SHARKARA

JANUARY – MARCH, 2021 VOLUME: 52, No. 01

ISBN: 978-93-5445-372-4

NATIONAL SUGAR INSTITUTE

Department of Food & Public Distribution
Ministry of Consumer Affairs, Food & Public Distribution
Government of India
Kanpur - 208017, INDIA
Email : nsikanpur@nic.in
Visit us at : http://nsi.gov.in
Follow us :

SHARKARA

VOLUME - 52, No .01

JANUARY - MARCH, 2021

It contains……

From Director's Desk...

The sugar production in the country during the current crushing season till March 2021 stands at 27.76 MMT which is about 20% higher than the corresponding period of last season and thus is expected to be around 30.5 MMT during the year. Maharashtra leads with 10.05 MMT production followed by Uttar Pradesh recording 9.37 MMT of the sugar production till March 2021. As regards Uttar Pradesh, lower sugar production is lower this year as compared to 9.72 MMT last year may be due to lower productivity of the prominent sugarcane variety and greater diversion of sugar through B Heavy molasses for ethanol production.

As a result of financial assistance offered by the Government of India through interest subvention schemes, more ethanol capacity is likely to come in future. As a result of capacity building, need for adequate quantity of feed stocks for ethanol production shall also emerge. As we have been stressing from quite some time it is important to identify potential alternate feed stocks and developing "Smart Distilleries" working on multiple feed stocks so as to attain higher capacity utilization and to cope up with ethanol requirement. With the IG ethanol policy at place, it is the need of hour to carryout techno-economic viability of such projects using feed stocks other than conventional ones.

However, Indian sugar industry is required to be competitive by making effective utilization of sugarcane value chain by developing value added products and diversifying to a greater extent having multiple products from each source. Production of sugar as per market requirement/consumer preferences is assuming greater significance now. Hygienic processing and packaging of sugar is going to be a key area for the sugar industry and we have been talking at-least about GMP and HACCP now. It is heartening to see that now that there is visibility of sugar brands and speciality sugars in the market, which is to be taken forward.

Institute is proactive in carrying out research on development of value added products from by-products and scientists of the institute are working on production of alkyl levulinates and low calorie sweetener from bagasse, bio-gas from filter cake, production of invert syrup from sweet sorghum, process for producing value added jaggery and jaggery based bakery & confectionary products and on purification of surplus condensates for use as replacement for fresh water. The institute is also working aggressively to promote technologies for production of potash rich fertilizer granules from incineration boiler ash, tableware & particle board from bagasse and jaggery based bakery/confectionary units etc. in association with apex organizations of the sugar industry and MSME Institutes/Centres. I look forward sugar factories taking it forward of their own or through joint ventures.

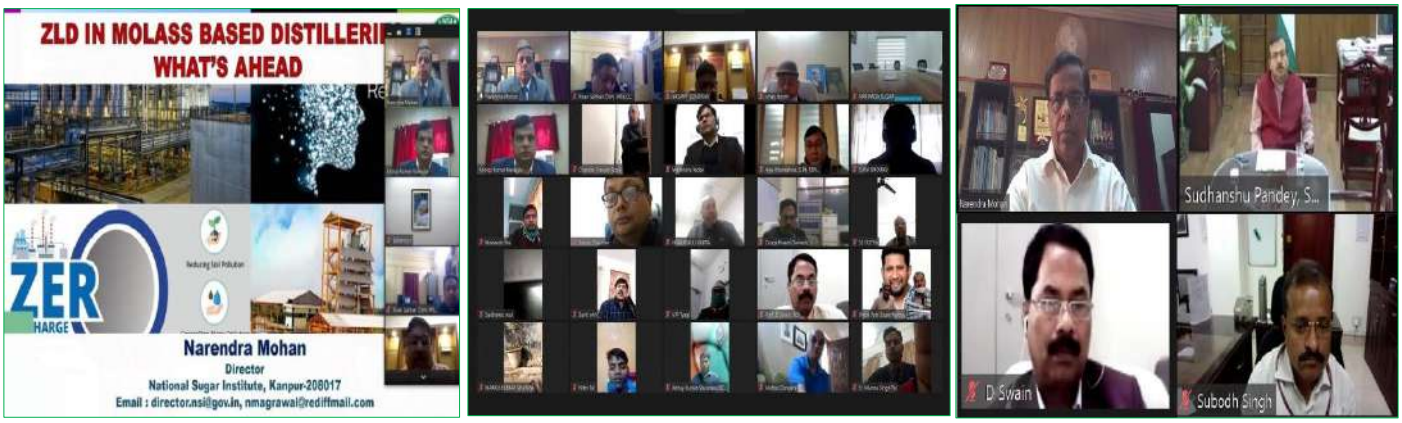
Wishing all of you a very happy and successful financial year 2021-22.

(Narendra Mohan)
Director

OUR PROVISIONS:

WEBINARS ORGANIZED:

1. A webinar on **"Alternate Technologies for Achieving ZLD & Value Added Products in Molasses based Distilleries"** organized by the institute on 19th January 2021, with the theme to think beyond available technologies relating to "Bio-composting and Incineration". Many innovative technologies viz. Spray Drying etc. were discussed.



2. A webinar on the topic **"Manufacture of Value added Products by Micro, Small & Medium Sector Units"** was organized on 16th March 2021 by National Sugar Institute, Kanpur to discuss project profiles of value added products viz. 100% bio-compostable tableware, particle board, potash rich fertilizer and compressed bio gas from by-products of the sugar industry. Secretary (Food & Public Distribution), Government of India, called upon the sugar factories to set up such units of their own or as joint ventures. New entrepreneurs may also come up; this may create rural development and job creation as well, he added.

3. Under the auspices of "**Azaadi Ka Amrut Mahotsav"**, One Day Seminar on **"Potential & Possibilities of Energy Saving in Sugar Industries"** was organized by NSI, Kanpur jointly with Spray Engineering Devices Limited & AASCT at M/s Dewan Sugars Ltd., Agwanpur, Moradabad on 22nd March 2021. More than 100 delegates from various sugar factories participated in the seminar.

FACULTY DEVELOPMENT PROGRAMME:

Eight faculty members from Nigerian Sugar Institute, Nigeria joined National Sugar Institute, Kanpur for the six months / one year Faculty Development Programme which is being conducted from 1st February 2021. Theoretical as well as practical training shall be given to these faculty members from Nigerian Sugar Institute.



ONLINE TRAINING PROGRAMME:

Three days online training programme was conducted in collaboration of CPCB on the topic **"Environmental Sustainability of Ethanol Industry"** for the officers of state pollution control boards. Programme was inaugurated by Mr. Tarun Sawhney, Vice Chairman and Managing Director, Triveni Engineering & Industries Limited on 17th February, 2021.

BRAIN-STORMING SESSION:

A brain-storming session was organized on **"Role of Potassium Salt of Active Phosphorus (PSAP) in Sugar Cane Productivity"** by Isha Agro, Pune in association with National Sugar Institute, Kanpur & Sugar Tech Journal 18th February 2021 at NSI, Kanpur. Technological interventions viz. use of potassium salt of active phosphorous and rain irrigation system were discussed.



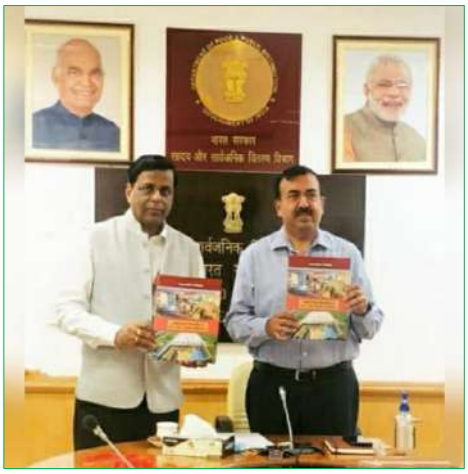
WORKSHOP ORGANIZED:

Workshop on the topic **"Use of Stainless Steel to Improve Process Efficiency and Reduce Maintenance Cost"** was held at National Sugar Institute, Kanpur on 5th March, 2021. Workshop was organized jointly by NSI, Kanpur and M/s Jindal Stainless Ltd., to create awareness about use of stainless steel at various unit operations in a sugar factory for better overall plant efficiency.



BOOK RELEASED:

Book entitled **"Analytical Handbook for Cane Sugar Industry"** written by Prof. Narendra Mohan, Director, National Sugar Institute, Kanpur released by Shri Sudhanshu Pandey, Secretary (Food & Public Distribution). Shri Subodh Kumar Singh, Joint Secretary (Sugar & Administration) also graced the occasion on 10th March, 2021.



XXXXX

OUR RESEARCH AREAS:

RESEARCH PAPERS:

Following research papers were published /sent for publication during the period:

1. Studies on isolation of Lignin from sugar industry based biomass and development of the process for the conversion of derived lignin and fermentable sugar to Value-added product - The separation (by TLC method) of lignin oxidation product obtained during the optimization study has been completed. The related characterization of the products is going on.

2. Studies on synthesis of lactic acid from sugarcane bagasse hemicellulose - The purification of hemicellulose obtained from sugarcane bagasse by using a new fractionation strategy; ethanol-water system, in presence of an organic acid, has been completed. The further reaction related to access lactic acid from the hemicellulose is to be carried out.

3. Studies on pot-efficient synthesis of alkyl-levulinates (Als) using sugarcane bagasse derived cellulose - The isolation and purification of methyl levulinate synthesized from bagasse cellulose (derived by implementing a new fractionation strategy-ethanol-water) has been completed. The reproducibility check of the optimized condition is under progress.

4. Studies on Production/isolation of C5 –Sugar Alcohol/Sugar using by-product resources of sugar industry - The microbial strains from M/s NCIM, Pune, have been received. The experiments related to strain propagation & activation have been performed.

5.Standardization of method for determination Preparatory Index - The preparatory index was determined by ICUMSA method, modified Aldrich & Rayner method & Australian method. Two nos. complete analysis set of preparatory index have been carried out during the month of March, 2021. Four nos. of analysis sets were completed on fiberized cane. Apart from above, Fibre % cane by direct method was also analysed and found 11.50 % to 15.20 %. Further experiments shall be carried out on laboratory shredded cane to achieve the conclusion.

6. Production of Natural Sugar Syrup From Sweet Sorghum - Looking beyond towards value addition and exploring routes for better utilization of resources, laboratory trials were conducted on assessing and exploiting the potential of sweet sorghum for production of 'natural sugar syrup'. Initially, raw juice of sweet sorghum was analysed for pH, brix, pol%, purity, colour, RS, TRS value. The final product 'sugar syrup' thus obtained was analysed for its energy value as well as for its diverse sugar profile. Further optimization of the process in respect of the duration of ion-exchange resin contact time as well as variation in the doses of active carbon as secondary de-colourizing agent and its effect on the product quality is to be assessed. During the study it was observed that the filtration step was bit cumbersome, and the same is being explored for ease of work and cost effectiveness of the process. Work on result

compilation of the study is going on and the same shall be presented in the form of paper soon. Side-by-side, a patent application in the subject matter is also been taken up.



7. Studies on deterioration patterns on different sugars - Sugar samples analysis for parameters such as colour, ash, pol, pH, RS, SO_2, turbidity as per plan of work has been completed in March 2021. Data compilation to draw the final conclusion is under progress.

8. Utilization of Potash Rich ash for production of valuable bio fertilizer - Sowing of sugarcane crop was done on 23rd October 2020 at NSI farm. Then prepared bio-fertilizers (Azatobacter and PSB) will be added to assess its effect on sugarcane productivity and quality parameters of cane juice.

9. Comparative study of Nine varieties of sweet sorghum for production of ethanol yield - Compilation of the data done. pH of the juice of different varieties ranged from 4.80 to 5.0, whereas total reducing sugar ranged 3.46% to 12.43% and reducing sugar from 1.29% to 2.2%. Ethanol yield varied with varieties and ranged from 22.05 L/T to 6 L/T. This year varieties SSV – 84, ICSSH-28 and CSH – 22SS performed best for ethanol yield with 22.5 L/T, 21.55 L/T and 18.5 L/T respectively.



10. Production of Jaggery based bakery and confectionery product – In wake of covid – 19 pandemic, the market for nutritious product has taken a tremendious turn. Looking to the consumption trends of sugar and the withdrawl of the consumers' choice towards sugary products indeed led to exploration of better and healthier alternatives for a variety of product profile. Jaggery has been the traditional sweetener with numerious health benefits. Batch trials were taken up to explore the use of jagger in place of sugar in various bakery and confectionery products. Dietry fibre biscuits enriched with goodness of jaggery, chocolstes, brownies, fruit cake, popcorn etc were some bakery and confectionery product that were produced. While carrying out a small market survey, it was observed that the so produced jaggery based products were very much acceptable and appreciated amongs consumers.

RESEARCH PAPERS:

1. A research paper on **"Sugarcane Industry: by-products valorization for economic sustainability"** by Narendra Mohan and Anushka Agarwal is published in International Journal of Creative Research Thoughts (IJCRT).

2. A paper entitled **"Potential Areas of Energy Generation & Saving in Sugar Industry"** by Prof. D. Swain was presented during the National Seminar on "Potential & Possibilities of Energy Saving in Sugar Industries" organized by NSI, SED & ASSCT at Moradabad on 22nd March 2021.

3. A paper entitled "**Potential of Energy Production and Saving in Sugar Industry"** by Prof. D. Swain, sent for publication in sugar journal **"Sharkara"** January – March 2021 addition.

4. Presentation on "**Advancements in Process House for Energy Conservation – A Review"** by Narendra Mohan & M.P. Singh was made during the National Seminar on "Potential & Possibilities of Energy Saving in Sugar Industries" organized by NSI, SED & ASSCT at Moradabad on 22nd March 2021.

5. A research paper titled **"Micronutrient Fortification of Sugar"** by Narendra Mohan, Ashok K. Garg & Anushka Agarwal has been accepted on 18th February for inclusion in the SASTA Congress 2021.

6. A Review paper titled **"Sugar industry – Sustainable Source of Bio-Energy/Renewable Fuel"** by Narendra Mohan, Sanjay Awasthi and Anushka Agarwal is published in International Journal of Engineering Research & Technology (IJERT), Vol. 10, Issue 01, January 2021.

7. A book chapter titled "**Advances in sugarcane industry: By-product valorization"** by Narendra Mohan & Anushka Agarwal has been published in book **"Sustainable Food Waste Management",** Springer, Singapore, 5th January, 2021. ISSN: 978-981-15-8967-6.

8. A review paper titled **"Diversification for economic sustainability of Indian sugar industry proposed for**" by Narendra Mohan has been sent for publication in the proceedings of proposed seminar to be organized by National Federation of Co-operative Sugar Factories, 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. Meeting of the Expert Committee on sugar standards was held at IISR, Lucknow on 25th September 2020, wherein seven grades and their sale price were approved for the sugar season 2020-21.

On the basis of the approved Standards, Bureau of Sugar Standards Grades distribution commenced from 1st October, 2020.

Price schedule for the sugar season 2020-21:

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 + 2 Velvet Cork in packing case	Rs.20,000/= each set
3	Single Sugar Standard Grade	Rs.2550/= each
4	Empty Sugar Standard Glass Bottle	Rs.450/= each
5	Packing case	Rs.600/= each
6	Velvet Cork	Rs.100/= each
7	Postal expenses, forwarding charges, if any	Extra as applicable
8	Payment	For Indian Sugar Standards 2020-21, payment shall be acceptable only through **BHARAT KOSH.** In any circumstances, **no Demand Draft / Cheque / Cash amount shall be accepted.**
9	Delivery of Sugar Standard Grades	Monday to Friday (10.00 AM to 5.00 PM)
10	Taxes	GST extra as applicable @18%.

The institute has taken up revision of various existing BIS standards viz. molasses tanks, raw, plantation white, refined and icing sugar etc. on behalf of Bureau of Indian Standards. BIS standards for some other sugars viz. organic sugar, brown sugar & low sulphur sugar are being drafted in consultation with various stake holders.

OUR ADVISORY:

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

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.

4. To render assistance to various government organizations in implementation of policies, validations and on associated matters.

5. To extend human resource management services to various government and private organizations.

CONSULTANCY SERVICES:

The consultancy services of the institute were provided to the following on various technical matters relating to diversion of B Heavy molasses, validation of ETP's, preparation of DPR's for various projects etc:

1	M/s The Sonipat Cooperative Sugar Mills Limited, District - Sonipat, Haryana.
2	M/s Mawana Sugar Works, Mawana, District - Meerut, U.P.
3	M/s Avadh Sugar & Energy Limited, Unit – Seohara, District - Bijnor, U.P.
4	M/s Haryana State Federation of Cooperative Sugar Mills Limited, Panchkula, Haryana.
5	M/s Dalmia Bharat Sugar & Industries Limited, Unit – Ramgarh, District – Sitapur, U.P.
6	M/s Balrampur Chini Mills Limited, Unit – Gularia, District – Lakhimpur – Kheri, U.P.
7	M/s Magadh Sugar & Energy Limited, Unit – New Swadeshi Sugar Mills, District – West Champaran, Bihar.
8	M/s Harinagar Sugar Mills Limited, Distillery Unit – Harinagar, District – West Champaran, Bihar.
9	M/s Kisan Sahakari Chini Mills Limited, Sathiaon, District – Azamgarh, U.P.
10	M/s Akbarpur Chini Mills Limited, Ambedkar Nagar, U.P.
11	Anamika Sugar Mills Private Limited, Agauta, Aurangabad, District – Bulandshahr, U.P.
12	M/s Bajaj Hindusthan Sugar Limited, Gola, District – Lakhimpur-Kheri, U.P.
13	M/s Bajaj Hindusthan Sugar Limited, Palia, District – Lakhimpur-Kheri, U.P.

14	M/s Bajaj Hindusthan Sugar Limited, Maqsoodapur, District – Shahjahanpur, U.P.
15	M/s Dalmia Chini Mills, Unit – Nigohi, District – Shahjahanpur, U.P.
16	M/s U.P. State Sugar Corporation, Limited, Munderwa, District – Basti, U.P.
17	M/s Triveni Engineering & Industries Limited, Chandanpur, Hasanpur, District – Amroha, U.P.
18	M/s Triveni Engineering & Industries, Limited, Sabitgarh, District – Bulandshahr, U.P.
19	M/s Saryu Sahkari Chini Mills, Belrayan, District – Lakhimpur-Kheri, U.P.
20	M/s Rosa Sugar Works, Roza, District – Shahjahanpur, U.P.
21	M/s Riga Sugar Co. Limited, Riga, District – Sitamarhi, Bihar.
22	M/s Oswal Overseas Limited, Sugar Division, Nawabganj, District – Bareilly, U.P.
23	M/s Mankapur Chini Mills Limited, District – Gonda, U.P.
24	M/s Manjhaulia Sugar Industries Private Limited, District – West Champaran, Bihar.
25	M/s KSCM, Sampurna Nagar, District – Lakhimpur-Kheri, U.P.
26	M/s J.K. Sugar Limited, Meerganj, District – Bareilly, U.P.
27	M/s Hassanpur Sugar Mills, Hassanpur, District – Samastipur, Bihar.
28	M/s Dwarikesh Sugar Industries Limited, Faridpur, District – Bareilly.
29	M/s Bihar Distillery & Bottlers Private Limited, Arra, District – Bhojpur, Bihar.
30	M/s Globus Spirits Limited, Dhandua, Jandaha, District – Vaishali, Bihar.
31	M/s Sonasati Organics Private, Limited, Kothi, District – Gopalganj, Bihar.
32	M/s Kisan Sahakari Chini Mills Limited, Sathiaon, District – Azamgarh, U.P.
33	M/s Venus Sugar Limited, District – Sambhal, U.P.
34	M/s The Sonipat Co-operative Sugar Mills Limited, District – Sonipat, Haryana.
35	M/s Balrampur Chini Mills Limited, Unit – Maizapur, District – Gonda, U.P.
36	M/s Balrampur Chini Mills Limited, Unit – Akbarpur, District – Ambedkarnagar, U.P.
37	M/s Triveni Engineering & Industries Limited, District – Muzaffarnagar, U.P.
38	M/s Triveni Engineering & Industries Limited, Unit – Rani Nangal, District – Moradabad, U.P.
39	M/s Simbhaoli Sugars Limited, Unit – Chilwaria, District – Bahraich, U.P.
40	M/s Bajaj Hindustan Sugar Limited, Golagokarnath, District – Lakhimpur Kheri, U.P.
41	M/s Avadh Sugar & Energy Limited, Unit – New India Sugar Mills, District – Kushinagar, U.P.

42	M/s Parle Biscuits Private Limited, (Sugar Division) District – Bahraich, U.P.
43	M/s DCM Shriram Limited, Sugar Unit – Rupapur, District – Hardoi, U.P.
44	M/s Shree Laxmi Nrusinh Sugars LLP, Amdapur, District – Parbhani, Maharashtra.
45	M/s Bajaj Hindustan Sugar Limited, Unit – Khambharkhera, District – Lakhimpur Kheri, U.P.
46	M/s Dhampur Sugar Mills Limited, Unit – Dhampur, District – Bijnor, U.P.
47	M/s Dhampur Sugar Mills Limited, Unit – Meerganj, District – Bareilly, U.P.
48	M/s Triveni Engineering & Industries Limited, Sugar Unit – Deoband, District – Saharanpur, U.P.
49	M/s DCM Shriam Limited, Sugar Unit – Ajbapur, District – Lakhimpur Kheri, U.P.
50	M/s DCM Shriam Limited, Distillery Unit – Ajbapur, District – Lakhimpur Kheri, U.P.
51	M/s Harinagar Sugar Mills Limited, Distillery Unit – Harinagar, District – West Champaran, Bihar.
52	M/s Dalmia Bharat Sugar & Industries Limited, Distillery Unit – Nigohi, District – Shahjahanpur, U.P.
53	M/s Bajaj Hindusthan Sugar Mills Limited, Unit – Utraula, District – Balrampur, U.P.
54	M/s Uttam Sugar Mills Limited (Distillery Division), Unit – Barkatpur, District – Bijnor, U.P.
55	M/s Hafed Sugar Mills, Assandh, District – Karnal, Haryana.
56	M/s Ramala Sahakari Chini Mills Limited, Ramala, District – Bagpat, U.P.
57	M/s Dhampur Sugar Mills Limited, Unit – Rajpura, District – Sambhal, U.P.
58	M/s Bajaj Hindusthan Sugar Limited, Unit – Thanabhawan, District – Shamli, U.P.
59	M/s Dhampur Sugar Mills Limited, Unit – Mansurpur, District – Muzaffarnagar, U.P.
60	M/s Dalmia Bharat Sugar & Industries Ltd., Unit – Nigohi, Shahjahanpur, U.P.
61	M/s Triveni Engineering & Ind. Ltd., Unit – Deoband, District - Saharanpur, U.P.
62	M/s Simbhaoli Sugar Mills Ltd., Unit – Brijnathpur, District – Hapur, U.P.
63	M/s Balrampur Chini Mills Unit – Maizapur, District – Gonda, U.P.
64	M/s Dhampur Sugar Mills Ltd., Unit – Asmoli, District - Sambhal, U.P.

ANALYTICAL SERVICES:

Besides analysis of sugar & sugar house products, Ethanol and effluents, institute started offering testing of Ethyl Alcohol based Sanitizer in its sophisticated, most modern NABL accredited analytical laboratory. Analytical services were rendered to following:

1	M/s Balrampur Chini Mills Limited, Unit - Balrampur, U.P.
2	M/s Maa Mahamaya Sahkari Shakkar Kharkhane Maryadit, District – Ambikapur, Chhattisgarh.
3	M/s Triveni Engineering & Industries Limited, Unit – Chandanpur, District – Amroha, U.P.
4	M/s Bajaj Hindusthan Sugar Limited, Rudhauli, U.P.
5	M/s Bajaj Hindusthan Sugar Limited, Utraula, U.P.
6	M/s L.H. Sugar Factory Limited, District – Pilibhit, U.P.
7	M/s Magadh Sugar & Energy, Unit – New Swadeshi Sugar Mills Limited, Narkatiaganj, Bihar.
8	M/s Triveni Engineering & Industries Limited, Unit Raninangal, District – Moradabad, U.P.
9	M/s DSM Sugar Meerganj, (A unit of Dhampur Sugar Mills Limited), Meerganj, District – Bareilly, U.P.
10	M/s The Shahabad, Co-op. Sugar Mills Limited, District – Kurukshetra, Haryana.
11	M/s Kesar Enterprises Limited, Baheri, District – Bareilly, U.P.
12	M/s The Ugar Sugar Works Ltd., Unit – Malli, District – Kalburgi, Karnataka.
13	M/s L H Sugar Factories Ltd., District – Pilibhit, U.P.
14	M/s The Kisan Sahkari Chini Mills., Mahmudabad, District – Sitapur, U.P.
15	The Kisan Sahkari Chini Mills Ltd., Powayan, District – Shahjahanpur, U.P.
16	The Kisan Sahkari Chini Mills Ltd., Tilhar, District – Shahjahanpur, U.P.

SALE OF SUGAR STANDARDS:

Sale of sugar standard grades commenced from 1st October 2020 for the sugar season 2020-21. Standard grades can be procured online also. The details are available on our website http://www.nsi.gov.in . Total 221 Nos. of Sugar Factories procured 1111 Nos. Standards till March 2021.

****

OUR OTHER ACTIVITIES:

1. Director, NSI, participated and made a presentation about **"Water Management in Indian Sugar Factories"** during the **"Multi-stake holder consultation on corporate water stewardship-Encouraging Water Stewardship"** organized by PHDCCI on 8th January, 2021.

2. Dr. Rakesh Bhatnagar, Vice Chancellor, Banaras Hindu University (BHU), also an alumni of NSI, Kanpur visited the institute to see the ongoing R&D work on 25th January, 2021. Issues regarding development of enzymes for enhancing fermentation efficiency, for use in 2G ethanol production and also on production of Bio-gas/Bio-CNG from agriculture waste discussed.

3. Boiler-Pooja was organized at Experimental Sugar Factory at the institute on 25th January 2021.

4. The Institute celebrated 72nd Republic Day on 26th January, 2021. On this occasion, Director hoisted the National Flag and took the salute from the security guards. Awards were also distributed to the winners of various competitions organized during **"Swachhta and Satarkata Pakhwadas".**



5. "**New Hostel cum Guest House**" became operational from 18th January, 2021 with stay of trainees from Nigerian Sugar Institute. The hostel cum guest house has all modern amenities including recreation room, lobby and wi-fi facilities.



6. Crushing operation of the Experimental Sugar Factory (ESF) was commenced to impart practical training to the students of various courses. During the year, Installation of continuous centrifugal machine, AC-VFD for mills was carried out on 12th February 2021.



7. Visit of students of M.Sc. (Chemistry) and faculty of Christ Church College, Kanpur was held to look into various facilities at the institute, Experimental Sugar Factory and explore the possibilities of building career in sugar industry on 19th February 2021.



8. Industrial visit of students of BBA/BCA of Dr. Virendra Swarup College of Management Studies was carried out to observe the unit operations/ manufacturing process at Experimental Sugar Factory of Institute on 26th February, 2021.



9. Swachhta oath was administered to staff and students and special cleanliness drive was undertaken in and around campus from 16th February 2021 during the **"Swachhta Pakhwada"**. Essay, painting competitions, tree plantation and nukkad natak were also organized at the institute to create awareness about the swachhta..

10. On the occasion of **"National Science Day"** on 28th February 2021, Director, National Sugar Institute called upon the students at Experimental Sugar Factory to learn the basics of science on which the various unit operations in a sugar factory have been developed and the equipment too.

These principles are to be taken forward for development of innovative processes with the concept of taking them from "Lab to Factory". The students are required to make full utilization of Experimental Sugar Factory which is considered as the nursery of budding technologists.

11. Students and Staff of BND College, Kanpur visited various facilities of the institute on 24th March, 2021. They took great interest to know career prospects in sugar industry, particularly in Ethanol sector.

12. Students of DBS College, Kanpur also visited various laboratories of the institute and also the Experimental Sugar Factory to seek first hand information about unit operations and sugarcane management during the crushing season 2021-22.

13. Students of Zee College of Pharmacy, Kanpur visited the institute to look into various facilities at the institute viz. Ethanol Unit, Speciality Sugar Division and Experimental Sugar Factory. They were also given information about various courses being conducted by the institute so that the students can explore the possibilities of building carrier in Sugar Industry/Alcohol Industry.

XXXXXX

HAPPENING IN THE SUGAR INDUSTRY:

USA – Sugar producers welcome the new US trade representative assured by her support for the no-cost sugar policy.

The newly confirmed U.S. Trade Representative Katherine Tai recently signalled during confirmation hearing strong support for America's sugar producers and affirmed her commitment to America's no-cost sugar policy.

EU – Sugar users group CIUS opposes return to market intervention.

CIUS, the committee of European Sugar Users placed its support behind the EU Commission and Council in arguing against returning "back to a more regulated sugar market as wished for by the European Parliament" in a recent press release.

USA – Louis Dreyfus sells Imperial Sugar to US Sugar.

United States Sugar Corp announced on March 24, 2021, that it will purchase the business and assets of its local rival Imperial Sugar from commodities trader Louis Dreyfus Company (LDC), according to a press release.

Kenya – Vuma Biofuels produces fuel briquettes from cane bagasse

Vuma Biofuels is exploiting bagasse it has access to from two cane sugar factories to produce fuel briquettes.

USA – Construction of a new micro sugar refinery in New York state commences.

Miami-based Sucro Sourcing has begun demolition and refurbishment for its new sugar refinery at the former Bethlehem Steel site in Lackawanna, New York state.

Spain – Sugar tax introduced in Catalonia had a marginal effect.

Economists from the University of Bath (United Kingdom), the International University of Catalonia (UIC) and the University of Las Palmas found that the introduction of a sugar tax in Catalonia had only a limited, moderate effect in shifting people's dietary habits and behaviours, according to a new study.

Cane sugar ethanol fermentation yields increased by 3% from promoting co-occurring Lactobacillus amylovorus.

Cane sugar ethanol fermentation represents a simple microbial community dominated by S. cerevisiae and co-occurring bacteria with a clearly defined functionality. Researchers at The Novo Nordisk Foundation Center for Biosustainability (DTU) and Yale University have discovered that both the total yield and the cost of the fermentation process could be improved by promoting the prevalence of a particular bacterial species.

EU – 2020/21 sugar production falls by 11% to 14.5 million tonnes.

Sugar production during the 2020/21 campaign fell by 11% to 14.5 million tonnes compared with the previous year, weighed down by the catastrophic decline (by 34%) in yield in France, the top producer in the bloc, according to the European Commission's Observatory Sugar Market report.

Bangladesh – Government's efforts to modernise sugar industry marred by ill-informed proposals.
The move to modernise public sugar mills in Bangladesh has apparently fallen flat, according to local press reports.

Cuba – 2021 sugar output forecast to drop by 25% to under 1 million tonnes.
The 2021 sugar production could be around 900,000 tonnes, a 25% drop, according to state media reports Reuters.

UK – Sugar tax results in consumption of sugar through soft drinks fall by 10%.
The sugar tax introduced in April 2018 appears to have the intended effect of reducing the purchase of sugar-sweetened beverages (SSBs) according to research by Cambridge University academics and published in the British Medical Journal.

Brazil – Raizen to go public as it aims to raise US$2.2 billion via IPO.
The sugar and ethanol producer and fuel distributor Raizen, a joint venture between Shell and Cosan, has started talks with investment banks for an IPO. The company made proposals to potential underwriters for an offering estimated at between BRL8 billion and BRL13 billion (US$2.21 billion), according to Valor Economico.

India – Eid Parry rolls out new low GI sugar.
In a bid to strengthen product portfolio in the health and wellness segment to address demands of increasingly health-conscious and discerning consumers, the sugar producer EID Parry has launched the new Parry's SweetCare, a new glycemic index (GI) sugar that contributes to lower blood sugar levels compared to white sugar.

UK – Neonics will not be applied to the 2021 sugar beet crop.
The emergency derogation for the use of a neonicotinoid seed treatment to control virus yellows in sugar beet in the UK will not be triggered this season.

Hershey's and American Sugar Refining Invest in 'rare sugars' start-up Bonumose.
The US-based start-up Bonumose has secured an investment from snacks manufacturer The Hershey Company and American Sugar Refining (ASR), a member of ASR Group, in a Series B investment round.

Vietnam – Government imposes duties on raw and refined sugar from Thailand.
The Ministry of Trade and Industry has decided to levy a temporary anti-dumping tax of 44.88% on raw sugar and 33.88% on refined sugar imported from Thailand.

Croatia – With the closure of Osijek sugar factory, only Županja plant survives.
The management of the Croatian Sugar Industry (HIŠ) company confirmed on 17th February that only the Županja factory will continue producing sugar, as the plant in Osijek would cease production, according to local press reports.

Tereos – Q3 earnings rise on the back of higher sugar prices.
The world's second-largest sugar producer Tereos recently reported higher third-quarter core earnings on the back of improving sugar prices, but the French company said factors including the coronavirus pandemic and a weak Brazilian real would curb profits in the year ahead.

Pakistan – Government will shoulder costs for installing video surveillance technology at sugar mills to monitor production.
The Economic Coordination Committee (ECC) approved on 8th February PKR350 million (US$2.2 million) for the installation of Video Analytics Surveillance (VAS) systems at sugar mills to monitor their operations and prevent tax evasion, according to local press reports.

India – The goal of 20% ethanol-gasoline blending rate likely by 2025.
India plans to achieve 20% ethanol-blending with gasoline by 2025, five years ahead of its previous target. India's Oil and Gas Minister Dharmendra Pradhan said on 24th January this was to help reduce its dependence on costly oil imports.

Vietnam plans to impose anti-dumping duty on raw and refined sugar from Thailand.
The Vietnamese government announced Feb. 9 its plans to impose an anti-dumping duty of on raw and refined sugar from Thailand, claiming soaring imports are undermining its domestic sugar industry.

Mauritius – 2020 sugar production drops by 18% due to drought.
Sugar output at the end of the 2020 campaign fell by 18.3% from the previous year to 270,523 tonnes, according to the Mauritius Chamber of Agriculture.

USA – Sucro Sourcing invests US$19 million towards new micro sugar refinery.
Sucro Sourcing, a sugar cane refiner and distributor, is planning to build at a former steel complex in Lackawanna, New York state a raw sugar storage warehouse, a micro sugar refinery, packaging and finished good warehousing and offices with an investment of US$19 million.

USA – California Ethanol + Power starts recruiting farmers to grow cane for new US$1 billion project.
California Ethanol + Power recently announced that it has commenced recruiting farmers in the local Imperial Valley farming communities to secure formal commitments to grow the first 20,000 acres (8094 ha) of sugarcane feedstock for US1 billion Sugar Valley Energy project.

Brazil – Raizen's acquisition of sugar-ethanol producer Biosev speeds up.
Raizen, jointly owned by Cosan and Shell, is close to acquiring Biosev, the sugar-ethanol company owned by Louis Dreyfus, according to local press reports.

India's sugar exports hampered by shortage of shipping containers.
Lack of shipping containers has put brakes to sugar exports from India, said exporters, according to local press reports.

Chad government signs MOU with Somdiaa to build a new sugar factory.

On December 24, 2020, the Chadian Minister of Finance and Budget, accompanied by the Minister of Industrial Development, Commercial and Private Sector Promotion signed with the representative of the French group Somdiaa a memorandum of understanding for the building of a cane sugar factory with the capacity of 173,000 tonnes in the Bahr Sara region of Chad.

Spain – Azucarera honoured for logistics excellence in bulk sugar transport.

AB Sugar's Azucarera, together with Thyssenkrupp Elevadores and Mango, were awarded the 'CEL 2020 Awards for Logistics Excellence', at the ceremony held on 13th January to accolade the 'Development of a sustainable strategy for the distribution of bulk sugar'.

India – KPR invests US$68 million in new sugar + ethanol plant in Karnataka.

K P R Mill has decided to establish a new sugar plus ethanol plant in Karnataka, investing INR5 billion (US$68.4 million).

Sri Lanka – Kantale Sugar Factory to be rebuilt with an investment of US$316 million.

Backed by a US$ 316 million investment, sugar production at Kantale Sugar Factory is expected to commence operations in 2023, after 30-year hiatus, as the Sri Lankan government, the major shareholder, is expected to hand over key assets, including the land belonging to the factory on lease basis, to MG Sugars Lanka Private Limited.

In the free trade agreement with China, Mauritius secures tariff quota of 15,000 tonnes, rising to 50,000 t.

The free trade agreement (FTA) between the government of the Republic of Mauritius and the government of the People's Republic of China came into force on January 01, 2021. The FTA was signed in October 2019 in Beijing.

Cargill plans to exit sugar trading business.

The agribusiness giant and commodities trader Cargill is in talks with Brazil's Copersucar to exit their sugar trading joint-venture, Alvean, and focus on its food processing and meat production businesses, according to Reuters and Bloomberg.

Poland – 2021 commenced with sugar tax on sugar-sweetened beverages.

From 1st January this year, Poland imposed a new tax on sugar-sweetened drinks.

India – Soft loans of US$622 million extended to grain-based distilleries to drive ethanol production expansion.

In an effort to speed up expansion in ethanol production by 10 billion litres, the government on 31st December approved interest subvention of INR45.73 billion (US$622 million) by extending the soft loan programme to include grain-based distilleries.

Kazakhstan – New beet sugar factory in Zhambyl region now expected to be operational in 2023.

The government supported new beet sugar factory in Zhambyl region is now set to be completed in 2023, according to local press reports.

Indian government approves sugar export subsidy of over US$475 million.

On December 16, 2020, the Cabinet Committee on Economic Affairs (CCEA), chaired by Prime Minister Narendra Modi approved its marketing year (MY) 2020/21 sugar subsidy, totalling INR 35 billion (US$475.8 million) to export six million tonnes under its Maximum Admissible Export Quota (MAEQ) program that facilitates sugar exports and subsidizes any related additional production costs.

India – Lack of cane supply forces Eid Parry to shut down its mill in Tamil Nadu.

EID Parry India Ltd., one of the largest makers of sugar, has decided to close its sugar factory in Tamil Nadu's Pudukottai district, saying in late December '20 it didn't see a future for the business because of poor sugarcane.

****

➢ **RESEARCH ARTICLE:**

"POTENTIAL OF ENERGY PRODUCTION AND SAVING IN SUGAR INDUSTRY"

by
Prof. D. Swain
National Sugar Institute
Kanpur, India

ABSTRACT

Sugar Industry is an energy intensive industry. More than 1.0 GJ is consumed for producing 1 quintal of sugar which is considered to be one of the most energy consuming products in any industry. Since, cane itself is the source of this energy, technocrats are less bothered for its higher consumption. Sustainability of any industry needs that it should operate on profit. Profit is the difference of sales realization and cost of production. Since, for the last couple of years there is surplus production, Govt. support has made the commodity to be sold at a Minimum Support Price (MSP), more realization from sales side cannot be expected and therefore, it is the cost of production which needs to be minimized. Cost of production is basically the sum of raw material cost and conversion cost from which additional revenue generated from by-products/co-products is deducted. Raw material cost and conversion cost keeps on increasing year by year as it is a farm produce and due to cost index respectively. It is therefore the additional revenue generation which plays a pivotal role in deciding the sustainability of sugar industry.

Energy saved is energy produced. So any amount of energy saved is considered to add additional revenue for the factory which in turn reduces the cost of production and increases the profit. This paper discusses the potential areas of energy generation and saving in sugar industry.

Key words

Sugarcane Agricultural Residue (SAR), Bagasse Moisture, Rankine Cycle, Variable Frequency Drive.

INTRODUCTION

Stem portion of sugarcane is taken to the factory for crushing. The rest of the parts like green and dry leaves, the top, the roots etc. to gather called sugarcane plant residue (SAR) remains in the field. The following table gives the different parts /products /byproducts from the sugarcane plant and their calorific values:

Table-1 (different parts /products /byproducts from the sugarcane plant and their calorific values)

Part/Product/ Byproduct	Quantity in ton per ton of cane crushed		Calorific Value in MJ/ton
SAR	0.125	3050	1593.625
Sugar	0.1	4100	1713.8
Bgasse	0.3	2270	2846.58
Filtercake	0.035	1800	263.34
Molasses	0.045	2570	483.417
	Total		6900.762

We use only bagasse as the source of energy for the production of Electricity. In sugar factory power plants, the efficiency of power plant varies from 10-21 % depending mostly on the operating steam parameters. More the value of the parameters, more is the efficiency. There is another source from which we can generate electricity is the SAR. This is left in the field and is either burnt or added to the field by mulching. Mulching does not give the desired results when the cane field is left for ratoon crop. It will be more effective when it is taken from the field, shredded in to pieces and then mulched in the inter rows. This way, only 50 % of the quantity of SAR will give the same result as it was for the whole quantity without shredding. The balance 50 % may be used for fuel purpose in the boilers of the factory. This will not only increase the power production but increase the no of days of power plant operation during off-season. So there are two ways by which we can increase the power generation in a sugar factory:

a. By collecting & using 50 % of the SAR from the field and using as the fuel.
b. By increasing the efficiency of the power plants of the sugar factory.

Cane preparation, Milling and Cooling and Condensing are the three areas where the use of power is very high in a sugar plant. Studies at these sections for reducing power consumption due to unnecessary power loss has given encouraging results and are mentioned in the paper.

MATERIALS AND METHODS

Increase in Power generation by use of SAR as an additional fuel in the boiler
The factory has an integrated cogeneration unit of 20 MW cogenerating power using steam of 67 bar and 480°C and a 50 kL/d distillery with bio-composting for obtaining ZLD (Zero Liquid Discharge). This plant uses 50% of SAR (obtained from its cane fields) as fuel in the boiler for steam generation.

SAR is composed mainly of the leaves and the tops that are left over in the fields during sugarcane harvesting. It is left in the field for about 20-25 days to dry. Tractor-mounted bailers collect 78 to 83% of the SAR from the field in the form of bales (the remaining SAR cannot be collected by balers). Approximately 35-40% of the bales are shredded by using a shredder at the site and returned to the

field between the plant rows as a mulch. Both the baler and the shredder are tractor mounted. The remaining 60-65% of the bailed SAR is transported to the factory, shredded and added to bagasse in line for use in the boiler as fuel. This means that half of the SCAR ultimately remains in the field and half goes to the mill. Since the SAR is 15-20% less than the weight of bagasse, addition of SAR results in almost no problems in the boiler.

A sugarcane plant consists of roots, green and dry leaves, green top and the stem which is taken for crushing in sugar factory. The average proportion of the different constituents obtained from analysis of 10 samples of two cultivars that we collected from the fields is given in Table 2. The total SAR is 12.29% of the sugarcane plant weight, equal to 16.85% on cane crushed (stem portion) (12.29*24166/17623). Half of this SAR is 8.43%. Leaving 1% for other use such as fodder, wind loss etc., SAR available for fuel purposes is estimated to be 7.43% (8.43% - 1%) on cane for the sugarcane cultivars sampled.

Table. 2. Proportion of different constituents of sugarcane plant by weight.

Part of the Plant	Weight in kg	Moisture %	SCAR % at 10% moisture
Stem	17623		
Green Leaves	2466	52.15	7.74
Dry Leaves	1050		
Green Top	2932	66.24	4.55
Roots	95		
Total	24166		12.29

*Analyzed for moisture% during harvesting; **Analyzed for moisture% after 20-25 days of sun drying in the field.

At 10% moisture, SAR has a gross calorific value in the range of 12750 to 13150 kJ/kg. Power and additional revenue generated from SAR for 180 days of sugar plant operation are given in Table 3. Hence, SAR itself can contribute about INR 1013 per ton of sugar produced.

Table 3. Power and additional revenue generation by using SAR.

Particulars	Unit	Value
Average crush rate of the factory	t/d	5,000
No of season days		180
Cane Crushed	t	900,000
Rate of Sugar Recovery	% cane	11
Sugar Produced	t	99,000
SAR available @ 7.43 % cane	t	66,870
Calorific value of SAR at 10 % moisture	kJ/kg	12,780
Power generation from SAR *	MWh/t	0.5
Total power from SAR	MWh	33,435
Power Tariff	INR/MWh	5000.00
Revenue from SAR power	INR	167,175,000
Cost of Fuel **	INR /t	1000.00
Total Cost of Conversion	INR	66,870,000
Net additional revenue from use of SAR	INR	100,305,000
Additional Revenue per ton of sugar	INR/t	1013.18

(* 0.5 MWh/t or 0.5 kWh/kg of biomass having gross calorific value 12750 kJ/kg contribute to an overall power plant efficiency of 0.5*3600/12750*100 = 14.12% and hence 0.5 MWh/t is a very reasonable figure; ** Cost of fuel includes the cost of collection from the field, baling, shredding and transport of SAR up to the bagasse yard).

Increased boiler efficiency by drying bagasse

The factory has an integrated cogeneration unit of 35 MW cogenerating power using steam of 87 bar and 510°C and a 50 kL/d distillery with bio-composting for obtaining ZLD (Zero Liquid Discharge). The co-gen plant has a bagasse dryer of 50 t/h drying bagasse from 50% moisture content to 40% moisture content.

Bagasse drying is a tool to bring down the moisture content of bagasse using the waste heat released to atmosphere through the mill chimney. For an 87-bar boiler, the available heat in flue gas is sufficient to bring down the moisture of its fuel from 50% to 40%. Each unit drop in moisture content of bagasse increases the efficiency of a boiler by about 0.55% (Figure 1). Bagasse drying is carried out by a flash dryer (induced type is used in this case). However, forced-type flash dryers are also used in many other places, giving almost the same results. In an induced-type flash dryer, induced draft fan is used for conveying the bagasse from the entry to the exit of the dryer, whereas in case of forced draft flash dryer it is used a forced draft fan.

A drop of 10 units in the moisture content of bagasse leads to 5.5% increase in boiler efficiency (Figure 2). This increase in cycle efficiency increases power production per kg of bagasse by 0.145 kWh, i.e. 145 kWh per t of bagasse or about 43 kWh per t of cane.

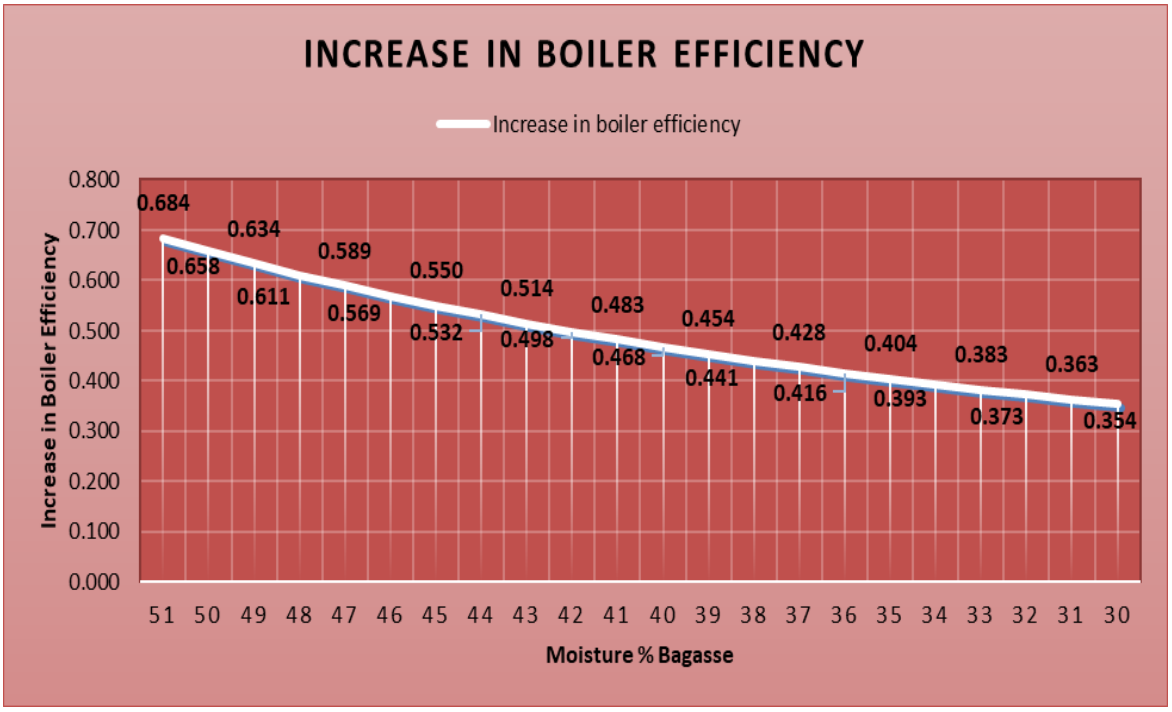


Figure 1. Increase in boiler efficiency (% GCV) per unit drop in bagasse moisture% (Mohan 2017).

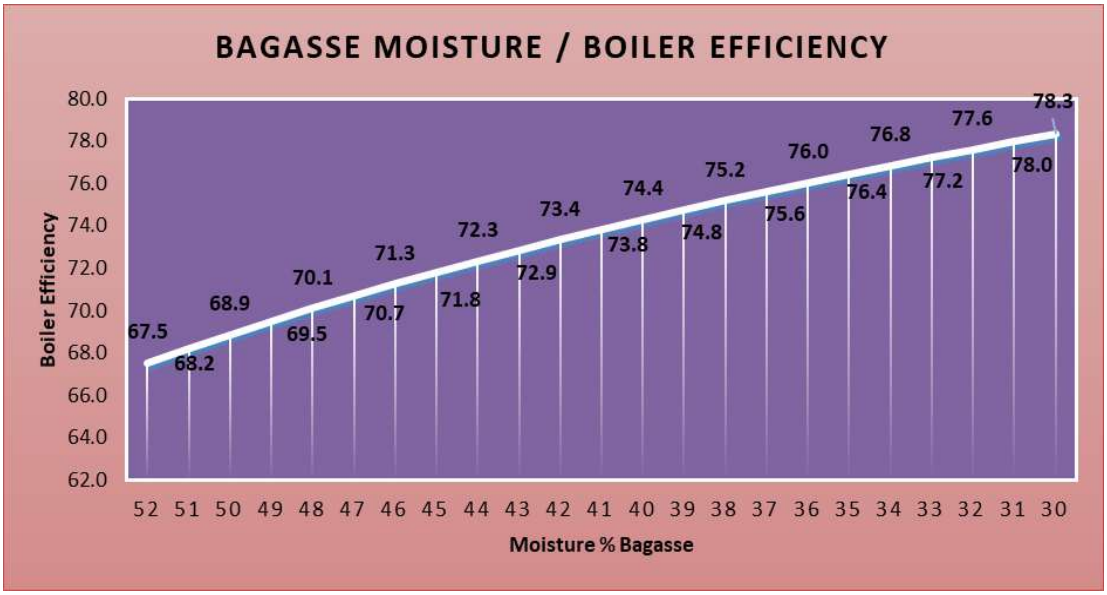


Figure 2. Estimated boiler efficiency (% GCV) per unit drop in bagasse moisture% (D Swain 2017).

The increase in additional power generation and, hence, resultant revenue generation are shown in Table 4. Bagasse drying alone gives additional revenue of US$ 4.74 per tonne of sugar

Table 4. Additional revenue generation through drying bagasse.

Particulars	Unit	Without Bagasse Drying	With Bagasse Drying
Average Cane crushed per day	t/d	5,000	5,000
Season Days		180	180
Total Cane Crushed	t	900,000	900,000
Average Sugar Recovery	% cane	11	11
Sugar Produced	t	99,000	99,000
Bagasse % cane	% cane	31.2	31.2
Bagasse Produced	t	280,800	280,800
Moisture % Bagasse	%	50.32	40.3
Bagasse after drying	t	280,800	233,671
Steam fuel Ratio *	kg/kg	2.4	2.9
Steam Produced	t	673,920	677,645
Specific Steam Consumption of Turbo-Generator	t/MWh	4.91	4.91
Power produced	MWh	137,255	138,013
Power Tariff	INR /MWh	5000.00	5000.00
Revenue from Power	INR	686,272,912	690,066,381
Increase in Revenue	INR		3,793,468
Additional revenue per ton of sugar	INR		38.32

Steam fuel ratio = GCV*η/(H-Hw) where H is Enthalpy of steam and Hw is the enthalpy of feed water at entry to the boiler.

Increased Power Generation by High Pressure and Temperature Rankine Cycle in Power Generation.

This is a 5000 t/d sugar factory producing plantation white sugar using the double sulphitation process. The factory has an integrated cogeneration unit of 30 MW cogenerating power using steam

of 125 bar and 540°C and a 60 kL/d distillery with incineration for obtaining ZLD (Zero Liquid Discharge).

In most of the sugar factories, cogeneration units work at very low cycle efficiency. For 67 bar and 87 bar pressure, the cycle efficiency is as low as 15-18% (considering steam consumption of the process house between 32-35% on cane), whereas it is between 20-25% for 110 bar and 125 bar (considering steam consumption of the process house between 32-35% on cane) (Table 5). Power plants operate at cycle efficiencies as high as 35-45% while working in 100% condensing mode.

Table 5. Expected power generation at different working pressures of boiler(s).

Particulars	Unit							
Boiler Pressure	bar G	67	87	110	125	140	160	225*
Cane crushed per hour	t	1	1	1	1	1	1	1
Bagasse Produced	t	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Steam Produced	t	0.72	0.75	0.78	0.81	0.84	0.87	0.96
Power Producible **	MWh	0.118	0.136	0.160	0.189	0.229	0.263	0.327
PP Efficiency	%	14.87	17.18	20.21	23.84	28.83	33.11	41.13
Exportable Power	MWh	0.084	0.101	0.122	0.148	0.184	0.215	0.272

* Critical pressure power plants.

**The turbine to operate at 45% condensing mode. Power plant efficiency = power produced*3600/(bagasse used * GCV), where GCV is taken as 9523 kJ/kg of bagasse.

Note: Power producible figures up to 125 bar G given are very common in the Indian sugar industry. Using bagasse as a fuel, working pressure and temperature up to 160 bar and 560°C can be achieved effectively, reaching up to 33% cycle efficiency. A factor which needs to be improved for increasing the pressure and temperature is the moisture content of bagasse or addition of coal as supplementary fuel to the extent of 20-25%. Moisture of bagasse is to be brought down to as low as possible using the waste heat going out of chimney. Of course, in high-pressure boilers the exhaust gas temperature is lower, but in such boilers, a compromise can be made by restricting the temperature of the inlet air in the air preheater. Details of cycle efficiency and power generated are given in Table 4.

About 50% of cogeneration plants in India work at 67 bar, 30% at 87 bar, 15% at 110 bar, about 1% at 125 bar, and the rest even at lower pressures of 32-45 bar. Revenue generation of the plant under consideration working at 125 bar steam pressure is given Table 6 and a comparison has been made with that of a 67-bar cogeneration plant. Details against 125 bar are actual for the plant under consideration, whereas 67 bar, 87 bar and 110 bar it is assumed on the basis of actual achievable figures and for 140, 160 and 225 bar, it is calculated theoretically.

Additional revenue generation in the case of 125 bar is estimated to be INR 2883 per ton of sugar and if cogeneration is carried out at 160 bar, it may go even up to INR 4488.

Table 6. Expected power and additional revenue generation at different boiler pressures.

Particulars	Unit							
Boiler Pressure	bar G	67	87	110	125	140	160	225*
Average Rate of Crush	t	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Season days		180	180	180	180	180	180	180
Cane crushed	t	900,000	900,000	900,000	900,000	900,000	900,000	900,000
Sugar Recovery % cane	%	11	11	11	11	11	11	11
Sugar Produced	t	99,000	99,000	99,000	99,000	99,000	99,000	99,000
Bagasse Produced	t	270,000	270,000	270,000	270,000	270,000	270,000	270,000
Steam Produced	t	621,000	648,000	675,000	702,000	729,000	756,000	783,000
Power Generated **	MWh	106,230	122,727	144,444	170,327	205,995	236,556	293,878
PP Efficiency	%	14.87	17.18	20.21	23.84	28.83	33.11	41.13
Exportable Power	MWh	75,807	90,655	110,200	133,494	165,595	193,100	244,690
Power tariff	INR/MWh	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Gross Revenue Generation	INR	379,032,787	453,272,727	551,000,000	667,471,963	827,975,477	965,501,511	1,223,448,980
Size of Power plant	MW	24	28	34	40	48	54	68
Installation Cost	Thousand INR	16,457	20,000	26,714	32,571	41,143	47,829	63,143
Interest @ 10 %	INR	1,645,714	2,000,000	2,671,429	3,257,143	4,114,286	4,782,857	6,314,286
Conversion Cost	INR	2,276,347	2,629,870	3,095,238	3,649,866	4,414,169	5,069,055	6,297,376
Net Revenue	INR	375,110,726	448,642,857	545,233,333	660,564,953	819,447,022	955,649,599	1,210,837,318
Difference in Net Revenue to 67 bar plant	INR				285,454,227	444,336,296	580,538,873	835,726,592
Additional revenue/ Ton sugar	INR				2,883.38	4,488.25	5,864.03	8,441.68

* Critical pressure power plants.
** The turbine operates at 45 % condensing mode

Additional Cogeneration by using slop as fuel

The plant considered in this case is the same plant in Case 3. It has a 60 kL/d distillery and uses an incineration path for achieving Zero Liquid Discharge (ZLD), which is a requirement for the distilleries under the Central Pollution Control Board guidelines. The investment for the incineration boiler is a mandatory requirement not for power generation but for achieving ZLD. The vinasse produced from the distillery at 9 L/L of alcohol is concentrated to a solid content of 60% (known as slop) and then used as fuel in a special type of slop-fired boiler. The gross calorific value of this slop at 60% solid is estimated to be 6823 kJ/kg. In the case of bio-composting, the compost produced has negligible value and the distillery is permitted to operate for 270 days only, whereas in case of

incineration, the plant is allowed to operate all year. The steam generated in the boiler not only meets the requirement of the distillery for distillation, dehydration, vinasse concentration and other miscellaneous use, but produces additional power to be exported to the grid. Hence, the total power generated by using slop is additional revenue for the sugar complex as otherwise, this power would come from the cogeneration plant of the sugar plant.

Additional power and revenue generated by cogeneration of power using slop are shown in Table 7. Power from slop may give additional revenue of US$1.30 per tonne of sugar produced.

Table 7. Power and additional revenue generation using slop.

Parameter	Unit	Value
Molasses production at 4.5% on cane	t	40,340
Ethanol production	kL	9,480
Slop production	t	23,537
Power production	MWh	4,237
Power tariff	INR/MWh	5000
Additional revenue	INR	21182897
Additional revenue/t sugar	INR	213.97

Power Saving at Cane Preparation:

About 6.5 kWh/tch power is consumed for cane preparation. The motors used are all / mostly slip-ring induction motors, LT motors and inefficient motors. These motors use external resistance for soft starting of the motors and to take care of the slip. If these motors are replaced by HT Induction motors with variable frequency drive, there will be a saving of about 10% of the total power consumption at the preparatory devices. Details of total power saved per season and the additional revenue generation is given in table no-8 below.

Table-8 Power and additional revenue generation due the ACVFD at Preparatory Devices.

Sl No	Particulars	Unit	Amount/ Quantity
1	TCD	t/day	5000
2	tch	t/h	208.33
3	Power consumption at preparatory devices	kWh/t	6
4	Power consumed per hour	kWh	1250.00
5	Saving %	%	10
6	Power saved per hour	kWh	125
7	Power saved per day	kWh	3000
8	No of days of working	day	180
9	Power saved per season	kWh	540000
10	Power tariff	INR/kWh	5
11	Additional amount generated	INR	2700000
12	Additional amount per ton sugar at 11 recovery	INR/t	27.27

It is seen from table that there is a saving of almost 5.4 lakh units of power and 27 lakh of rupees per season or INR 3 per tch.

Power Saving at Mills

At mills, the total power consumed by all the mills in the tandem is to the tune of 7.5 to 8.5 kWh/tch. The motors used are mostly 6 pulse LT motors with VV&VFD/VFD. It is seen by installation of 12 pulse AC VFD HT motors in place of 6 pulse AC VFD LT motors, there is a power saving to the tune of 5 % of the total power consumption at the mills. Details of total power saved per season and the additional revenue generation is given in table no-9 below.

Table-9 Power and additional revenue generation due the replacement of 6 pulse ACVFD by 12 pulse ACVFD.

Particulars	Unit	Amount/ Quantity
TCD	t/day	5000
tch	t/h	208.33
Power consumption at Mills	kWh/t	8
Power consumed per hour	kWh	1666.67
Saving %	%	5
Power saved per hour	kWh	83.33333
Power saved per day	kWh	2000
No of days of working	day	180
Power saved per season	kWh	360000
Power tariff	INR/kWh	5
Additional amount generated	INR	1800000
Additional amount per ton sugar at 11 recovery	INR/t	18.18

It is seen from table that there is a saving of almost 3.6 lakh units of power and 18 lakh of rupees per season or INR 18.18 per ton of sugar
Power Saving at Cooling and Condensing Station.

It is observed that the power consumption at cooling and condensing section is about 3.5-4 kWh/tch. Though the multi-jet condensers are replaced by single entry condensers, there is no control system for water consumption and also for header pressure. There is no VFD used with the injection pump motors, cooling tower fans, cooling tower pumps. This equipment run at full rpm throughout the season. On installation of HT AC VFD motors with these equipment brings down the power consumption to between 1.5 to 2 kWh/tch.

Details of total power saved per season and the additional revenue generation is given in table no-10 below.

Table-10 Power and additional revenue generation due the ACVFD at Preparatory Devices.

Particulars	Unit	Amount/ Quantity
TCD	t/day	5000
tch	t/h	208.33
Power consumption at Cooling & Condensing St	kWh/t	3.75
Power consumed per hour	kWh	781.25
Saving %	%	50
Power saved per hour	kWh	390.625
Power saved per day	kWh	9375
No of days of working	day	180
Power saved per season	kWh	1687500
Power tariff	INR/kWh	5
Additional amount generated	INR	8437500
Additional amount per ton sugar at 11 recovery	INR/t	85.23

Total additional revenue

Summing the additional revenue generated from all the above cases, the net additional revenue generation per ton of sugar is INR 4279.86. Hence, proper use of SAR, improving efficiency of power generation and the use of vinasse incineration may support a sugar complex to the tune of INR 4300 per ton of sugar produced or about INR 400 per ton of cane crushed.

DISCUSSION

There is 80:20 ratio of gross revenue (sugar: other source) generation when there is no additional source of revenue (Figure 3) and sugar, power and alcohol are produced in conventional method. With the addition of revenues from SAR, high-pressure cogenertion, bagasse drying and vinasse, the gross revenue generation becomes 73:27, improving the sustainability of the plant even in adverse conditions of sugar prices and sugar recovery as shown in Figure 4.

When alcohol is produced by diverting intermediate products such as B-heavy molasses, for a given situation sugar production decreases by about 15.7% and alcohol production increases by about 96%. This further improves the revenue generation to almost 63:37 (sugar: other sources) and improves the sustainability of the plant (Figure 5).

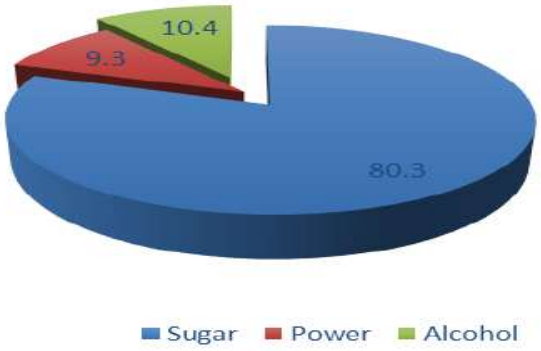


Figure 3. Revenue-sharing by-products and coproducts only.

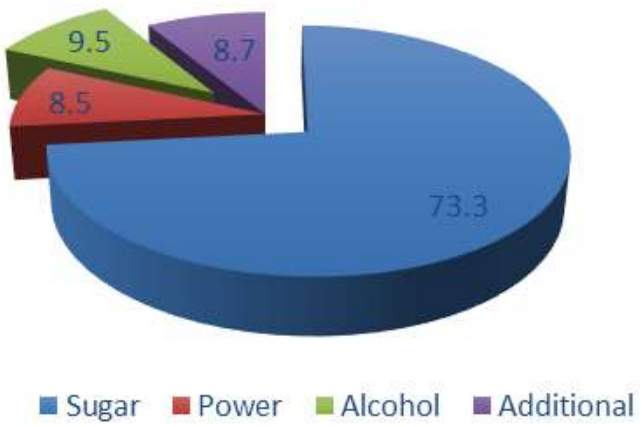


Figure 4. Revenue-sharing by products, coproducts and additional source.

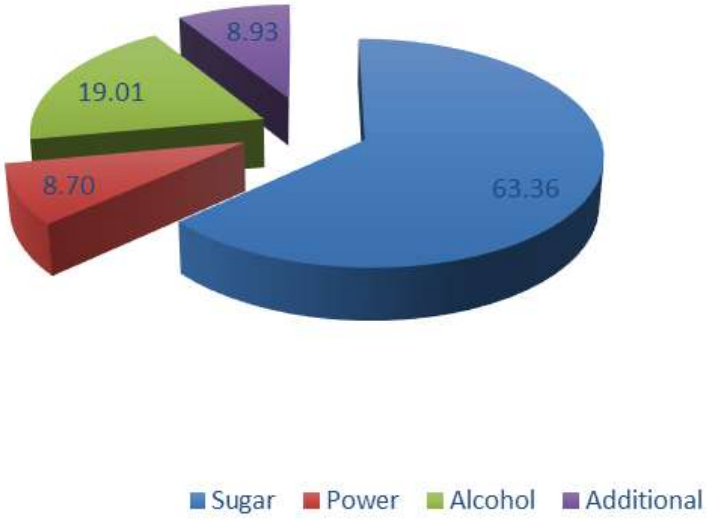


Figure 5. Revenue-sharing by-products, coproducts and additional source and B-heavy diversion

CONCLUSIONS:

1. Additional Power generation may lead to the sustainability of a sugar mill.
2. Proper use of biomass and improved efficiency in power generation and saving of energy increases the revenue generation of the plant by almost INR 400 /t of sugarcane crushed.
3. Sustainability of a sugar unit can be assured by improving the revenue generation through products and coproducts at 63:37.

****

ABSTRACTS:

Effect of surface residue and potassium sources on potassium availability in two contrasting soils in South Africa by R. Van Antwerpen, N. Miles & JH Meyer published in International Sugar Journal in January, 2021.

Condensed molasses stillage (CMS) is an inexpensive source of potassium (K) that is recycled back to sugarcane fields. Little information on CMS use as a fertiliser is available in the literature. The objective of this paper was to compare CMS as a source of K with conventional inorganic fertiliser. Consideration is also given to the efficacy of CMS when applied on residues left in the field after harvest. Trials were established on two contrasting soils, a pedorhodic (pH CaCl2 4.26, clay 46.6% and organic matter 5.4%) and glossic (pH CaCl2 4.29, clay 15.6% and organic matter 1.5%).

Energy cane bagasse as a source of prebiotics by Giovanna M. Aita**,** Young Hwan Moon**,** Chardcie Verret & Tyrenee Foster published in International Sugar Journal in January, 2021**.**

Prebiotics can be grouped into established prebiotics (inulin, fructooligosaccharides, galactooligosaccharides, lactulose, polydextrose) or emerging prebiotics (isomaltooligosaccharides, xylooligosaccharides (XOS), lactitol). XOS are non-toxic, stable at acidic pH, heat resistant, and can achieve positive biological effects at low daily doses and low caloric content, properties that are the same or more desirable than the already established prebiotics. XOS are present in plants in very low amounts so there is a great opportunity to isolate XOS with varying degrees of polymerization from the hemicellulose (xylan) fraction of lignocellulosic materials (e.g., bagasse), a source that offers both economic and environmental advantages.

Influences of incondensable gas on Robert evaporator condensates by Bryan Lavarack**,** Brett Bampton & Belinda Clews published in International Sugar Journal in January, 2021**.**

With the development of cogeneration at Racecourse Mill and other Australian mills, more evaporation is being undertaken in the front end of the evaporator stage to achieve better steam economies. Longer residence times for juice at higher temperatures at the front of the evaporator set comprising Robert type evaporator vessels leads to increased rates of sucrose degradation and to increased corrosion rates of calandria, condensate pipework and condensate pumps. The higher corrosion rates require premature replacement of these items and associated increases in production costs. In addition, lower revenues result from increased sucrose degradation.

Differential response of Sugarcane (Saccharum species hybrid) genotypes to varied concentrations of NAA and sucrose for rapid in vitro root induction by Meniari Taku, Suresh Yadav, T.E. Nagaraja, H.C. Lohithaswa & K.V. Shivakumar published in International Sugar Journal in January, 2021.

An experiment was carried out to elicit the effect of different combinations of 2-naphthaleneacetic acid (NAA) and sucrose on in vitro root induction in the sugarcane genotypes, viz CoVC 09-61-02, CoVC 07-06-05, CoVC 09-61-07, CoC-671 and CoVC 10-38-07. Among different combinations of NAA and

sucrose used, medium containing 2.5 mg/l NAA + 30 g/l sucrose was the best for inducing rooting in genotypes CoVC 09-61-02 and CoVC 07-06-05. For genotypes CoVC 09-61-07 and CoVC 10-38-07, the medium supplemented with 4.5 mg/l NAA + 25 g/l sucrose was found to be the best for rooting.

Relative contribution of genetic and environmental effects on non-sugar compounds of cane juice by S Ostengo**,** MI Cuenya**,** S. Zossi & M Balzarini published in International Sugar Journal in January, 2021**.**

The juice of the sugar cane is composed of sugars, water and insoluble substances referred to as non-sugar compounds. Both sugar and non-sugar compounds are important in the factory because they are responsible for adverse effects on the quality and recovery of sucrose. Increases in the ash and starch contents may affect sucrose recovery and crystallization.

Does root tip breakage caused by the harvester sufficiently predict sugar losses during beet storage? by Heinz-Josef Koch published in International Sugar Journal in February, 2021**.**

In Europe, campaign lengths have increased to up to 120 days necessitating a longer sugar beet (Beta vulgaris L.) storage period post-harvest. Sugar beet harvest is performed by 6-row self-propelled harvesters. Depending on the harvester setting (cleaning turbine rotational speed, harvester driving speed), harvest can cause considerable injuries to the beet taproot, thereby causing mass and sugar losses during storage. The proportion of the cleaning unit, when adjusted to an efficient reduction of soil tare, on injuries in relation to damages exerted by other harvester sections has not yet been quantified.

The assessment of quantitative and qualitative yield related traits in some Iranian and foreign sugar beet cultivars under natural rhizomania infection conditions by Esmail Nabizadeh & Heydar Azizi published in International Sugar Journal in February, 2021**.**

Field trials conducted in 2014 and 2015 at the Miandoab Agricultural and Natural Resources Research station, Iran, evaluated the relative resistance of 16 sugar beet cultivars to Rhizomania. Eleven important agro-physiological traits were assessed, including root yield, sugar yield, white sugar yield, α-amino nitrogen, alkalinity coefficient, and white sugar content. The cultivar F-20928 and Sharif (the sensitive check) produced the highest and lowest beet yields of 89.68 and 43.69 t/ha, respectively. Simple correlation analysis showed that the maximum negative and positive significant ($p \leq 0.01$) correlations were observed between root yield trait and sugar content (-0.61**) and sugar yield (0.90**).

Improving bagasse-furnace combustion and modeling by F Plaza & AP Mann published in International Sugar Journal in February, 2021.

The control of bagasse combustion in the furnace is an important part of boiler operations for sugarcane factories. High bagasse moistures and/or high boiler steam loads can lead to furnace combustion issues. Significant effort has been carried out, for example, in improving boiler operating procedures and equipment interlocks to minimize the probability of such

occurrences. This paper has considered options and designs to reduce the likelihood of bagasse deposition on furnace grates and resultant furnace instability. The literature described a modified conventional spreader design that resulted in improved combustion.

Syndrome Basses Richesses (SBR) in sugar beet – An upcoming threat to sugar production in Europe by Louise Holmquist published in International Sugar Journal in February, 2021.

The planthopper *Pentastiridius leporinus* is the main vector of *Candidatus* Arsenophonus phytopathogenicus, a plant pathogenic bacterium associated with the sugar beet disease syndrome 'basses richesses' (SBR). The disease first identified in eastern France in1991 has continued to spread in other parts of Europe. SBR causes devastating yield losses. The main disease control strategy currently is through growing tolerant cultivars.

Implications of crystal-size distributions in product massecuites from horizontal and vertical continuous pans by R Broadfoot & I Ashtiani Abdi published in International Sugar Journal in March, 2021**.**

The crystal-size distribution of product massecuites from continuous pans has always been of major interest to designers of these pans. As several overseas cane factories seek to operate continuous pans with lower pressure vapour, e.g. vapour 3 or vapour 4 from the evaporators, and also to use seed with smaller crystal size in order to increase the extent of crystallisation conducted in continuous pans, a closer examination of the factors affecting the crystal size distributions of product massecuites is warranted. Both these changes tend to produce a broader spread of crystal sizes.

Economic evaluation of sugarcane harvesting best practice (HBP) by M Thompson**,** B Nothard**,** P Patane**,** G Landers **&** CA Norris published in International Sugar Journal in March, 2021**.**

Mechanical sugarcane harvesting is commonly undertaken at ground speeds that exceed the cleaning capacity of modern harvesters, which is likely to increase extraneous matter (EM) levels in the cane supply. To attempt to reduce the higher EM levels, operators typically increase extractor fan speeds above recommendations, resulting in unintended cane loss. Past research indicates that using harvesting best practice (HBP) settings can minimise cane loss and stool damage. These benefits would increase grower revenue and be an incentive for growers to request harvesting contractors operate using HBP settings.

Ethanol Production with Multi feed Stock(Cane Juice Syrup, B Heavy and C Heavy Molasses) - Economic and financial viability in the Sugar complex by CA.K.Marimuthu published in Indian Sugar Journal in March 2021.

Energy crisis is a growing global concern because of the dependence on petroleumbased fossil fuel, which is exhausted very fast to meet the continuously increasing demands. Besides, fossil energy also has the direct impact on the atmosphere. It has been realized that fossil energy causes greenhouse gas emissions that have adverse effects on the environment. Petroleum-based fuels causes the increase of CO level in the environment, which is directly responsible for global

warming. It is an ongoing interest to find out a renewable and environmentally friendly source of energy for the industrial economies. Bioethanol in this aspect is an attractive option for renewable and sustainable energy source.

Measurement and Analysis of Total Factor Productivity Growth in Sugarcane Crops in Western Maharashtra by Swati Choudhari, D.B.Yadav and A. J. Amale published in Indian Sugar Journal in February 2021.

Total factor productivity (TFP) index can be used as one measure of the effect of the technological change. TFP index that measures the growth in the net output that is not accounted for by the growth of basic factors inputs such as land, labour, and capital, but the technological change is embodied in them is superior to the partial approach, as it is a composite measure of productivity, which relates outputs to all input simultaneously. TFP, sometimes referred to as multifactor productivity, is a true measure of economic efficiency.

Editor

Dr. Ashutosh Bajpai
Professor Sugar Technology
For & on behalf of:
NATIONAL SUGAR INSTITUTE
Ministry of Consumer Affairs,
Food & Public Distribution
Department of Food
& Public Distribution
Kalyanpur,
Kanpur – 208017
Uttar Pradesh (India)

Visit us at http//:nsi.gov.in
Contact:
nsikanpur@nic.in, director.nsi@gov.in
Telephone
+91-512-2570730 Fax: +91-512-2570247