

**ESTIMATION OF QUALITY OF MELT USING ION
EXCHANGE RESIN METHOD**

*Capstone Project-II Report submitted in
partial fulfillment for the award of the
degree of*

BACHELOR OF TECHNOLOGY

Submitted by

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IN

DEPARTMENT OF MECHANICAL & CHEMICAL ENGINEERING

Under the Supervision of

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**DEPARTMENT OF MECHANICAL & CHEMICAL
ENGINEERING**

CERTIFICATE

It is certified that this project report “ **Estimation of Quality of Melt Using Ion Exchange Resin Method** ” is the bonafide work of “ **Rajan Devkota (1714101083) and Atal Babu(1714101026)** ” who carried out the project work under my supervision.

SIGNATURE OF SUPERVISOR

DECLARATION

We, here by, declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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5. The contents of the thesis have been organized based on the guidelines.
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Statement of Preparation:

This project is based on the sugar production system of sugar industry. We have discussed the entire production process from ground level. Initially we started with status of Indian sugar industry, in a brief structure. And further we discussed about the different types of sugar along with the background of juice and its color type. The main focus of this project is to study about the clarification of the melt using the IER method. Later we have also discussed about the future scope and drawbacks of Indian sugar industry.

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ABSTRACT

India is the third highest shareholder in sugar production industry and it is the second highest agro based production in India. So increase in demand of the sugar increase the production rate of the sugar. So this paper mainly deals with the purification and clarification of sugar and its melts which is the most important factor in determining the sugar quality in both cane and sugar manufacturing process. This paper deals with the current and upgraded technology, as of now, like IER, to improve the clarification and purity of the sugar and sugar melts.

Beside that it also discuss the whole procedure of experimental details of the clarification process. Using of different chemicals to remove the solid and soluble impurities are also discussed in this paper.

The paper intends to examination the exhibition of sugar industry in significant sugar creating territories of India identifying with different standard ameters, for example, region under Sugarcane, sugarcane creation, efficiency of sugarcane, sugar creation, stick usage for sugar creation, number of production lines in activity, introduced limit, Limit use, sugar recuperation percent and length of stick smashing The aftereffects of the examination uncovered that larger part of the states showed positive huge development nearby under sugarcane, sugarcane Yield, sugarcane creation, number of sugar plants in activity, usage of sugarcane for sugar creation, introduced limits and sugar creation. This Positive development rates was because of expansion sought after for sugar utilization, redirection of stick increment sugar utilization, plunge rsion of stick from khnadasari and gur Fabricating units to sugar processing plants and expanded interest for side-effects of sugarcane (bagasse and molasses) for additional creation of liquor and co-age Furthermore, mixing of ethanol with petrol.

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CHAPTER 1

1. INTRODUCTION

Sugarcane production accounts for 3% of total cultivated area and come up with 2.6% of the total worth of agriculture production. India is the largest consumer and second largest farmer of sugar in the world wide. In India 500 sugar factories are on operation and almost 75 factories are in rest condition. Sugar industries establish an important area between organized industries in India. A huge cloud of agricultural labourers are connected in sugarcane industries and almost fifty million sugar farmers are their dependents, gathering in of the crops and supporting activities ,which represent 7.5% of the rural residents of the country.

Sugar industry in India has assumed a significant part in the improvement of financial states of the Country populace. It has helped in activating country assets, creating Work, higher pay, and improvement of transport and correspondence Offices. It is likewise relevant to take note of that a portion of the sugar plants have Expanded their exercises utilizing the side-effect created from sugar plants. The Exercises so created incorporate setting up of refineries, natural synthetic plants, Paper plants, Board production lines and cogeneration plants. The business creates its Own replenish able biomass and utilizations it as a fuel without relying upon the fossil Fuel. Consequently, commitment of sugar industry to the Indian economy is huge.

Customary innovation utilized in the handling of Sugarcane includes extraction of juice from the sugar - Esoteric, either by processing or by dispersion, clarification of the crude juice extricated, fixation to syrup and crystallization of the sugar in the Syrup. Products of sugarcane (bagasse and molasses) are used as making alcohol and power generation and ethanol with petrol due to government policies.

Many of the sugar industry in India do not have product utilization plants, project based on molasses and bagasse should be essential. Sugar industry has producing line of work, higher salary, growth of transport and communication solution. Indian Sugar industry can be widely categorized in two sub sectors, the organized area i.e. sugar factories and unorganized i.e. producers of sweeteners like gur and khandsari.

1.1. Sugar Industry Condition in India

State wise growth in Sugarcane Yield in the Country -Sugarcane crop is basically developed for its vegetative development to extricate juice. The harvest Fills well in tropical and sub-heat and humidities between the scopes 35°N to 35°S. Warm and damp environment is especially ideal for its development and the Temperature going from 30°C to 40°C with yearly precipitation going between 70cm to 150 cm is the awesome its effective development. The development rate examination uncovered that Haryana state recorded the most noteworthy Positive development pace of 1.51 percent followed by Madhya Pradesh (2.92%), Gujarat (2.44%), Karnataka (2.10%), Bihar (1.90%), Tamil Nadu (1.81%), Andhra Pradesh (1.73%) and Uttar Pradesh (1.38%). The most noteworthy sugarcane creation in these states due effectiveness in the expense of creation and furthermore good climatic and soil conditions [7]. Further, the state like Uttar Pradesh, there was additionally a help from state government through declaration of State Advised Price (SAP) aside from focal government fixed fair and Remunerative Price (FRP) for additional advancement ranchers to develop more territory under sugarcane. Further, different variables like water accessibility, soil condition and accessibility of number of sugar processing plants and their administrations urged the sugarcane cultivators to arrive at higher development rate in sugarcane creation in the above said states. The Punjab state is the solitary state, which had negative development pace of – 0.62 percent because of shift in editing design towards paddy and wheat crop, which were more profitable than sugarcane crop.

State wise Sugar Factories in Operation - with respect to development paces of number of sugar industrial facilities in activity in the investigation time frame, it was uncovered that Karnataka state enlisted the most noteworthy development rate (3.5%) trailed by Maharashtra (2.62%), Haryana (2.35%), Tamil Nadu (1.67%),Gujarat (1.65%), Uttar Pradesh (1.05%), Madhya Pradesh (0.97%) and Andhra Pradesh (0.58%). On opposite, Bihar was the lone state, which recorded negative development pace of – 4.87 percent. Notwithstanding, a critical development in the quantity of sugar production lines at all India level (1.49%) was taken note. The explanation could be credited to expanded territory and creation of sugarcane attributable to great climate, water and soil conditions and furthermore because of redirection of sugarcane from its creation of customary sugars to sugar creation (Gur and Khandsari). On the other hand, de-authorizing of sugar arrangements (1997-98) has prompted expansion in

the number of sugar production lines across the states from the period 1997-98 to 2012-13 in correlation with past periods

State wise Installed Capacity of Sugar Factories - The development rate investigation of introduced limit of sugar plants across the states Furthermore, India all in all showed that the most noteworthy development was recorded in the states Of Uttar Pradesh (5.97%) trailed by Madhya Pradesh (5.67%), Karnataka (5.29%), Maharashtra (4.95%), Haryana (4.74%), Punjab (4.64%), Tamil Nadu (4.03%), Gujarat (3.41%), Andhra Pradesh (2.79%) and Bihar (1.22%). This higher Development rate in the introduced limit of the industrial facilities over the investigation time frame was expected to increment in the quantity of sugar industrial facilities in India (342 to 526) during the equivalent enough said. Additionally, the sugar production lines which were set up during a decade ago came Up with higher introduced limit and the old sugar manufacturing plants which were at that point Existing likewise got adjusted and reinstalled higher stick pulverizing limit. Further, Expanded interest for sugar and its side-effects for additional creation of liquor, Ethanol and co-age and changed authorizing strategy worked with simple Availability to monetary help for working with up-degree and modernization of plants.

State wise Utilization of Sugarcane for Sugar Production - In India, numerous states recorded higher development rate in use of sugarcane for Sugar creation. The most elevated was seen on account of Karnataka state (4.12%), trailed by Uttar Pradesh (2.75%), Punjab (2.39%), and Haryana (1.51%) What's more, Tamil Nadu (1.39%)? Higher stick used for sugar creation in these states was fundamentally because of productive administration of expanded stock of stick. On the Opposite, Bihar (- 0.92%) and Madhya Pradesh (- 0.17%) states recorded a Negative development in use of pure sweetener creation. This was because of lower Smashing limit of the sugar industrial facilities and furthermore many were of old with out of date Types of gear/hardware, troublesome instalment of stick charges, expansion in the redirection of stick towards Gur and Khandsari creation and so on

State wise Duration of Crushing Season - The development rate examination for term of devastating season showed negative developments in every one of the States. In any case, Karnataka state showed a lower extent of negative Development in correlation with other significant sugar delivering states, which was to the Tune of – 0.12 percent. On opposite, the

territories of Punjab (- 2.11%) and Haryana (- 1.52%) had detailed a high adverse development rate in pounding period. Henceforth, the investigation at all India level was negative development rate to the tune of – 0.69 percent. This could be because of higher variance in sugarcane creation and recurrent Creation of sugarcane, absence of staggered estate, blend of assortments with Distinctive term and redirection of stick for other reason and so forth.

1.2. Introduction to Sugar

Sugar, any of various sweet, dismal, water-dissolvable mixtures present in the sap of seed plants and the milk of warm blooded animals and making up the least complex gathering of starches. (See additionally carb.) The most widely recognized sugar is sucrose, a translucent table top and modern sugar utilized in food varieties and drinks.

1.2.1. Brown Sugar

Brown colored sugars (light to dim) are either solidified from a combination of earthy colored and yellow syrups (with caramel added for most obscure shading) or made by covering white gems with an earthy colored sugar syrup.

1.2.2. Beet Sugar

Beet sugar processing plants by and large produce just white sugar from sugar beets. Earthy colored sugars are utilized stick molasses as a mother alcohol segment or as a gem covering

1.2.3. Invert Sugar

Upset sugar, a combination of glucose (dextrose) and fructose delivered from sugar (sucrose) by utilization of warmth and a corrosive “sugar specialist,” like cream of tartar or citrus extract, influences the pleasantness, solvency, and measure of crystallization in candy making. Rearrange sugar is additionally set up as a syrup of around 75% focus by the activity of corrosive or compounds on sugar in arrangement.

1.2.4. Open Dish Sugar

In mechanical sugarcane preparing, crystallization is directed under vacuum to bring down working temperatures, however some sugar is delivered in the jungles by “open dish” measures. In these cycles, roughly explained juices are reduced in open holders until a sludgy mass of precious stones can be moved to moulds. The solidified earthy colored item is sold as panela or piloncillo in Latin America and as gur or khansari in Asia.

1.2.5. Raw Sugar

This crude sugar, the sugar of business, is put away in sacks in nations where work is bountiful and modest. For the most part, nonetheless, it is put away in mass and dispatched free, similar to grain, in dry-mass boats to regions where it will be refined.

1.3. Background of Sugar Juice

1.3.1. Stick Juice Colorants

The essential target of sugar refining is the evacuation of shading, among different contaminations, to create as unadulterated and low shading a precious stone as is doable. Shading decides the evaluation of Sugar – crude or white – and is the fundamental worry of purchaser and shoppers (Ellis, 2004). It follows At that point that critical exertion has gone into the examination of the idea of shading, anticipation of its Development and techniques for its expulsion.

1.3.2. Common Colorants

Colorants can be categorized as one of two classes: regular and those framed during creation. Plant colours: Plant shades are characteristic in the design of the stick plant. They have been Portrayed as being principally flavonoids and phenolic (Davis, 2001; Bento, 2003). They can involve as much as 66% of shading in crude sugar. Flavonoids can be an impressive issue for sugar creation, as they may represent 30% of the tinge of crude sugar at pH 7 (Mersad, 2003). Bento (2003) reports that, because of their dissolvability, flavonoids can go through the Sugar creation measure without being taken out. The incorporation of a glycoside in their design causes a partiality for sugar gems. Phenolic are for the most part uncoloured until they go through Responses with mixtures like amines or iron. The two phenolic and flavonoids go through enzymatic oxidation responses, which lead to measure framed colorants, depicted later. Plant colours will in general have atomic loads of under 1000 Daltons (Da). They are profoundly ionized, which gives them a high marker esteem (IV, proportion of the absorbance at 420 nm of an example at pH 9 to pH 4). They are promptly eliminated during refining, but at the same time are without any problem Fused in the sugar gem. Rants Formed during Production Melanin's: Melanin's have been arranged by Davis (2001) as a development of melanoidins. They are shaped by enzymatic oxidation of phenolic compounds in quinones by Polyphenol oxidases (PPO) to create indole polymers (Mersad, 2003). They structure at Temperature between – 18 °C and 55 °C and at pH somewhere in

the range of 4.5 and 8. These conditions are Graphic of cutting and processing, and these exercises make contact between the PPO and its Substrates. Further reactivity with amines may prompt the development of melanoidins. Melanoidins: Mersad (2003) portrays these colorants as the results of Maillard responses (non Enzymatic searing), which are build-up responses of a carbonyl compound, for example, a Diminishing sugar, with amino acids, proteins or smelling salts. They structure at encompassing temperatures, yet the response is progressed by temperature rise. Their arrangement is likewise best in class by high brix and Low immaculateness. Melanoidins grow gradually in acidic media and heighten in essential media. Arrangement Tops during dissipation and proceeds through crystallization. Their atomic weight is ordinarily more prominent than 2500 Da. They have a marginally bad charge at impartial pH, yet are decidedly charged in acidic conditions. They are heartless toward pH, and have a low IV. Caramels: Caramels are of extensive interest to the food business. Their arrangement can fluctuate extraordinarily, contingent upon development conditions. The chief interest of the sugar business concerns those which are framed from the warm corruption of sucrose (Mersad, 2003). They have a High atomic weight, which increments after some time because of proceeded with polymerization (Davis, 2001). They are somewhat charged, and are not pH delicate. Upset Degradation Products: These colorants are alluded to as hexose antacid corruption Items (Mersad) and basic corruption results of fructose (Davis, 2001). They are delivered by deterioration of monosaccharides in soluble media. They will in general be earthy colored in Shading, acidic (which can cause reversal), and, subsequently, structure more debasement shading items. Since they are delivered by high temperatures, their creation is nonstop all through the Sugar measure, especially on warmed surfcoloran

1.3.3. Evacuation of Colour – Traditional Methods

White sugar is right now delivered by treatment facilities, which are generally free of the crude Sugar plant. A few refining strategies are utilized – affination, carbonatation, sulphitation, Crystallization and adsorptive decolourization. Affination includes washing the following film of molasses from the outside of the crude Gem and is the initial phase in conventional refining. The division includes blending of crude sugar with hefty syrup (75 brix), at that point cleansing the blend in centrifugal and washing with high temp water after the syrup has been turned off (Chen, 1985). Carbonatation is utilized for the expulsion of

insoluble matter that adds to the turbidity of the sugar alcohol, yet additionally gives a level of decolourization. It comprises of accelerating Calcium carbonate in the washed crude alcohol by adding lime and rising in carbon dioxide under Controlled states of temperature and alkalinity. Translucent calcium carbonate is framed, which traps a significant part of the insoluble matter, just as a bit of the debris and shaded substances (Chen, 1985). Phosphatation is like carbonatation aside from that it utilizes lime and phosphoric corrosive. Filtration of the calcium phosphate floc delivered is troublesome, so air buoyancy is normally utilized to eliminate the floc from the alcohol. Phosphatation produces comparable shading decrease to Carbonatation – around 25-half – yet lucidity of the carbonatation alcohol is marginally better in light of the fact that The last alcohol is pressure separated (Chen and Chou, 1993).Sulfitation is an interaction that is utilized in the creation of production line made white sugars. Sulfitation measures are dependent upon a few varieties, however the central standards include the Utilization of sulphur dioxide related to lime to eliminate shading and shading framing items. The Component of shading expulsion has been depicted as all the more a concealment of shading arrangement as as an evacuation of shading effectively present (Davis, 2001). The restraint is additionally definite as being achieved by the blend of the sulphite bunch with diminishing sugars, which obstructs the Arrangement of caramels and melanoidins. Sulfitation is additionally known to hinder Maillard-type Responses. Crystallization is maybe the best strategy for the expulsion of colorant.

CHAPTER 2

2. INTRODUCTION

Before carrying out the experiments we have gone through different articles and journals in the internet. Review of every paper is briefly described below.

2.1. Review

Ali Kamel Abdel-Rahman et al. [1] has discussed about the membrane operation and its performance on filtration of sugar juice. This paper has also described about the new alternative separation process over the conventional sugar production. And at the end it has given the proper cost evaluation of using The Membrane.

Mrs.R.Hemalatha et al. [2] has discussed the overall growth of Indian Sugar Industry. They have figured out the capital investment and production capacity of the sugar plant to be 50, 000 crores and 210 lakhs metric tonnes respectively, according to ISMA Report, 2008. Beside that, the paper also discuss the sugar cane production potential in India and sugar cane pricing policy.

Murlidhar Ananda Lokhande et al. [3] has discussed the different government policy related to the sugar and sugar trade. This paper gives the detailed data of sugar cane production corresponding to the sugar cane occupied area (hectare). According to the data area under sugar cane has negative growth in 1997-98, 2002-03 and 2003-04 whereas sugar cane has negative growth in 1996-97, 2000-01, 2002-03 and 200-04. Also this paper gives sugar production in tones corresponding to No. of operating sugar factories.

Sayan Sarkar et al. [4] has discussed the importance and history of sugar industry. Also, this paper briefly talks about the problems and the challenge confronted in the sugar industry along with the measures undertaken by the government to eradicate those cahllenges and problems.

Patil Ganeshgouda et al. [5] has briefly mentioned the performance of sugar industry based on the different sugar producing states. For the analysis they considered the 10 major states based on different criteria as highest area for sugar cane cultivation, sugar cane production

and more. They also talk about state wise sugar cane growth in the country, operating factories, utilization of sugar cane for production, installed capacity of sugar factories and recovery of sugar factories.

Rosa Maria Cripa Moreno et al. [6], this paper is more about the clarification of sugar cane juice using two different methods, microfiltration and filtration by addition of coagulating agents, and comparison between them. In the comparison between the two methods all the physical and chemical properties were found to be similar except for reducing sugar and pol. In that parameter the microfiltration method was found efficient over conventional method of adding the anticoagulant agent.

M. Moodley et al. [7], this paper basically deals with decolourising the melt with hydrogen peroxide with other additive chemicals. Here the melt is treated with only hydrogen peroxide, hydrogen peroxide with sulphitation, hydrogen peroxide with carbonation, hydrogen peroxide with phosphatation. And latter this paper also gives the cost table of the different chemicals.

Benard Munide et al. [8] has discussed the processing condition of the factory of particular place. Also the collected sugar cane juice is studied with and without pre-treatment (i.e. heating to 90 degree and adding alum). This paper also studies the sucrose, glucose and fructose of the sugarcane by HPLC. It also determines the brix of that particular cane juice and residual aluminium ions.

DMT Nguyen et al. [9] has discussed about the phenolic compounds and acids separated from the sugar cane juice. This paper also studies the concentration of caffeic acid and its degradation using H_2O_2 and fenton's reagent. The phenolic compounds present in the juices were determined using HPLC and was found that phenolic acid were more in burnt juice then the regular one.

M. Moodley et al. [10] this paper again deals with the another method of decolourising the melt. This paper studies the cationic flocculants agents which is used to remove the colour from the melt. For cationic flocculants different chemical like carbonation, phosphatation were used.

SB Davis et al. [11] has also discussed about the colour process along side giving the review of different colour types as plant pigments, melanoidins, caramels, alkaline degradation products of fructose (ADFs). The same process carbonation and sulphitation is discussed in this paper.

Sheetal et al. [12] has discussed the different growth mechanism of Indian sugar industry. This paper has discussed the different aspects of growth like mechanism implemented by government, marketing strategy and progress, numbers of suppliers and their growth, diversification in operations, improving the infrastructure of the mill house and many more.

SASTA Laboratory Manual et al. [13] this paper is more about defining the terms used in the sugar industry and different calculation methodology and formulas used in calculating different terms like crystal content, crystal recovery, estimated recoverable crystal and many more.

CHAPTER 3

3. DETAILED PROCEDURE

3.1. Cane Yard

There are following processes in sugar Factories to –

Sugarcane come from outside field in cane yard.

After the sugarcane come into auxiliary cane carrier (ACC).

Truck tippler :- the main work of truck tippler is to unload the sugarcane from truck by cane unloader#1.

Head on cutter#1 (HOC) is a cutting device to cut the sugarcane and go for further process in main cane carrier (MCC).

Remaining sugarcane is come into main cane carrier (MCC) and sugarcane unload by cane unloader#2 as well as 3, 4, 5. There are 5 unloader to unload the sugarcane from truck as well as tractor.

Chopper: - it is a cutting device which cut the sugarcane with the help of cutting blades attached to it. This cutting machine have 60 knives to cut the sugarcane.

Cutter is also a cutting device and it cuts the sugarcane in smaller pieces. (64 knives)

Pusher: - it device like a drum that pushes the pieces of crushed sugarcane and levels it so that they do not get out of the carrier.



Figure 1: Cane yard

Head on cutter#2:- it is cutting device which cuts the small pieces of sugarcane more smaller pieces.

Belt conveyor#1 (BC):- it is a belt conveyor which conveys the sugarcane pieces for further processing.

Shredder :- it is also a cutting device compare to all other cutting device they cut the sugarcane pieces to very small pieces like fine crushed sugarcane.it device has 2 motor to operate the machine (1000KW each).

Comber: - Basically work of comber is comb the crushed sugar cane.

Magnetic separator: - the main work of magnetic separator to collect the magnetic particle from the crushed sugarcane.



Figure 2: Cane crushing in shredder

After the cutting process of sugarcane by different cutting devices the crushed sugarcane come in mill house with the help of rake elevator (RE)

After that cutting process of sugarcane by different cutting devices the crushed sugarcane come in mill house with the help of rake elevator (RE).

3.2. Mill House Process

There are five sets of mills for extracting the juice out of crushed sugarcane:-

Mill#0 has a set of TRPF (toothed roller pressure feed) and this mill operate on motor drive and 70% - 80% juice collect from mill#0 and remaining crushed sugarcane goes to mill#1 mill#2 mill#3 mill#4 for further process.

Mill#1 has a set of GRPF (grooved roller pressure feed) and this mill operate on hydraulic drive.

Mill#2 and mill#3 have only a set of mill roller and this mill has also operate on hydraulic drive.

Mill#4 has a set of GRPF (grooved roller pressure feed) and this mill has also operate on motor drive, we spray the crushed sugarcane with hot water (70degg – 80degg) to collect the remaining juice from crushed sugarcane .

After collect all the juice from crushed sugarcane is called bagasse and bagasse goes to boiler with the help of belt conveyer.

There is intake rake elevator placed between the two mills to the transfer sugarcane from the one mill to another mill.

All the juice get from mill house has collect in a juice tank through rotary and juice goes to boiling house with the help of screened juice pump for boiling process.



Figure 3: Operating Mills

3.3. Boiling House Process

The juice from mill house goes to vapour line juice heater (50-60 dig Celsius).

Then juice goes to dynamic juice heater (70-72 degg).

Then juice goes to raw juice heater, where it is heated on (73-74)

Through rotary, raw juice heater juice goes to sulphited tank where we mix CaCO_3 with raw juice to get the clear juice and then it goes to receiver tank.

Raw juice goes to DCH#1(direct contact heater) and DCH#2 (88-89) with the help of deficated pump.

DCH#3 (98-99) and DCH#4 (101-105) heated on very high temperature and direct contact heater goes to flush tank for purification of juice and removes ammonia (NH_3).

Then it goes to Dorr#1 and Dorr#2.

From Dorr the clear juice is is stored in the clear juice tank and the juice mud is transferred in the O.C. (Oliver cane mud) filter.

Then O.C. filter goes to FCS (filtrate clarification system) and after the clarification filtered juice goes to clear tank.

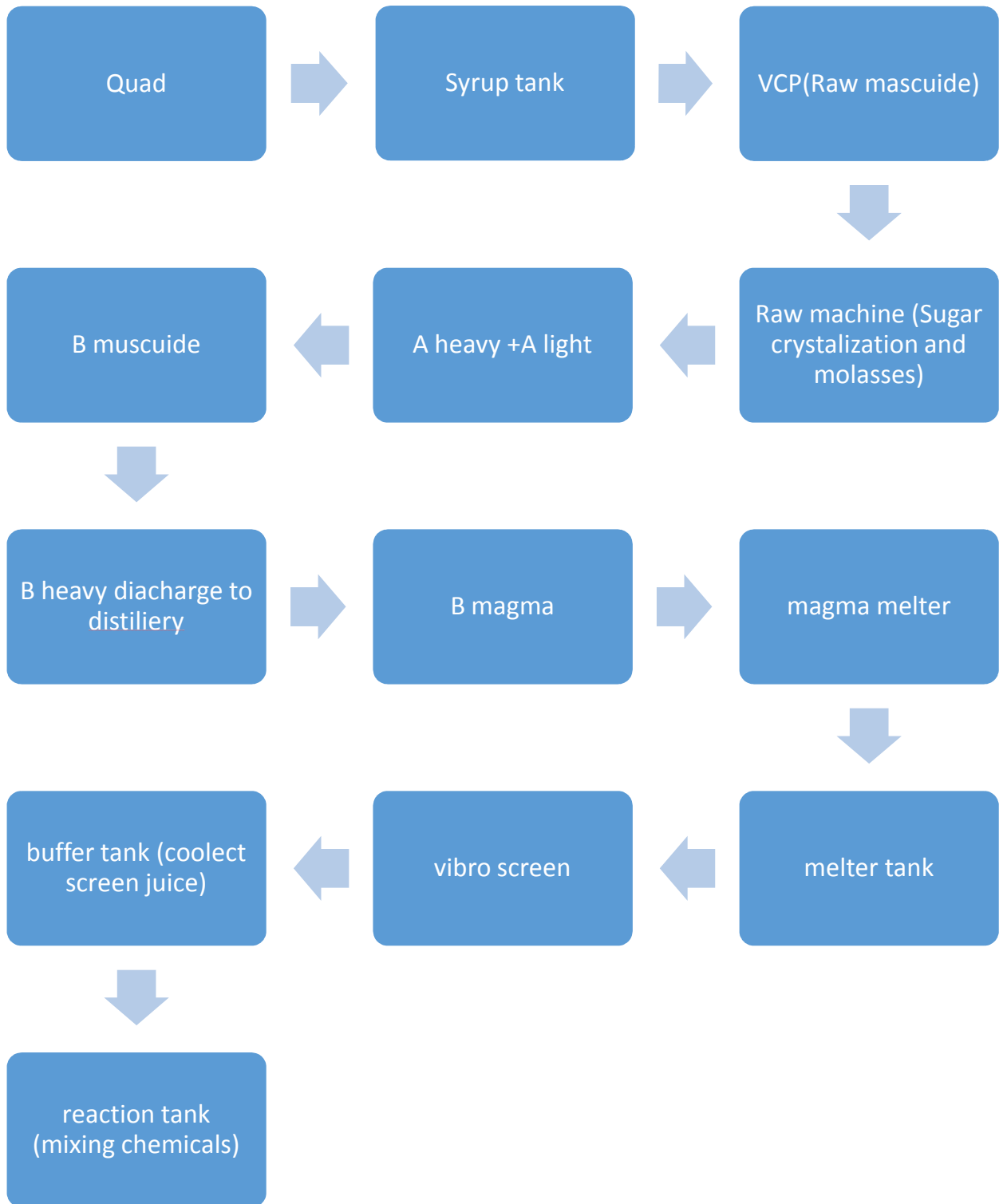
The collected juice in the clear tank goes to second direct contact juice heater and then DCH juice goes to semi kestner .

There is two semi kestner SET (A) and SET (B) and five FFE to use as vapour to extract the water from juice.

Now it goes to quad, where thickness of juice 70-72 brix.

After the process of boiling of juice it goes to PAN station, where the processes take place which thickness of juice.

3.4. Pan Station Process Chart



CHAPTER 4

4. EXPERIMENTAL DETAILS

4.1. Ion Exchange Resin

Ion exchange resins have been utilized for more than fifty years in the sugar business. In any case, Early saps, in light of styrenic polymers in the chloride structure, were restricted in the degree of syrup Shading they could adequately measure. In the event that shading levels were too high, the regenerates would in the end neglect to desorb the shading bodies, and the tars would be delivered futile. In this manner, they were utilized essentially as polishers, following conventional shading evacuation techniques for bone singe also, granular actuated carbon. With the approach of large scale reticular tars in the 1960's, and acrylic saps in the 1970's, Particle trade turned into the head decolourizer in various plants. These gums are able to do Withstanding higher shading stacking and display characteristics of high steadiness and, on account of acrylic Tars, simplicity of recovery. Adsorption of shading particles by the pitches isn't really particle trade in character. Fries (1982) depicts the component of adsorption as an assistance by the tars' utilitarian Bunches that make the tar hydrophilic, which permits the sugar arrangement and shading bodies to reach the hydrophobic spine of the polymeric gum. Bento (1998) portrays the sap as acting through two components: ionic holding between the anionic utilitarian gathering of the sap to the anionic shading atom, and hydrophobic connection between the polar parts of colorant and the styrenic divinyl-benzenic grid. While a few treatment facilities utilize just one sort of gum, it has been illustrated (Fries, 1982) that a blend of styrenic and acrylic saps give more prominent decolourization ability and less affectability to shading stacking. Acrylic gums eliminate fragrant, high sub-atomic weight (HMW) colorants that foul styrenic resin.

4.2. Experiment Procedure

The experiment was performed their own factory chemical laboratory (i.e. quality check lab). After going through the different procedure the raw melt which has purity of 42% comes to reaction tank where we use different chemical and to purify the raw melt. A particular volume (around 250-350ml) of the raw melt was taken to lab for purity test. Then after the raw melt is passed to MCS (melt clarification system) where it is heated around (80-85) degg

C to remove the solid impurities. After the same melt is again treated with phosphoric acid and chemipol to remove the remaining impurities after heating in melt clarification tank. The process of ion exchange in the refinery is ongoing process whereby sugar liquor is passed through a resin bed and colour is trapped within the bed. Sugarcane is necessary food item for daily human life.

Starting of the day, we take any of the drinks like as coffee, tea, milk, Horlicks like many of thing for forming those drinks sugar is necessary item and for making sweets, drinks, cooking. It is very necessary products in human life. In Indian economy sugar industry move into important place.

India has conventional climate and weather and suitable environment for producing sugarcane and developing sugar industry also. Products of sugarcane (bagasse and molasses) are used as making alcohol and power generation and ethanol with petrol due to government policies.



Figure 4: Sample before treating with chemicals in the laboratory

Many of the sugar industry in India do not have product utilization plants, project based on molasses and bagasse should be essential.

All the decolourisation work was done in the research facility -

What's more, the treated mixers were then bubbled under standard conditions in the SMRI pilot dish. The skillet has been portrayed Beforehand (Lionnet, 1987). The overall methods utilized for the tests were as per the following:

- (a) The liquefy (68° brix) was all around mixed and kept at guaranteed Temperature in a 2liter vessel.

- (b) If required the softening pH was acclimated to 7.2 with milk of lime.
- (c) The necessary volume of hydrogen peroxide was then added to the blended dissolve, at 80°C, and a response time of 3 minutes was permitted. During that period the pH was kept at 7.2 utilizing milk of lime.

CHAPTER 5

5. RESULTS AND DISCUSSION

IER act as form to change the resin or polymer. It is an unsolvable matrix (or support structure). Basically in the small radius (0.25-0.5mm) microbeads uses for white or yellowish, fabricated from an organic polymer substrate and remove cations with sodium ions of sodium chloride. The raw melt in the reaction tank had purity of 42%. After going through the different chemical treatment discussed in experimental details, the purity of the melt was increased by almost 40% i.e. the purity of the melt now becomes 80-82%. Which is now known as clear melt and this clear melt with the higher purity level is transferred to fine liquor tank for sugar production.

S.NO.	PARTICULAR	Bx	Colour(IU)
1.	Raw melt	68.80	597
2.	Clear melt	64.70	357
3.	IER inlet	62.70	354

Tabular representation of the results

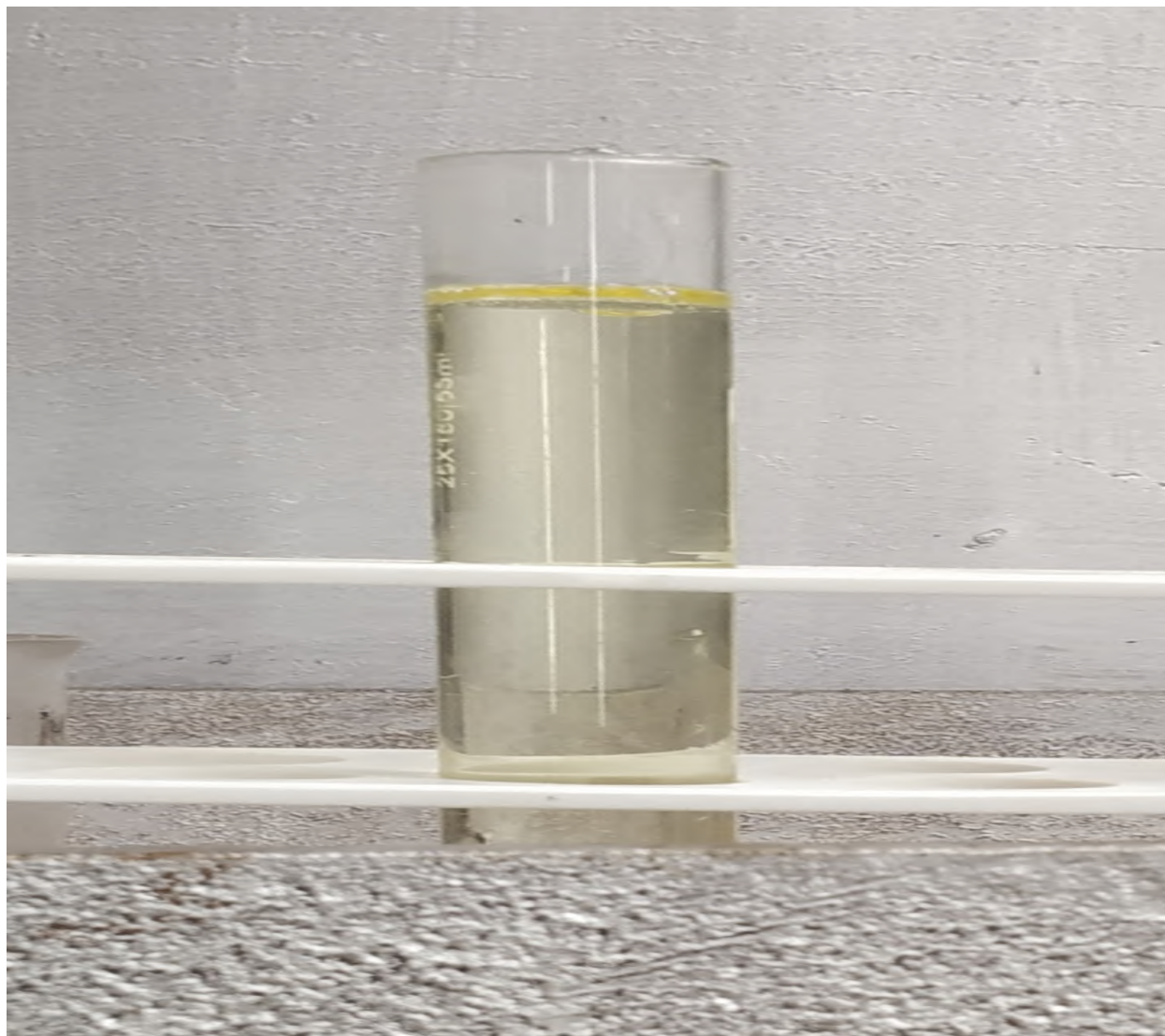


Figure 5: Sample after treating with chemicals in the laboratory

After the experiment performed we also determined the PH value of the raw melt and clear melt. The pH value of raw melt ranges from 6.8-7.2 whereas the PH value clear melt was formed to be 6.5. So we can conclude that the raw melt, mostly formed, falls under basic nature whereas the clear melt falls under acidic nature. The colour transformation between the raw melt and clear melt is due to removal non- sugar impurities from raw melt using resin.

CHAPTER 6

6. CONCLUSION AND FUTURE SCOPE

As of now in many other sugar factories, around the globe, sugar industries are being automated. The production, in most of the scenario, is controlled and operated by the central processing system. Which ultimately reduce the labour expenses and increases the productivity. But in India, most of the sugar industry are dependent in the human resources and labour. Only for few special operation like controlling the belt conveyor, intake carrier, operating mills, autonomous system are used. But still, they require lots of human resources. Apart from that, boiling house, pan station and refinery is still carried out manually to great extent.

Beside above mention drawback of autonomous system, till today most of the sugar industry uses the conventional condensers. But those conventional condensers can be replaced by the air condensers. These condensers uses air instead of water and creates vacuum inside the evaporators and pans which ultimately removes the necessity of water pond spray for creating vacuum.

There is an improvement space in the juice extraction system too. The Australian model MILSIM, enables the factory engineer to access the mill performance and the progress being carried out for prediction of efficient performance under different parameter.

The purification system can also be improved to some extent. The requirement of purification system is extensively determined by the sugar quality required. One of the most widely discussed purification technology is membrane filtration. Using membrane filtration, there are lots of advantages like,

1. Increment in the recovery rate
2. They reduce the scaling of evaporator
3. Increment of the utilization of downstream equipment
4. Reduction in the scaling of juice sterilization

Above all, there is still some gap in the evaporating technology. The new evaporating technology is more likely to improve the capacity of pre-existing equipment and improving the energy efficiency.

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[1] Rajan Devkota, Atal Babu, Karun Kant, Prashant Gupta, Shrikant Vidya*, 'Thermo acoustics: A review', School of Mechanical Engineering, Galgotias University, India (Accepted in ICIME -2021)

[2] Rajan Devkota, Atal Babu, 'Estimation of quality of melt using Ion Exchange Resin (IER) method', School of Mechanical Engineering, Galgotias University, India (Accepted in ICAPIE-2021)

APPENDIX-A

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APENDIX-B

The paper

Estimation of quality of Sugar melt using IER Technique

Atal Babu, Rajan Devkota, Shrikant Vidya*

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Abstract. India is the third highest share holder in sugar production industry and it is the second highest agro based production in India. So increase in demand of the sugar increase the production rate of the sugar. So this paper mainly deals with the purification and clarification of sugar and its melts which is the most important factor in determining the sugar quality in both cane and sugar manufacturing process. This paper deals with the current and upgraded technology, as of now, like Ion Exchange Resin (IER) to improve the clarification and purity of the sugar and sugar melts. Beside that it also discuss the whole procedure of experimental details of the clarification process has also been discussed. Utilization of different chemicals to remove the solid and soluble impurities has also been discussed in this paper.

Keywords: Sugarcane, Sugar industry, Sugar melt, IER

1 Introduction

Sugarcane production accounts for 3% of total cultivated area and come up with 2.6% of the total worth of agriculture production. India is the largest consumer and second largest farmer of sugar in the world wide. In India 500 sugar factories are on operation and almost 75 factories are in rest condition. Sugar industries establish an important area between organized industries in India. A huge cloud of agricultural labourers are connected in sugarcane industries and almost fifty million sugar farmers are their dependents, gathering in of the crops and supporting activities ,which represent 7.5% of the rural residents of the country. India has played an important role in development of social economic conditions of the rural residents. Sugarcane is necessary food item for daily human life. In Indian economy, sugar industry holds an important place. India has conventional climate and weather and suitable environment for producing sugarcane and developing sugar industry also. Products of sugarcane (bagasse and molasses) are used as making alcohol and power generation and ethanol with petrol due to government policies.

Many of the sugar industry in India do not have product utilization plants, project based on molasses and bagasse should be essential. Sugar industry has producing line of work, higher salary, growth of transport and communication solution. Indian Sugar industry can be widely categorized in two sub sectors, the organized area i.e. sugar factories and unorganized i.e. producers of sweeteners like gur and khandsari. This factory is observed in rural area and enjoys much greater independence than sugar industry. After the cutting process of sugarcane by different cutting devices, the crushed sugarcane is transferred in mill house with the help of rake elevator (RE). There are five sets of mills for extracting the juice out of crushed sugarcane :-Mill#0 - TRPF (toothed roller pressure feed), Mill#1 - GRPF (grooved roller pressure feed), Mill#2 and Mill#3 - mill roller operated on hydraulic drive and Mill#4 - GRPF (grooved roller pressure feed).

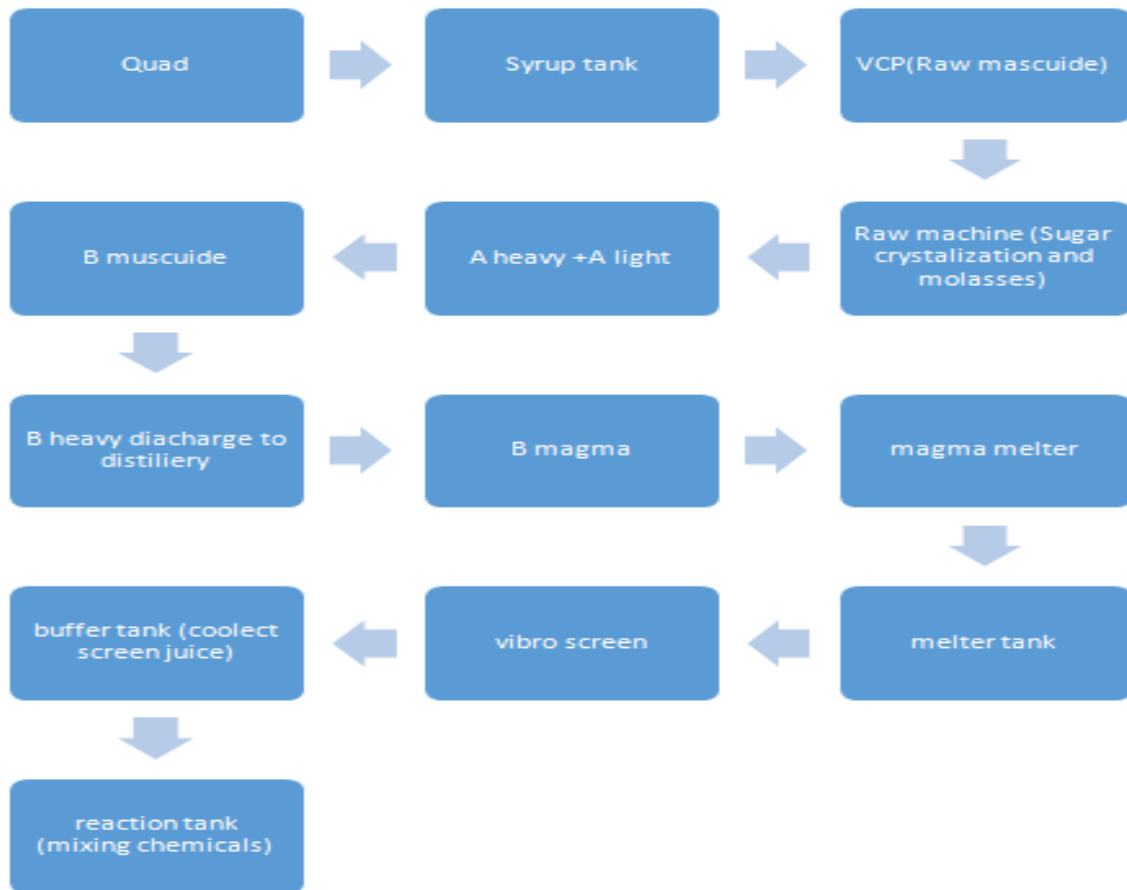


Fig.1: Flow chart of processing of thickness of juice in PAN station

2. Experimental Details

The experiment was performed in the chemical laboratory (i.e. quality check lab) of DALMIA Bharat sugar & industries limited, India. After going through the different procedures the raw melt which has purity of 42% comes to reaction tank where different chemicals were used to purify the raw melt. A particular volume (around 250-350ml) of the raw melt was taken to lab for purity test. Then, the raw melt was passed to MCS (melt clarification system) where it was heated around (80-85) deg Celsius to remove the solid impurities. After, the same melt was again treated with phosphoric acid and chemipol to remove the remaining impurities after heating in melt clarification tank. The process of ion exchange in the refinery is ongoing process whereby sugar liquor is passed through a resin bed and colour is trapped within the bed.

3. Results & Discussion

IER act as form to change the resin or polymer. It is an unsolvable matrix (or support structure). Basically in the small radius (0.25-0.5mm) microbeads uses for white or yellowish, fabricated from an organic polymer substrate and remove cations with sodium ions of sodium chloride. The raw melt in the reaction tank had purity of 42%. After going through the different chemical treatment discussed in experimental details, the purity of the melt was increased by almost 40% i.e. the purity of the melt now becomes 80-82%. Which is now known as clear melt and this clear melt with the higher purity level is transferred to fine liquor tank for sugar production.

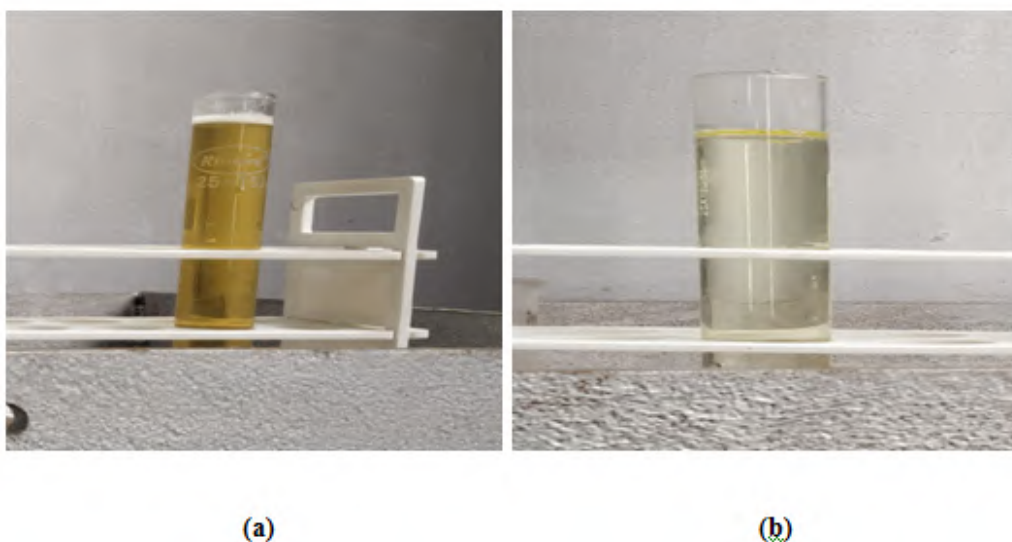


Fig. 2: Sample of melt (a) before treated chemicals (b) after treatment

After the experiments, determination of the PH value of the raw melt and clear melt was also done. The pH value of raw melt ranges from 6.8-7.2 whereas the PH value of clear melt was found to be 6.5. So we can conclude that the raw melt, mostly formed, falls under basic nature whereas the clear melt falls under acidic nature. The colour transformation between the raw melt and clear melt was due to removal of non-sugar impurities from raw melt using resin.

Table 1: Measured Parameters of melt

S.NO.	PARTICULAR	Bx	Colour (IU)
1.	Raw melt	68.80	597
2.	Clear melt	64.70	357
3.	IER melt	62.70	354

4. Conclusion

In sugar factory sugarcane comes from different places like gate sugarcane and center sugarcane. 70% of the sugarcane comes from Gate sugarcane and remaining sugarcane come in center sugarcane. A new chemical technique, Ion Exchange Resin (IER) has been used in this study to make sugar more pure than produced before. The observed value of the purity increases by 40 % almost. The raw melt is basic in nature while the clear melt is acidic in nature. However, there is need for sugar industries, sugarcane growers and the governments to power the cyclicity of sugarcane production which usually occurs once in 2-3 years for overcoming shortages and surplus production, as it was witnessed by negative expansion in duration of crushing period and capacity utilization in sugar factories.

future researchers to build up advanced material using this way and thus, to heighten technological development.

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