IAA Journal of Scientific Research 12(1):22-30, 2025.
©IAAJOURNALS
https://doi.org/10.59298/IAAJSR/2025/2230.19
www.iaajournals.org
ISSN: 2636-7319
IAAJSR:223019

Investigation of Sugar Retention in Sugarcane Bagasse and Optimization Using Modified Single Pass-Imbibition (MSP-I)

Ssemaganda Muhammadi and Ampaire Wycliffe

School of Natural and Applied Sciences, Kampala International University, Uganda

ABSTRACT

After the first extraction operation, a sizable amount of residual sugar was found in the bagasse, according to my investigation at Lugazi Sugar Corporation. To meet the industry's demand for effective and affordable extraction techniques, this study examined the potential of Modified Single-Pass Imbibition (MSP-I) to improve sugar recovery from sugarcane bagasse. The objective was to maximize sugar extraction while minimizing water usage and evaporation expenses, enhancing process sustainability. The specific goals were to compare MSP-I with conventional single-pass imbibition, analyze the impact of MSP-I on production costs, and determine how well MSP-I improves sugar recovery. Polarimetry, an experimental method that yields precise measurements of sugar content, was used to accomplish these goals. A pilot-scale setup was used in the study to compare MSP-I with conventional single-pass imbibition. The sugar recovery showed a considerable improvement, with an average rise of 29.29% and the same volume of water consumption, according to the results. Moreover, the MSP-I method maintains the evaporation expenses demonstrating significant energy savings. Remarkably, the altered imbibition method showed decreased bagasse moisture content and better juice quality. These results imply that MSP-I is a workable and affordable way to improve sugar recovery from bagasse from sugarcane. The findings are noteworthy because they show how MSP-I can boost productivity, lessen its negative effects on the environment, and boost profitability in the sugar industry. I propose employing MSP-I in sugarcane processing plants, particularly those wanting to enhance sugar extraction while minimizing water and energy use.

Keywords: Modified Single-Pass Imbibition (MSP-I); Sugar recovery; Bagasse; Sustainability; Polarimetry

INTRODUCTION

The sugar industry is one of the largest agro-based industries in Uganda and plays an important role in the country's development. Nowadays there are several projects undertaken in Uganda to expand the existing and install new sugar factories for the country's sugar consumption as well as build a competitive sugar industry in the top ten sugar-producing countries around the world [1]. The amount of sugar extracted from sugar cane and the quality of the juice produced is influenced by the quality of sugarcane delivered at the mill. The efficiency of sucrose extraction from cane is largely affected by the percentage of cane fibre content[2]. As fibre naturally retains some sucrose, the higher the cane fibre content, the more sucrose is lost in the bagasse. On the other hand, the efficiency of sucrose extracted from the juice is determined by the purity of the juice [3].

A sugarcane plant is made up of juice and fibre. The juice includes a sucrose solution and other soluble inorganic and organic substances, whilst fibre constitutes all the insoluble sub-stances in the cane [1]. Juice extracted from the cane is sent for further processing whilst the fibre (now termed bagasse) is used for electricity generation in the boiler house. The quality and chemical composition of sugarcane juice varies depending on the age of sugar cane, the growing conditions, the harvesting time as well as the cane cultivar grown by the farmer [4]. The amount of sugar extracted from sugar cane and the quality of the juice produced is influenced by the quality of sugarcane delivered at the mill. The efficiency of sucrose extraction from cane is largely affected by the percentage of cane fibre content [5]. As fibre naturally retains some sucrose, the higher the cane fibre content, the more the sucrose that is lost in the bagasse. On the other hand, the efficiency of sucrose extracted from the juice is determined by the purity of the juice [6].

Efficient sugar extraction is crucial for the profitability and sustainability of sugar production [7]. This initial stage's effectiveness directly impacts the final product's overall yield and quality [8]. Maximizing sugar recovery from raw materials, such as sugarcane or sugar beets, ensures that the greatest possible amount of sugar is obtained from each batch, which is vital for maintaining economic viability [8]. Inefficiencies in extraction can lead to significant losses, both in terms of sugar content and financial returns. Moreover, efficient extraction reduces waste and the environmental footprint of the milling operation by ensuring that fewer resources are used and less by-product is generated. This not only helps in minimizing operational costs but also aligns with sustainability goals by reducing the amount of raw material needed and enhancing the use of by-products like bagasse and molasses [8]. In an industry where margins can be tight and competition fierce, the ability to extract sugar efficiently is a key factor in achieving a competitive edge and ensuring long-term success

Sugar in Uganda serves for direct household consumption and as an intermediate input for other industries like pastries, bottling companies, and breweries. The per capita consumption in Uganda is one of the lowest in the world[1]. The current level of per capita consumption is estimated to be about 3.6 kg, which is even below the world average minimum of 5 to 6 kg. The Ugandan consumption of sugar was forecasted for the coming 10 years, taking into account the current Ugandan population of 108 million in 2019, a population growth rate per annum of 2.53 %, and an annual average economic growth rate of 13.09%. It is assumed that the per capita sugar consumption could increase at the rate of the economic growth of the nation[3].

Sugar Corporation of Uganda Limited SCOUL is a sugar manufacturer owned by the Mehta family and established in the year 1924 by the Late Nanji Khalidas Mehta. It exists as the oldest sugar manufacturing company in Uganda. The sugar factory together with the distillery is located in Lugazi town, Buikwe District 45km from Kampala along the Kampala - Jinja highway[9]. The business was incorporated in 1934 as a limited liability company to produce sugar for both local and international markets and this sugar is manufactured from locally grown sugarcane supplied by the company plantations and outgrowers. In 1972, the owners left the company due to political instabilities, and the assets of the Uganda Sugar Factory were expropriated by the then Government of Uganda. In 1980, the existing government invited the Mehta family and handed them back their assets under the joint venture agreement, which vested all the assets in a new company known as Sugar Corporation of Uganda Limited [9].

Strategic plans like growing, purchasing, and use of high-quality sugarcane and types of equipment, employing and maintenance of skilled labor to minimize costs while maximizing efficiency, and a good working environment are put in place to achieve the company's objectives [9]. The sugar extraction from sugarcane involves a series of mechanical and chemical processes aimed at maximizing the recovery of sucrose while minimizing waste. The process begins with sugarcane harvesting, after which the cane is transported to the mill for washing and chopping [10]. The chopped cane undergoes crushing, where heavy rollers are used to extract the juice. During this stage, imbibition is often applied, which involves spraying water or diluted juice over the crushed cane fibres to wash out the residual sugar, thus improving extraction efficiency [8]. Imbibition, particularly double imbibition, has been widely adopted to enhance the recovery of sugar from bagasse[8].

Once the juice is extracted, it undergoes clarification to remove impurities like dirt, fibres, and organic matter. According to [11], the addition of lime (calcium hydroxide) is crucial in neutralizing the juice's acidity and aiding in the coagulation of impurities. The clarified juice is then concentrated by evaporation, where water is removed to form a thick syrup with a high sugar content [12]. The evaporation process is typically conducted using multi-effect evaporators to conserve energy while achieving the necessary concentration [12].

Apart from sugar, the procedure yields valuable by-products such as molasses, which is frequently utilized in the manufacturing of ethanol, and bagasse, which can be utilized as a biofuel to power the mill [13]. The importance of efficient sugar extraction is highlighted in the works of [2] and [14], both of whom underscore the role of imbibition in maximizing sugar recovery. Recent studies have also pointed out the sustainability aspects of sugar production, with the use of bagasse as an energy source helping to reduce the carbon footprint of sugar mills [3]. This method enhances sugar extraction efficiency and reduces sugar loss in the bagasse, the fibrous material left after the cane is crushed. The primary objective of imbibition is to ensure that as much sugar as possible is recovered from the cane fibres before they are discarded or repurposed [15]. During the milling process, the crushed cane is passed through a series of mills or rollers, and as the cane progresses, it becomes increasingly dry [3]. At this point, water or diluted juice is introduced into the cane to dissolve the remaining sugar trapped in the fibres. This wash water extracts additional sucrose from the bagasse, which would otherwise remain locked in the fibres. The process is often repeated in multiple stages to maximize recovery, with double imbibition being a common technique that uses two stages of water or juice addition [16].

It is experienced that there is no significant difference or effect up to imbibition temperatures of 60°C to 70°C [14]. However, beyond this, there is a fairly marked positive difference in extraction; the gain in extraction may be up to 0.4%. It is believed that the high temperature of the imbibition tends to destroy the tissues of the cell walls of the bagasse fibres on account of the heat. The material of the cell walls, which is impermeable, gets softened and water, thus getting direct access to the juice

contained in the bagasse fibre cells, resulting in higher extraction efficiency besides dissolution of the juice [17]. However, it is to be noted that the cane carries on its rind a certain quantity of wax, which is found at the “wax ring” below the node. Some varieties of the cane may be richer in wax contents than others. This wax, upon melting, may cause assistance for slippages in the Mills.
The quantity of water introduced to bagasse would facilitate rather than hinder the extraction of juice by the following mill. Experience shows that the moisture of the final bagasse increases slightly with the quantity of imbibition [18]. In Australia, a case has been found where the moisture increased from 47.4 to 50 % when imbibition per unit fibre was increased from 200 to 285 % [19]. It is suggested that the last mill does not succeed in removing completely from the bagasse all the excess water, which has been added to it. The higher, the imbibition water, the higher is extraction obtained. However, the gain of extraction is beyond a certain limit of imbibition and is less marked. Small quantities of imbibition do not completely saturate the bagasse [20]. A very high quantity of imbibition makes the bagasse very wet as it approaches the following mill, and difficulty is experienced in feeding. There is also an argument that the higher temperatures of imbibition may compensate for this effect by influencing a slight reduction of bagasse moisture on account of possible evaporation [12]. Thus, these are a practical limit to the quantity of imbibition water to be used. Additional fuel is to be purchased for additional imbibition water added, to evaporate it. The value of sugar recovered is to be balanced against the cost of fuel involved. However, in modern factories, very rarely the evaporation capacities limit the quantity of imbibition. Most often, it is choking at the mills that govern the imbibition and the practical limit is reached below optimal quantity [21].
Sugar extraction from sugarcane involves several challenges that can reduce the overall efficiency of the process, particularly related to incomplete sugar recovery and the retention of sugar in bagasse. One of the most significant challenges is ensuring that the maximum amount of sucrose is extracted from the cane during milling [22]. During the milling process, not all sugar in the cane is successfully extracted. The crushing process typically involves multiple mills, each designed to squeeze out as much juice as possible from the cane. However, some sucrose inevitably remains in the fibres. According to [23], even with optimal milling, mechanical limitations can result in losing 2-4% of the total sugar content in the bagasse. This incomplete recovery occurs because the physical extraction of juice from fibrous materials is inherently inefficient, especially as the fibres become compressed and drier after each stage of milling [24]. One of the primary factors that contribute to incomplete recovery is the lack of uniformity in cane quality. Cane that has not been properly matured or that has been damaged during harvesting may not release as much sugar during the extraction process [25]. Additionally, factors such as milling efficiency, roller speed, and pressure all influence how much sugar is recovered at each stage of the extraction process [16].
Bagasse, the fibrous residue remaining after sugarcane juice is extracted, plays a crucial role in this challenge. Although bagasse is often repurposed as fuel in sugar mills, it also retains some of the sugar, which represents a direct loss in production efficiency. [26], The presence of residual sugar in the bagasse is a major concern for sugar mills because this sugar cannot be easily recovered without additional treatment. Several studies have shown that the amount of sucrose retained in bagasse can be reduced through the use of processes like imbibition, which involves washing the fibres with water to extract more sugar [27].

METHODOLOGY

Materials

Polari meter, Beaker, Rod, Conical flask, Analytical balance, Tin, Rapi-pol extractor, Lead sub-acetate

Sampling

The representative samples of this research project were obtained from the last mill as the bagasse was heading to the co-generation side for the production of electricity[10]. These samples were collected for seven days, two times a day that is in the morning and the afternoon in intervals of 5 minutes. The samples were mixed very well and uniformly to obtain accurate results[15].

Preparation of the sample for the pol determination

300g of the representative sample was weighed and 3 liters of water were added to form a mixture. The sample was tightly closed and put in a machine to allow water to mix properly with the bagasse fibres[21]. This mixture was stirred thoroughly to ensure even contact between the water and the bagasse, allowing for maximum dilution of the sugar using the rapi- pol extractor. After this, the solution was subjected to an analytical procedure for pol determination. The resultant juice was separated from the fibre[15].

Analytical procedure for pol determination.

150ml of the already dissolved sugar samples were measured into a clear, dry beaker. A spatula end-full of dry lead sub-acetate was added to the beaker containing the sample to ease the clarification process. The mixture was stirred vigorously using a rod and was allowed to stand for I minute[4]. The mixture was filtered and the first 10ml of the filtrate was discarded as it helped in rinsing the filter and the conical flask[14]. The clear filtrate was then half-filled in a 200mm pol-tube shaken lengthwise 2-3 times and then emptied for rinsing[28]. The pol-tube was then filled above the bulge with the sample solution and the tube was tilted slowly back and forth to ensure complete bubble escape to have a stable polarimeter reading. The polarimeter was set to zero using a stabilizer tube and then after which the sample solution in the pol-tube was placed in the polarimeter. The instrument was given some time while processing and the extract polarimeter reading to be taken was indicated by a tick on the polarimeter screen[15].

Actual pol = brix factor of a sample (table 2 in the laboratory) x polarimeter reading of the sample.

Pol% bagasse = pol reading x 2 x moisture factor.

Pol% bagasse is supposed to be read in 400mm tube hence the multiplication factor 2 is applied when a 200mm tube is used.

RESULTS

Table 1: showing values of sugar/sucrose for single-pass imbibition

Days	**Time**	**Single pass imbibition**			
		1st sample reading	2nd sample reading	3rd sample reading	Average reading
1	Morning	1.85	1.83	1.84	1.84
1	Afternoon	1.96	1.98	1.97	1.97
2	Morning	1.88	1.85	1.89	1.87
2	Afternoon	1.91	1.95	1.93	1.93
3	Morning	1.79	1.78	1.76	1.78
3	Afternoon	1.84	1.80	1.82	1.82
4	Morning	2.10	2.00	2.20	2.10
4	Afternoon	1.98	1.96	1.97	1.97
5	Morning	2.16	2.12	2.14	2.14
5	Afternoon	2.07	2.06	2.07	2.07
6	Morning	1.88	1.89	1.87	1.88
6	Afternoon	1.97	1.96	1.95	1.96
7	Morning	2.20	2.20	2.20	2.20
7	Afternoon	2.15	2.19	2.17	2.17

Average reading = 1.98 units; Maximum reading = 2.20 units; Minimum reading = 1.78 units

Table 2: showing values of sucrose/pol for modified single-pass imbibition

Modified single-pass imbibition					
Days	Time	1st sample reading	2nd sample reading	3rd sample reading	Average reading
1	Morning	1.41	1.42	1.40	1.41
1	Afternoon	1.43	1.41	1.42	1.42
2	Morning	1.39	1.38	1.36	1.38
2	Afternoon	1.38	1.39	1.37	1.38
3	Morning	1.31	1.30	1.29	1.30
3	Afternoon	1.40	1.40	1.41	1.40
4	Morning	1.45	1.44	1.43	1.44
4	Afternoon	1.42	1.40	1.44	1.42
5	Morning	1.41	1.41	1.40	1.41
5	Afternoon	1.38	1.37	1.36	1.37
6	Morning	1.32	1.30	1.31	1.31
6	Afternoon	1.37	1.34	1.35	1.35
7	Morning	1.46	1.47	1.45	1.46
7	Afternoon	1.43	1.41	1.42	1.42

Average reading = 1.40 units; Maximum reading = 1.46 units; Minimum reading = 1.31 units

Table 3: Summary table

Method	**Maximum reading**	**Minimum reading**	**Average reading**
Single-pass	2.20	1.79	1.98
Modified single-pass imbibition	1.46	1.31	1.40

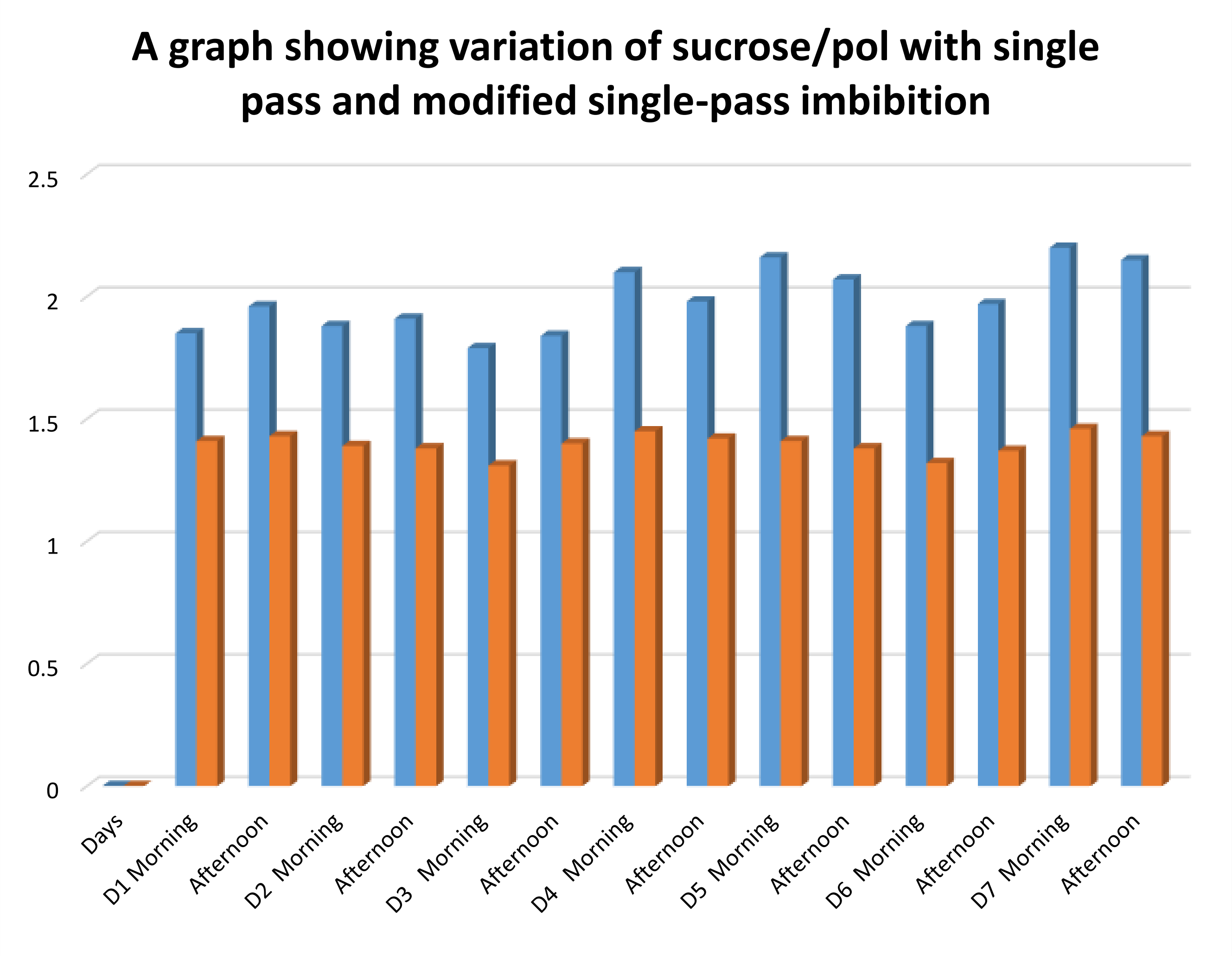

Figure 1: A graph showing variation of sucrose/pol with single pass and modified single-pass imbibition

DISCUSSION

Reduction in Sugar Retention

The difference in polarimeter readings between the two processes highlights the reduction in sugar losses: The average reading for **modified single-pass imbibition** is **1.40**, compared to **1.98** for the single pass. This represents a decrease of **0.58 units** on the polarimeter scale, showing that modified single-pass imbibition is much more effective at reducing the sugar content in the bagasse. To quantify this in terms of **percentage reduction** in sugar retention.

$$\text{Percentage reduction} = \frac{\text{single pass reading} - \text{modified single-pass imbibition reading}}{\text{Single pass reading}} \times 100\%$$

$$\text{Percentage reduction} = \frac{1.98 - 1.40}{1.98} \times 100\%$$

$$= 29.29\%$$

Therefore, modified single-pass imbibition can reduce sugar retention in the bagasse by approximately 29.29% compared to the single-pass process.

The findings from the polarimeter readings clearly show that **modified single-pass imbibition** results in significantly reduced sugar retention in the sugarcane bagasse compared to the single single-passes. To fully understand these results, it is essential to connect them to the underlying theory of double imbibition and how it improves sugar extraction efficiency. The differences between the two processes, the single pass imbibition (used by the company) and the double imbibition (my proposed solution), the key focus was on how the polarimeter readings reflect sugar retention in the bagasse and how switching to double imbibition can help reduce sugar losses.

Single-Pass Imbibition is the current method used by the company, where water is added to the sugarcane bagasse to extract the remaining sugar. However, this process results in a higher amount of sugar being left in the bagasse, leading to significant sugar losses. Double Imbibition: In my proposed method, a second pass of water (or a mixture of water and juice from previous stages) is applied to the bagasse.

Reduced sugar retention means that the company could recover a significant portion of the sugar that would otherwise be lost with single-pass imbibition. This can directly translate into increased sugar yield from the same amount of sugarcane, enhancing overall production efficiency and profitability. For example, if the company processes 100 tons of sugarcane per day and modified single-pass imbibition reduces sugar loss by 29.29%, this could potentially recover several tons of sugar that would otherwise be discarded with the bagasse. Imbibition is a process where water is added to the sugarcane bagasse to wash out the remaining sugar after the initial extraction. In a single-pass imbibition process, only one round of water or juice is passed through the bagasse, meaning that some residual sugar is left behind. The modified single-pass imbibition method involves more than one pass of the same volume of water used during single-pass imbibition through the bagasse, increasing the overall contact between the water and the remaining sugar.

The difference in maximum and minimum readings also shows that the double imbibition process is more consistent. The range of readings for modified single-pass imbibition is much narrower (from 1.31 to 1.46), while the range for single-pass imbibition is wider (from 1.79 to 2.20). This indicates that modified single-pass imbibition not only extracts more sugar but does so more reliably across different shifts and days.While the results demonstrate the effectiveness of modified single-pass imbibition in reducing sugar losses, several limitations were not addressed in this study. The research focused solely on polarimeter readings, without considering important factors such as **temperature**, **time**, **pressure** and **pH**, which can significantly impact the efficiency of sugar extraction. Temperature variations could affect sugar solubility, while the duration of the imbibition process may influence the completeness of sugar removal. Additionally, the pH of the water used in the process could alter the chemical properties of the sugar, affecting extraction efficiency. Operational aspects, such as increased energy and water consumption, potential machinery wear, and the costs associated with installing equipment for modified single-pass imbibition, were also not analyzed. Further investigation into these parameters is necessary to fully assess the process's long-term feasibility, cost-effectiveness, and potential environmental impacts.

CONCLUSION

By analyzing the data, it's clear that **modified single-pass imbibition** reduces sugar retention by approximately **29.29%**, offering a more efficient alternative to the current single-pass process. This reduction in sugar loss could lead to **increased production yields** and higher profitability for the company. The improved results observed with double imbibition are a direct consequence of these theoretical principles. By increasing the amount of water contact and creating a stronger dilution gradient, double imbibition extracts more sugar from the bagasse, reducing sugar loss and improving overall efficiency. This method leverages well-established concepts of mass transfer, diffusion, and multi-stage washing, making it a scientifically sound and effective approach to optimizing sugar recovery in industrial settings.

This study has demonstrated that modified single-pass imbibition is an effective method for reducing sugar retention in sugarcane bagasse, resulting in a **29.29% reduction** in sugar losses compared to the current single-pass imbibition process. Polarimeter readings collected over seven days consistently show that the proposed method enhances sugar recovery, making it a promising solution for the company. Despite its effectiveness, the study identified certain limitations, including the lack of control over key variables such as temperature, pressure, time, and pH, as well as the need to assess the operational and environmental impacts of double imbibition. Addressing these factors through further investigation and pilot testing will be crucial for optimizing the process and ensuring its successful implementation. In conclusion, adopting modified single-pass imbibition presents a valuable opportunity to improve sugar production efficiency, increase profitability, and minimize sugar losses, making it a viable option for the company's future operations.

Recommendations

Adopting modified single-pass imbibition could provide the company with measurable gains in sugar recovery, as demonstrated by the decrease in polarimeter readings. This method not only recovers more sugar but also standardizes the extraction process, making the plant's performance more predictable and efficient. Although there may be initial costs in modifying the process, the long-term benefits of improved sugar recovery could outweigh these costs significantly.

Optimization of Process Parameters: Further studies should be conducted to optimize key process parameters such as **temperature**, **time**, and **pH**. Controlling these variables may further improve the efficiency of the modified single-pass imbibition process and maximize sugar extraction.

Cost-Benefit Analysis: It is recommended that the company conducts a detailed cost-benefit analysis, considering the potential increase in energy and water consumption, equipment wear, and retrofitting costs. This will help determine the long-term economic viability of implementing modified single-pass imbibition.

Pilot Testing: Before full-scale implementation, pilot testing of modified single-pass imbibition should be carried out under real operational conditions to assess its impact on sugar recovery, energy use, and maintenance requirements. This will provide practical insights into any operational challenges and help fine-tune the process.

Environmental Considerations: An environmental impact assessment should be undertaken to ensure that the increased water usage in modified single-pass imbibition does not lead to excessive waste or negative environmental effects. Water recycling methods could also be explored to mitigate these concerns.

REFERENCES

1. Bocha, M.: Performance Evaluation of Sugar Cane Milling Plant and Optimization of Process Parameters: A Case of Wonji-Shoa Sugar Factory. (2019)
2. Caron, J., Markusen, J.R.: No Title No Title No Title. 1–23 (2016)
3. Olaoye, J.O.: Development of a sugarcane juice extractor for small scale industries. J. Agric. Technol. 7, (2011)
4. Yano, B.B.R., Silva, S.A.M., Almeida, D.H., Aquino, V.B.M., Christoforo, A.L., Rodrigues, E.F.C., Junior, A.N.C., Silva, A.P., Lahr, F.A.R.: Use of sugarcane bagasse and industrial timber residue in particleboard production. BioResources. 15, (2020). https://doi.org/10.15376/biores.15.3.4753-4762
5. Alotaibi, F., Bamagoos, A.A., Ismaeil, F.M., Zhang, W., Abou-Elwafa, S.F.: Application of beet sugar byproducts improves sugar beet biofortification in saline soils and reduces sugar losses in beet sugar processing. Environ. Sci. Pollut. Res. 28, (2021). https://doi.org/10.1007/s11356-021-12935-5
6. Karimova, M., Kashiri, R., Pourafshary, P., Hazlett, R.: A Review of Wettability Alteration by Spontaneous Imbibition Using Low-Salinity Water in Naturally Fractured Reservoirs. Energies. 16, (2023). https://doi.org/10.3390/en16052373
7. Wang, D., Tian, J., Guan, J., Ding, Y., Wang, M.L., Tonnis, B., Liu, J., Huang, Q.: Valorization of sugarcane bagasse for sugar extraction and residue as an adsorbent for pollutant removal. Front. Bioeng. Biotechnol. 10, 893941 (2022). https://doi.org/10.3389/fbioe.2022.893941
8. Rodrigues, T.G., Machado, R.L.: Life Cycle Assessment of the Sugarcane Supply Chain in the Brazilian Midwest Region. Sustainability. 16,285(2024). https://doi.org/10.3390/su16010285
9. Nampewo, C.: Saving Mabira Rainforest: Using Public Interest Litigation in Uganda to Save Mabira and Other Forests. SSRN Electron.J.(2013). https://doi.org/10.2139/ssrn.2202587
10. Sánchez, V.F., Xocua, L.C., López, M.T.C.: Improve the extraction efficiency of a tandem sugarcane mil. Int. J. Adv. Eng. Manag. Sci. 4,357–359(2018). https://doi.org/10.22161/ijaems.4.5.2
11. Juneja, A., Kumar, D., Singh, V.K., Yadvika, Singh, V.: Chemical free two-step hydrothermal pretreatment to improve sugar yields from energy cane. Energies. 13, (2020). https://doi.org/10.3390/en13215805
12. Suripto, MacHfud, Romli, M., Rosidi, A.H.Y.: Risk analysis and mitigation strategy for sugar cane production processes (Case Study: X Sugar Cane Factory - West Java). In: IOP Conference Series: Earth and Environmental Science (2018)
13. Qiu, M., Meng, Y., Chen, J., Chen, Y., Li, Z., Li, J.: Dual multi-objective optimisation of the cane milling process. Comput. Ind. Eng. 179, 109146 (2023). https://doi.org/10.1016/j.cie.2023.109146
14. Luo, J., Guo, S., Wu, Y., Wan, Y.: Separation of Sucrose and Reducing Sugar in Cane Molasses by Nanofiltration. Food Bioprocess Technol. 11, (2018). https://doi.org/10.1007/s11947-018-2062-0
15. Gomaa, R.: Effect of Imbibition Rate on Milling Quality of some Sugar Cane Varieties. J. Food Dairy Sci. 10, (2019). https://doi.org/10.21608/jfds.2019.36188
16. Duan, Q., Mao, H., Huang, Z., Li, X., Mao, H., Tang, W.: Sensitivity of important parameters in a three-dimensional simulation of the milling process of sugar cane with modified Drucker–Prager Cap model based on evolutionary material properties. J. Food Process. Preserv. 43, (2019). https://doi.org/10.1111/jfpp.14176
17. Chantasiriwan, S.: Numerical model of sugar mills with compound Imbibition. 35th Annu. Conf. Aust. Soc. Sugar Cane Technol. 2013 ASSCT 2013. 200–205 (2013)
18. Singh, R.V., Sharma, P., Sambyal, K.: Application of Sugarcane Bagasse in Chemicals and Food Packaging Industry: Potential and Challenges, (2022)
19. Piñón-Muñiz, M.I., Ramos-Sánchez, V.H., Gutiérrez-Méndez, N., Pérez-Vega, S.B., Sacramento-Rivero, J.C., Vargas-Consuelos, C.I., Martinez, F.M., Graeve, O.A., Orozco-Mena, R.E., Quintero-Ramos, A., Sánchez-Madrigal, M.A., Salmerón, I.: Potential use of Sotol bagasse (Dasylirion spp.) as a new biomass source for liquid biofuels production: Comprehensive characterization and ABE fermentation. Renew. Energy. 212, (2023). https://doi.org/10.1016/j.renene.2023.05.055

20. Souza, P.P.L. de, Eires, R., Malheiro, R.: Sugarcane Bagasse as Aggregate in Composites for Building Blocks. Energies. 16,(2023). https://doi.org/10.3390/en16010398
21. Ajala, E.O., Ighalo, J.O., Ajala, M.A., Adeniyi, A.G., Ayanshola, A.M.: Sugarcane bagasse: a biomass sufficiently applied for improving global energy, environment and economic sustainability. Bioresour. Bioprocess. 8, (2021). https://doi.org/10.1186/s40643-021-00440-z
22. Babu, A.S., Adeyeye, S.A.O.: Extraction of sugar from sugar beets and cane sugar. In: Extraction Processes in the Food Industry. pp. 177–196. Elsevier (2024)
23. Sikanna, R., Rajmah, D.N.A., Ramadani, K., Musafira, M., Nur, A., Febryanti, A.: Synthesis and Characterization of Bagasse (Saccharumofficinarum L.) Silica Gel Modified Diphenylcarbazone. Elkawnie. 7, (2021). https://doi.org/10.22373/ekw.v7i1.9239
24. Acharya, S.K., Punya Priya Mishra, Mehar, S.K.: The influence of fiber treatment on the performance of bagasse fiber-reinforced polymer composite. J. Reinf. Plast. Compos. 28,(2009). https://doi.org/10.1177/0731684408094221
25. Li, Y.R., Yang, L.T.: Sugarcane Agriculture and Sugar Industry in China, (2015)
26. Vargas-Ramirez, J.M., Wiesenborn, D.P.: Effect of storage conditions on industrial sugar retention in energy beets. Biofuels Eng.1,(2015). https://doi.org/10.1515/bfuel-2016-0001
27. Tong, R., Wu, C., Zhao, C., Yu, D.: Effect of $CaCO_3$ and/or polyaluminium chloride (PAC) treatment on the main components in prehydrolysis liquor of whangee dissolving pulp. BioResources. 12, (2017). https://doi.org/10.15376/biores.12.4.9476-9486
28. Xue, S., Uppugundla, N., Bowman, M.J., Cavalier, D., Da Costa Sousa, L., Dale, B.E., Balan, V.: Sugar loss and enzyme inhibition due to oligosaccharide accumulation during high solids-loading enzymatic hydrolysis. Biotechnol. Biofuels. 8, (2015). https://doi.org/10.1186/s13068-015-0378-9

CITE AS: Ssemaganda Muhammadi and Ampaire Wycliffe (2025). Investigation of Sugar Retention in Sugarcane Bagasse and Optimization Using Modified Single Pass-Imbibition (MSP-I). IAA Journal of Scientific Research 12(1):22-30. https://doi.org/10.59298/IAAJSR/2025/2230.19