the second time in its history, Mexico's competition regulator the Federal Commission of Economic Competition (Cofece) is undertaking an investigation into the possible commission of absolute monopoly practices in the production, distribution and marketing of sugar in the country. The first one took place less than five years ago.

Philippines to import 200,000 tonnes of sugar as local output drops.

The Philippines government has allowed traders to import 200,000 tonnes of sugar to stabilize the supply and price of the sweetener in the domestic market.

Crop yields increased by 47% from stimulating photorespiration.

A new study led by researchers at the University of Essex has revealed that the output of major food crops could be increased by nearly 50% simply by boosting the production of a specific protein that is involved in photorespiration.

➤ ABSTRACTS:

Are gums produced in the factory? Quantification of gums isolated from mixed juice and final molasses by K.M. Foxon & H. Du Clou published in International Sugar Journal April, 2018.

Gummy massecuites in sugar factories are associated with exhaustion problems in pans and inefficient purging in centrifuges. Gums originate in stale cane because of microbial activity during burn/harvest-to-crush delays, especially in the rainy season, but are also thought to be generated by microbial activity within the factory. The proportion of gums generated within the factory is not known. This study investigated the phenomenon of gum formation in the factory by comparing the total amount of gums in mixed juice and in final molasses and considering the fate of gums in a factory.

Carbon dioxide enrichment effects on the decomposition of sugarcane residues by Nilza Patrícia Ramos, Thiers Alves Vidal, Nilza Patrícia Ramos, Thiers Alves Vidal, Rebeca Ramos, Raffaella Rossetto and Kátia de Lima Nechet published in International Sugar Journal April, 2018.

The aim of this study was to determine the decomposition dynamics of sugarcane residue under conditions of enriched atmospheric CO₂ concentration using a FACE facility (Free-Air Carbon Dioxide Enrichment). The experiment, conducted in Jaguariúna, São Paulo State, Brazil, using the

Climapest FACE facility, received two treatments: elevated CO₂ (550 ± 100 µmol mol⁻¹) and ambient CO₂ (400 µmol mol⁻¹), for a single amount (5 t ha⁻¹) of straw (cane trash), in a randomized-block design with six replications.

A time-series analysis of large-scale grower input costs in the South African sugarcane industry: 2000/01 to 2014/15 by R.J. Nicholson & M. Kadwa published in International Sugar Journal April, 2018.

There is an increased focus globally on the economic impacts of research and development. Farmers are more unlikely to adopt new technologies and management practices, if they have an adverse impact on profitability. This is mainly due to lower gross margins, resulting from above-inflation input cost increases. In the sugarcane industry, the gross margin squeeze has been more prominent, due to gradual decreased global yields and lower world prices since 2010. Therefore, a greater understanding of sugarcane production economics is required in the sugarcane research environment.

Solution for dextran problem with applications of dextran detection kit and dextranase in China cane/beet sugar factories by Ying Liu, Da-feng Liang, Rong-Zhen Lin, Guowei Chang, Bu Ma & Gui-Yun Liu published in International Sugar Journal April, 2018.

Anti-dextran monoclonal antibody immunonephelometry quantitative detection kit (or dextran detection kit) and dextranase are

necessary components for dealing with dextran in sugar factories in China. In this paper, we have demonstrated the detection and elimination of dextran in cane/beet sugar factories. The level of dextran in incoming cane or sugar beet, and in the intermediate and final products were determined with the dextran detection kit. Dextranase was applied at 15 g/ton or beet or cane and dextran elimination levels monitored. Boiling efficiency was measured and found to improve following dextranase addition.

There's yellow, and then there's yellow—which one is YCS? by Annelie Marquardt, Kate Wathen-Dunn, Robert J. Henry & Frederik C. Botha published in International Sugar Journal April, 2018.

Yellow canopy syndrome (YCS) symptoms include leaf yellowing of the mid-canopy, a reduction in photosynthesis and yield decreases of up to 30%. The cause of YCS remains unknown. It has been speculated leaf yellowing from YCS is produced by triggering the early onset of senescence, or through implications of water-stress. Inability to differentiate accurately between YCS and other conditions leading to leaf yellowing is a serious limitation for research and the development of strategies to manage YCS. The aim of this work is to determine if there are distinct metabolic or gene expression changes in YCS.

Sugar storage in silos by M. Schuermann, R. Timmers, P. Avram & B. Morgenroth published in International Sugar Journal April, 2018.

There are large differences in the usual storage of white sugar from beet and cane. Beet white sugar is usually stored in silos. Cane white sugar is commonly filled in bags and stored in warehouses. Sugar quality is much better using silo storage instead of warehouses in terms of fluidity and aspects of hygiene as well as food production. Silo-handled sugar can either be filled in the usual packaging machines or be filled and transported in road tankers – the latter is very economical especially for industrial use.

Influence of yield and other cane characteristics on cane loss and product quality by S. Khawprateep, T.A. Jensen, B.L. Schroeder & S. Eberhard published in International Sugar Journal April, 2018.

Field and crop conditions affect cane loss, cane-supply quality and the amount of extraneous matter that is mixed with cane billets supplied to the mill. The size of the crop produced also impacts on machine performance and cane loss during harvest. Crop physical properties and the composition of the sugarcane stalk are driven by a wide range of agronomic practices, including nutrition. The objective of this study was to investigate the impact of different crop conditions on sugar loss during harvest, with in-field nutrient practices being the primary driver of the changing cutting pour rates.

The development of standard operating procedures for boilers at Mackay Sugar Limited by Robert Wilson & Bryan Lavarack published in International Sugar Journal May, 2018.

Following the introduction of the operational excellence (OE) program at Mackay Sugar Limited (MSL), a new type of standard operating procedure (SOP) has been developed and is being introduced for all production related activities at Marian, Racecourse, Farleigh and Mossman mills. The main objectives of the new SOPs are several. These include to standardise on best practices across all factory sites and to provide a basis for training personnel in production systems at MSL. The expected outcomes are better and safer operational practices and improved consistency in operations.

Strategies for cane production in marginal environments and under more environmental scrutiny by Rianto van Antwerpen , Ronald Ng Cheong, Neil Miles & Robert Gilbert published in International Sugar Journal May, 2018.

Climate change is impacting on production conditions and sugarcane producers need to adapt to this challenging environment. Although some places on the globe will receive more rainfall, this paper addresses management strategies to mitigate the likelier scenario of reduced water availability, applied to marginal environments. The objective is to highlight key practices for the sustainable production of sugarcane under water-limiting conditions, with the focus being on soil-related aspects. The condition and properties of the soil have a significant effect on root development.

Evaluation of sucrose loss in evaporators for different processing configurations by

D.W. Rackemann & R. Broadfoot published in International Sugar Journal May, 2018.

The chemical compositions were determined for juice and condensate samples collected at various locations in the Robert evaporator sets at two Australian sugar factories. The purpose of the investigations was primarily to determine the magnitude of sucrose degradation and the consequences of those degradation reactions, such as reduced pH of condensate. Robert evaporators are used almost exclusively in Australian sugar factories. One of the factories involved in the trials incorporates a cogeneration facility and undertakes extensive vapour bleeding from large vessels at the first and second effects.

Development of condition-based maintenance for sugar mill assets by H Yu, P. Borghesani, M.E. Cholette, G.A. Kent, L Ma & B.J. Burke published in International Sugar Journal May, 2018.

The highly competitive international market is challenging the Australian sugar industry with volatile sugar prices particularly when prices are low. The need to be sustainable during periods of low global sugar prices is driving the industry to seek ways to reduce maintenance costs. Generally, the current maintenance decision-making is based on traditional experience-based practices despite high maintenance expenditure. This study has proposed a general framework for the implementation of condition-based maintenance in sugar mills. The structure of the framework has been discussed, including the equipment condition assessment tools,

the operation and maintenance cost models, and the maintenance optimization approach.

Challenges of cane ripening using Corsair (fluazifop-p-butyl) and Moddus (trinexapac-ethyl) to improve sucrose content in sugarcane at Ramu Agri Industries Limited (RAIL), Papua New Guinea by Sam Emete, Duncan Butler & Lastus S. Kuniata published in International Sugar Journal May, 2018.

The use of chemical ripeners to improve sucrose content in sugarcane has been used in several sugar industries around the world. Chemical ripeners have not been used consistently on a commercial scale at Ramu Agri Industries Limited (RAIL) Papua New Guinea (PNG), due to a lack of in-situ research into their potential benefits and disadvantages under local conditions. Replicated field experiments were conducted at RAIL between 2014 and 2016 to evaluate the effects of Corsair (fluazifop-p-butyl) and Moddus (trinexapac-ethyl) on sucrose content and sugar production in three major varieties (Q198A, B72177 and R570) at varying spray to harvest intervals.

Breeding for a brave, new world – the opportunities for a sugar beet breeder by Hendrik Tschoep published in International Sugar Journal June, 2018.

While yields of many arable crops have plateaued, Sugar Beet continues to deliver significant yield increases annually. Innovative plant breeding, assisted by technology, has played a leading part. However, looking ahead Sugar Beet breeders

must predict changes in climate as well as changing patterns of pest, weed and disease threat together with advances in crop management. Increasing restrictions on the use of plant protection products will put more emphasis on the role of genetics to control pests and diseases. SESVanderHave is a business dedicated to the Sugar Beet crop, supplying seed to some 52 countries.

Optimisation of farm management for reducing cane losses during mechanised sugarcane harvesting by using SCHLOT software model by T. Bahadori & S. Norris published in International Sugar Journal June, 2018.

Reducing cane harvest losses is an important part of farm management. Harvest waste consists of two parts: the collected waste and non-collectable waste. These cane losses are mainly caused by the operation of harvesting machines and the performance of their operators. In Australia, the Norris Crop Energy Technology Company designed software to manage sugarcane harvesting system (SCHLOT) and we found that it is a valuable model for Iranian sugarcane harvesters that can optimise Austoft 7000 harvester machines. Factors including linear ground speed of the harvester, the speed of fan rotation, conditions of field harvest variety, field density and yield.

Learnings from the 2015 Pongola silo failure by W.K. Lawlor published in International Sugar Journal June, 2018.

During June 2015 the refined sugar silo at the Pongola Sugar Mill suffered a severe buckling failure. The failure occurred with the silo in operation and full of sugar. During the months which followed the silo was stabilised, strengthened, the sugar was removed, the damaged sections were safely dismantled and a thorough investigation into the cause of the failure was undertaken. This paper reports on the steps taken to safely dismantle the silo and on the various mechanisms by which silos can fail which were considered during the investigation.

Sugarcane production efficiency of small-scale farmers in Thailand by Thanaporn Athipanyakul published in International Sugar Journal June, 2018.

This paper estimates the production efficiency of sugarcane farmers in Thailand using a non-parametric data envelopment analysis (DEA) and primary data collected from 94 sugarcane farmer respondents during in the 2014/15 crop year. The empirical results suggest that Thai sugarcane farmers operate at 80.89% productive efficiency; that is, given their output quantity, farmers should reduce their input by 19.11% without changing their technology use. The findings concerning the returns to scale in sugarcane production show that farmers in 60.64% of observed sugarcane farms experience increasing returns to scale, implying smaller operations.

Electronic cane consignment at Isis Mill by Paul Nicol & Gary McNair published in International Sugar Journal June, 2018.

Cane consignment is a critical link in the delivery of cane from the field to factory. Traditionally, this has occurred in paper form, completed by the haul-out driver, passing through several sets of hands before finally reaching the sugar mill weighbridge. The entering of consignment information into the mill payment system typically occurred as a just-in-time system, where cane was delivered to the yard and tickets eventually made their way to the weighbridge clerk for manual entry into the system.

How digitalisation/automation addresses sugar production challenges by Z. Shan published in International Sugar Journal June, 2018.

While every sugar producer faces specific manufacturing challenges, there are several that resonate across the industry. Among today's most pressing concerns include the need to optimise energy consumption, reduce material use and inventory costs and increase asset utilisation and throughput. Other priorities include the need to improve quality and reduce variations, errors and waste while maximising material traceability and fulfilling regulatory compliance. Finally, there is a greater awareness and desire to embrace an agile manufacturing environment.

Analysis of Financial Statements in the Sugar Industry by Dilip S. Patil, J.N. Mohanthy & Sanjay Agarwal published in STAI 2017.

This paper aims at making financial analysis of a sugar entity in terms of liquidity,

solvency, operational efficiency and profitability. Management practices with professional approach tend to improve the financial performance of sugar factories by implementing some innovative practices to reduce the controllable cost and generating additional revenues.

Review of High Powered Committee Reports on Sugar Industry in India by N.K. Shukla & M.K. Biswas published in STAI 2017.

The Government of India (GOI), understanding the paramount importance of Indian sugar industry in rural economy and regional development, has constituted various 'High Powered Committees' from time to time: to review the status of Indian sugar sector; to study its growth and development in comparison to other countries producing sugar from sugarcane; to suggest modifications, amendments or repeal of any existing law and controls in order to enhance sugarcane and sugar productivity and attain optimal efficiency through innovative technology and modernisation; to study and analyse the numerous problems faced by the industry and to suggest ways and means to solve such problems. The committees were also asked to review the government's policies in this regard and if needed, to make recommendations to modify or change the faulty policies. The article has attempted to thoroughly discuss thereports of various committees in case of only three critical issues. 1. Cane area reservation 2. Sugarcane pricing policy and 3. Ethanol and co-generation strategy.

The Comprehensive and Global Practices on Hr. Management to Enhance Productivity in the Sugar Industry by Girish Kohli A. published in STAI 2017.

Looking to the scams in the country, the researcher has undertaken a study to look into and adopt best global based practice on HR Management. HR is the heart of the institution and its management is a very difficult task. Therefore, need to study Human capital have been emerged in the sugar industry.

Bio-Fuels – our Future Fuels Satindar by Kaur & Kamalpreet Brar published in STAI 2017.

Bio-Diesel has been prepared by the action of Oleaginous yeast *Trichosporon* sps yeast strain to produce lipids by growing them on glucose, glycerol and sugarcane bagasse acid hydrolysate (SBAH). Trans-esterification was carried out to produce Bio-Diesel which was tested for its FAME properties by GC-FID, FT-IR and NMR, found to be very suitable.

Comprehensive Study of Suchem Dt14 – Bio-Additive for Vapor Condensate Treatment - Post Mee for Distillery by Santosh Kumar, Seema Paroha & Srikanteshwara published in STAI 2017.

Distillery operation requires abundant quantity of water for process and utilities. Water recycling techniques have been adopted in distillery to cut down the raw water consumption. Fermentation process requires water as diluent. Multiple effect

evaporators generate huge volume of condensate having low solids. But the water is having high COD levels which make water unusable for process and other applications. One of the major sources of process output water is vapour condensate water which is not being utilized effectively due to high COD load. Due to this high COD load there are chances of high levels of contaminations leading to increased Volatile acid levels when this water is used in the fermentation process. With increased VA and reduced pH levels the fermentation efficiencies drastically drop down. Suzalkem Technologies Private Limited successfully developed a Bio Catalyst with which high COD water can be utilized in the fermentation process without affecting the process efficiency.

Eco-Friendly Cip for Spent Wash Evaporators by G. Venkateswara Rao, K. Sri Haribabu & G. Sankara Rao published in STAI 2017.

World is facing the problem of waste management. Industrial processes are responsible for the production of waste pollutants. Huge quantity of toxic waste is being generated in distilleries which needs proper treatment for the reduction of toxicity. The treatment of these pollutants is very difficult and needs high cost. Many technologies are available at present. Incineration is one of the best technologies for treating the distillery spent wash. The process of incineration involves biotreatment followed by concentration in multiple effect evaporation system. Multiple effect

evaporators plays a vital role in reducing the volume of spent wash generated from the distilleries. Steam and power are the major utilities in MEE system. Generally, MEE needs CIP for every 18 – 20 hrs of continuous operation. CIP involves circulation of chemical for about 4 hrs to remove the scale from the evaporator tubes. The difficulties in CIP are cost of chemical, loss of working hours, cost of utilities and disposal of chemicals. CIP of the evaporator is adversely affecting capacity utilization and increases the cost of production of spirits. As a part of research and development, KCP has developed Eco-friendly cleaning system to overcome the above problems. The process involves circulation of RSW in the tubes of evaporators for about 2 – 2.5 hrs. to remove the scales formed in the evaporators. This avoids chemical cleaning and improves the capacity utilization. This paper explains the ecofriendly treatment technology for cleaning of the distillery spent wash evaporator.

Optimization of Steam Requirement by Energy Integration in Molasses and Grain Distilleries by Sanjay Desai & Sandeep Chichbankar published in STAI 2017.

Optimum Capex and Low Opex is the key to success for any manufacturing Industry. Over the years, there is enormous advancement in distillery technology to manufacture potable alcohol and biofuel. Performance benchmarks in terms of energy economy, process efficiencies, product quality, water conservation and effluent management have improved to a great extent. Cost of production

per liter of ethanol is majorly contributed by raw material cost and cost of utilities. In this scenario, it is of prime importance to save on energy requirement. The only way to achieve this is through innovative technologies for energy integration. This paper discusses on the possibilities of the integration in molasses and grain distilleries.

Proteolytic Enzymes as a Molasses Preservative Gautam Kapoor, J.S. Arya & Dharmendra Pathak published in STAI 2017.

Molasses is an intermediate product obtained during sugar process. Usually, it has more than 850 Brix i.e. only 15% moisture. It contains more than 45% fermentable sugars. Basis composition, it is impossible to microorganism which could survive in this environment for too long. But microorganisms like *Lactobacillus* spp. and Gram -ve *Coccobacilli* possibly *Pseudomonas* spp. are able to survive in this medium and deteriorate the molasses. Therefore molasses preservation requires product which can stop deterioration and maintain total reducing sugar (TRS) value in molasses to produce alcohol. Therefore, two groups of proteolytic enzymes were developed which prevents the deterioration of molasses by preventing the microbial growth at 20ppm but also enhance the 2.1 – 4.3% of TRS content during storage of molasses up to six months or till application continued.

Simultaneous Production of Ethanol in Sugar Mill from Molasses, Bagasse, Cane Trash & other Cellulosic Material along

with White Sugar Production by P.N. Singh published in STAI 2017.

Looking at the infinite requirement of ethanol to replace the fossil fuels and help save the nature & Environment by controlling the carbon emission, sufficient production would be the main target for technologists in sugar industries. Efforts must be made to deliver maximum raw materials for production of ethanol, after fulfilling the indigenous requirement of sugar in the country, in form of higher purity molasses, bagasse, cane trash etc. Minimum consumption of steam should be the modus operandi in sugar mills and the huge savings of bagasse can be used for conversion in ethanol along with collected cane trash etc. The incineration boiler and condensing TG would be the main power plant for supply of steam and power to sugar mill and distillery.

Treatment of Sugar Factory Vapour Condensate using Foul Resistant (Ro) Membranes, making the Permeate Suitable for direct use as Boiler Feed Water by S.K. Sachdeva, K.K. Kapoor & Rajeev Mishra published in STAI 2017.

The present study relates to treatment of vapour condensate for use at boilers at Saraswati Sugar Mills Ltd, Yamunanagar, for improving its efficiency and to eliminate bore well water requirement for boilers operation. Instead of installing a conventional RO plant for treatment of tubewell water for use at boilers, we explored the possibility of simultaneously treatment of surplus vapour condensate for use as boiler feed water. We

were successfully able to treat the vapour condensate with this condensate polishing unit by using specialised RO Membranes which resulted not only in saving of tubewell water consumption but also in improving the boilers efficiency in addition to life of the boiler tubes. We were able to treat tubewell water also with this unit as per requirements during the season.

Use of Sugarcane Bagasse as Potential Renewable Feedstock for Production of a Bio-Detergent by Narendra Mohan, Vishnu P. Srivastava & Anushka Agarwal published in STAI 2017.

Biomass and renewable raw materials are the basis and driver for an even greater alignment of industry to the principles of green chemistry and sustainability. Carbohydrates are growing important renewable raw material for detergent industry.

Carbohydrate-based surfactants/detergents are the final results of a product concept that is based on the greatest possible use of renewable resources. Sugar based detergents are gaining increased attention due to advantage with regard to performance, health of consumer and environmental compatibility compared to some standard products. Alkyl glycosides are emerging class of sugar based surfactants that are low in toxicity, ecologically safe and made from renewable resources at low cost. The sugar industry can be a major feedstock supplier and investor in the development of material technologies that are based on renewable resources. Bagasse is widely seen as one of the best feedstocks for the early stage adoption and commercialization of

biorefinery technologies. While bagasse is currently widely used for co-generation, the utilisation of this bagasse to produce higher value products is a profound opportunity to improve the sustainability and economic profitability of processing operations. In this context, we have developed a new green and sustainable route for the direct conversion of bagasse into pentose based glycoside detergents implementing acidic decanol-based pretreatment strategy.

Edited & Published by:

A.K. Garg

Asstt. Prof. of Sugar Technology

For & on behalf of:

NATIONAL SUGAR INSTITUTE

Ministry of Consumer Affairs,

Food & Public Distribution

Department of Food

& Public Distribution

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