ECO FRIENDLY BIO-DEGRADABLE MOULDED PULP PACKAGING USING SUGARCANE BAGASSE

ECO FRIENDLY; BIODEGRADABLE MOLDED PULP PACKAGING USING SUGARCANE BAGASSE

A project submitted in fulfillment of the requirements for the Diploma in Printing Technology

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Under the guidance of

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Submitted To

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CERTIFICATE

This to certify that the project work entitled **"Publishing book on Eco friendly biodegradable molded pulp packaging using sugarcane bagasse"** is the bonafide work of the following students of Diploma in Printing Technology, SIGA Polytechnic college, Chennai-600010, who carried out the project work under my guidance and supervision.

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I certify to the best on my knownledge that this project is not part of any other project.

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Submitted for the end semester parctical exams held on .....

Internal Examiner **External Examiner**

FOREWORD

This record is consonance with the curriculum for the Diploma in Printing Technology. The project work was undertaken by us for this benificial objective. This live experience and practical work will be helpful to our career. While doing this project we have learned to work together as a team recognized each other insight and wisdom.

ACKNOWLEDGEMENT

We express our sincere gratitude and indebtedness to our guide Mr. V. John Fredrick along with our Head of the Department as well as our Project Co-Ordinator Mr. J. Ignatius Adaikalaraj, SIGA Polythechnic College, their valuable suggestion in the field of management and entrepreneurship, their constant encouragement, support and care throughout the course of our project work.

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Dedicated to.....

To SIGA, for its loving Guidance and concern for us

SYNOPSIS

ECO FRIENDLY; BIODEGRADABLE MOLDED PULP PACKAGING USING SUGARCANE BAGASSE

Agro fiber materials biodegradable additive technology is proven better than competing technologies in terms of required effectiveness in landfill biodegradation, recyclability and proven stability in storage and service life of treated products without fear of premature degradation. Almost the largest volume of mass produced, moulded pulp packages are egg trays instantly recognisable by consumers and egg boxes. As the name implies this type of packaging is made from pulp which is moulded into a shape designed to hold protect the product to be packed. The primary function of moulded pulp packaging is to provide impact protection against breakage, chipping, ect. This is achieved in the designed, which locates and stabilises the product.

By taking waste bagasse after crushing the Sugarcane as the raw material, through milling, forming, drying and other procedures. Final products can take replace foaming and plastic products, which is very eco-friendly. Practical application: Productive packaging for electronic goods, toys, cosmetrics, pro product for computers, personal computer parts, small home appliances, acoustic products, medical goods, automobile parts, hand and pneumatic tools, glass, pottery and porcelain goods, and appliction in making lunch boxes.

This project focuses on preparing the Fruits and vegetable Trays (Fresh packaging for fruit & vegitable) of different sizes for fresh foods and other paper pulp food packaging, These are Biodegradable, Ecofriendly, Odourless, Unbleached, Freezable, Microwavable, Non toxic, Sustainable Resources.All these fresh foods packaging trays will be tested will be for their quality and sustainability.

PLANING AND SCHEDULING

06.01.2018	Collecting the Sugarcane bagasse.
07.01.2018	Then colleting a bagasse & keep it on the college teres.
08.01.2018	Then recieve the bagasse & store on the college teres.
11.01.2018	Moring we are go & dry the bagasse on the college teres. Then to buy the long size screen and put on the baggass for dry purpose. Evening to get the bagasse & keep it on the college teres.
12.01.2018	Again to dry the bagasse on the college teres. And one week to do the work again and again. Then the ready to make a powder.
13.01.2018	Our project group members go to teres, when we are checked baggass are dryed. And hit the bagasse.
14.01.2018	Separating the bagasse by bitting using the bamboo stick.
03.02.2018	Making sugarcane bagasse into pulp.
10.02.2018	Making sugarcane bagasse into pulp by another method.
18.02.2018	Searching for a mould work.
24.02.2018	Making a mould by using white cement.
01.03.2018	Finally get the mould making pulp into tray.
15.03.2018	Refering the book content.
20.03.2018	Making a book and tray.
28.03.2018	Finishing a final tray and book.

CONTENTS

METHOD OF PLANTING SUGARCANE

TYPES OF TRAYS

INTRODUCTION

Amongst the largest volume of mass-produced moulded pulp products in Europe and North America which are instantly recognized by consumers are egg trays, and egg boxes. Other examples of typical moulded pulp packaging. As the name implies, this type of packaging is made from pulp which is moulded to a shape designed to hold and protect the product to be packed. The primary function of moulded pulp packaging is impact production against breakage, chipping, etc. This is achieved in the design which locates and stabilizes the product. The structural design can also provide a degree of springiness and, therefore, shock amelioration.

Application

- Moulded pulp packaging includes Trays.
- In addition to those used for eggs and fruits, such as apples, similar trays with different cavities are used for ampoules and vials.
- Punnet-style trays with handles for mushrooms.
- Top and bottom trays are designed to locate and protect bottles and jars.
- Clam shell style containers in which the product is enclosed as for 6\12 eggs or single or multiple bottles.
- Corner or edge protectors for ceramics, radiators and furniture.

Recent new applications of moulded pulp packaging include trays for the location of collapsible tubes, e.g. foods and toiletries, and for electronic products, e.g. car radios, and computer associated products such as flat screens laptop computers.

The main end-use industries served are:

- Food and drink
- Chemicals
- Electronics and IT equipment
- Furniture
- Ceramic wares and radiators.

Jerry cup

Raw materials

Every moulded pulp item is produced by mixing water with either wood pulp made from recovered waste paper/paperboard to a consistency of normally 96% water and 4% fiber. Where required a waterproofing agent such as rosin or a wax emulsion is added. Dye may be added to produce a specific color.

The fiber used is predominantly made from specific grades of recovered paper and paperboard. However, where required, virgin fibre either chemical or mechanical, bleached or unbleached may be used. Baled recovered paper or pulp is hydropulped and diluted to the correct consistency.

Production

The mould is essentially the 'shape' of the product required. All tool set are two pieces of the 'male and female' type. This results in the moulded pulp product having one side which is smooth and one which is rougher. The mould is perforated to allow the removal of water by suction. It is covered, or lined, depending on the shape which side is required to have a smooth surface finish, by gauze is made from strands of stainless steel wire 50 μm thick and gap, or pitch, between parallel strands. It imparts a smooth surface to the surface of the moulded product.

For an egg box produced by this process, the outside surface is required to be smooth so that a printed self-adhesive label can, subsequently, be applied.

The die set would comprise, for the outside, a smooth female tool mould and, correspondingly, an inside male/de-mould. This results in a rough finish on the inside of the egg box.

If we require a tray with a smooth inside surface, then the inside would be in contact with a smooth male mould and the outside would be in contact with a female de-mould. This imparts a rough finish to the outside surface of the moulded products. Shows all the components which are needed to make a full tool set, i.e. aluminium backplate, retaining plates, etc. The forming mould is a complex piece of engineering. It is expensive. It is designed by specialist engineers and is normally made from aluminium, though resin-based tooling, e.g. 'Ciba' indicated in can also be used. The use of computer aided design (CAD) has facilitated mould design and enabled much more complicated designs to be produced than hitherto.

The tool set is made on a milling machine under computer numerical control (CNC). This is based on the output from the CAD tool design and a computer aided manufacturing (CAM) tool path.

After CNC machining and then manual drilling, the face of the mould used to form the product is covered with the fine mesh gauze. This is applied manually. It is a specialized skill acquired after years of training. Once the product is formed by vacuum (suction) on the mould, it is transferred to the drying process using a

transfer mould which is a mirror image of the forming mould and is made from aluminium or epoxy resin.

Reverse air flow is used to eject the formed piece of pulp from the suction-formed mould onto the transfer mould.

Machines used for pulp moulding range from inexpensive hand operated machines to fully computer controlled automatic machines capable of producing thousands of tonnes of moulded pulp packaging per annum.

Product drying

Lemon trays

Strawberry trays

Apple trays

The product is dried in one of two ways. It is either dried by the circulation of heat inside long aluminium gas burning driers or by in-mould thermoforming which uses additional heated moulds to furthers press and dry the product. This in mould drying results in a very high quality finished product, which rivals vacuum and thermoformed plastic mouldings in both aesthetics and geometrics.

Along with its low environmental cost in real and life cycle senses, this new in-

mould pressed pulp packaging is now the most popular choice for packing in the electronics and mobile communication industries, e.g. the packaging of products such as modems, mobile phones and computer printers.

Printing/decoration

As already noted, coloured, moulded pulp packaging can be produced by using a dryed pulp. Decorative finishes can be applied by spray gun.

Text such as brand and end-user names, symbols such as the recyclable logo or trademarks and decorative patterns can be incorporated in the mould to produce an embossed or debossed effect.

Multicoloured self-adhesive labels provide the best option for high quality printing. Direct printing is also possible on moulded pulp surfaces and whilst the better result is achieved on the smooth side, it is also possible to print a small font size adequately on the rough side, e.g. inside of egg boxes.

Mills tray

Mills tray

Raw material preparation

Collected the agricultural residue of bagasse and banana fibers, dried under sun for few days and then wash it by tap water repeatedly.Development of experimental work.

The first known proposal for installing a depithing equipment goes back to 1912-1914, when Cuban bagasse was treated in an ordinary electric mixer. At the end of the 40's, it was developed the Horkel depither mill, based on a large number of experimental works (Keller, 1966; Lois, 1982). In the Horkel depither, the rotor equipped with swinging hammers and supported by bearings at its ends, is placed horizontally. The rotor is driven by a motor through pulleys and belts transmission at a speed of 800-1000 rpm. In industrial practice, the Horkel required an additional screening of the accepted fi ber, which involved rotating screens as part of the whole installation (Lois, 1986).

Afterwards, a vertical rotor Rietz mill for depithing operations was adapted in Hawaii. This depither machine has a vertical shaft with swinging rotary hammers surrounded by a perforated cylindrical basket. The raw bagasse is fed by gravity through chutes located at the top of the equipment and fractions of pith and depithed fiber are discharged by gravity on diff erent outputs. Other important developments were.

a) The Gunkel depithing mill, and afterwards the Peadco depither installed in the pulp and paper factory located in Paramonga, Peru, both with the design solution based of hanging vertical rotors equipped with swinging hammers rotating inside a perforated cylindrical basket.

b) Horizontal double rotor SPM Pawert depithers (Switz erland) with pneumatic evacuation for fiber and pith. The two rotors, with curved screens under

each rotor, and equipped with heavy swinging hammers, rotate in the same direction, so that the bagasse, fed by a lateral chute, is launched from the first rotor to the second one.

c) Development of Wesmaco depither (Malinak, 1980) and Pallmann-Centurion depither (Pallmann, 2011), respectively, with vertical rotor supported on upper and lower brackets, both designed for preparation of bagasse and similar annual plants with simultaneous separation of pith and fi bers. First of them is built with a transmission at 90° through a pair of conical gears.

d) Vertical rotor KC-4 depither developed by Kimberly Clark of Mexico (Mexico) with hanging vertical rotor and only one upper support. And finally,

e) Development of Cuban depither named Caribe S.M. by its designer in chief Lois J.A. (1986), Head of the group responsible for its design, which comprises a rotary hammer assembly, vertically suspended from a rigid framework fixed to its base and having two openings in its top for an inflow of raw bagasse, a screening wall spaced inside enclosure and forming the outer boundary of a zone for processing bagasse with suspended rotor fixed on upper and lower support with a special sinusoid-shaped distribution of hammers that promotes and increases the input capacity of bagasse.

The rotor assembly of this depither consists of rotor shaft and hammers. The hammers are held in place by Depithers for Efficient Preparation of Sugarcane Bagasse Fibers in Pulp and Paper Industry 420 Ingeniería Investigación Tecnología, volumen XIII (número 4), octubre-diciembre 2012: 417-424 ISSN 1405-7743 FI-UNAM plates and each hammer is secured between two plates. Each hammer has a hole to accept a securing shaft. The transmission unit comprises a vertical driving motor through pulleys and belts, transmission at a speed of 1150 rpm. The hammers of the rotor assembly have a clearance of about 10 to 20 mm between their ends and the cylindrical perforated chamber.

The development of this depither has been characterized by emphasis on bagasse feeding by gravity with a vertical rotor and self separation of pith, which increases processing capacity and gives bett er mechanical operation (Lois, 1982). The equipment is backed by a Cuban patent (ONIITEM, 1986; 1992). As a result of the studies carried out with the collaboration and support of the Cuban Research Institute of Sugar Cane Derivatives (ICIDCA), this vertical rotor bagasse depither was developed with a number of new characteristics which give this equipment greater versatility. Two models are available, S.M. Caribe-800 (medium capacity) and S.M. Caribe-1150 (large capacity).both models and contains their main

technical characteristics. The first prototypes were built in a workshop specialized in the construction, repair and maintenance of centrifugal machines.

Experimental methodology

Mechanical evaluation: by checking the correct performanceof the equip ment with test runs directly in the manufacturer workshop. Vibration values were carefully monitored and controlled at the planes: A (Axial); H (Horizontal) and V (Vertical), as well. The values of temperature on the upper and lower bearings of the rotor assembly were also controlled.

Parameters	S.M. Caribe-800	S.M. Caribe-1150
Input processing capacity, t/hr, bone dry	6.0-7.0	10.0-11.0
Separation by weight, %	30-35	30-35
Fiber content, average yield in accepted fraction, %	75-80	75-80
Installed power, Kw	55	150
Diameter of inner perforated basket, mm	800	1150
Height of perforated basket, mm	810	1160
Number of hammers or knives	36	54

Technological evaluation: periodical sampling and analysis were carried out during two crop seasons of bagasse processing on continuous operation in order to determine depithing efficiency and fiber quality.

Mechanical evaluation

Once the mechanical adjustments were completed, depithers were subjected to a vibration analysis during three hours of running tests in a conveniently designed mechanical test station. The vibration analysis technique consists of vibration measurement and its interpretation (Sadett in et al., 2006). Measuring the severity of the vibration is the method recommended by ISO Standard 2372 for the overall monitoring of the rotor condition. It detects the most common mechanical failures, such as imbalance, structural weakness and loose parts. The effective value of the vibration velocity in mm/s was used for assessing the machine condition. Vibration analysis was performed by experienced personnel, so existing failures could be easily detected. In the case of all evaluated depithers periodical vibration control was done during the tests by means of a portable digital acceleration velocity sensor with the following characteristics:

- Frequency range 10 to 1000 Hz
- Range of measurement RMS
- Velocity measuring range: 0.5-49.9 mm/s
- Acceleration mm/s: 20.5-49.9 (0.05-5.1 g)
- Accuracy ± (0.2 mm / s + 2% of reading)
- Displacement: 0.5-99.9 μ (0.02-3.94 mils)
- Evaluation of the condition according to ISO 2372 and ISO10816

shows the vibration monitoring points. All measurements done in the depithers correspond in the Machine Class designation to Class II: medium-sized machines (typically electric motors with 15 to 75 kW output) without special foundations, rigidly mounted engines, or machines on special foundations up to 300 kW. Table 2 shows the results of the S.M. Caribe depither compared to those obtained with the other depithers installed in the country. In addition, temperature of bearings in upper and lower supports in all evaluated depithers was systematically controlled, confi rming that stabilized critical values for these components were never reached. The lowest vibrations were registered for the S.M. Caribe depither with all values below 7.1 mm/s which according to ISO Norm 2372 is the maximum permissible limit for that type of equipment indicating that it can run in continuous operation without any restrictions.

Technological evaluation

Evaluation for both S.M. Caribe models was performed during two crop sugarcane seasons at the "Pablo Noriega" experimental sugar mill which supplies moist depithed bagasse to the "Research and Production Unit of Pulp and Paper from Sugarcane Bagasse CUBA-9" in Quivican, province of Havana. Quality parameters of depithed bagasse.

The infl uence of depithed bagasse, on the quality of paper produced at this factory, In the opinion of the technicians of that Research and Production Unit, it was achieved a clear and convincing improvement in the quality of paper produced and their degree of brightness, and a significant decrease in the consumption of chemicals in the bleaching area, as well.

Depither	Plane	Vibration Control Points		
		1	2	3
Hanging rotor with only upper support (Kimberly)	H	3.9	(18.9)	(18.9)
	V	6.0	(25.1)	(25.1)
	A	5.9	(14.9)	(14.9)
Rotor with upper and lower supports (Pallmann)	H	7.1	6.4	3.7
	V	4.7	6.4	3.3
	A	2.2	6.3	3.2
Rotor with upper and lower supports (S.M. Caribe)	H	3.0	3.7	3.3
	V	6.2	4.4	4.4
	A	2.4	3.2	4.6

Results obtained from technological evaluation of the depither S.M. Caribe 1150.

Composition of depithed bagasse	Average value %	Variance	Std deviation	Min.value %	Max. value%
Fiber	80.4	1.312	1.145	78.3	84.4
pith	8.71	1.316	1.147	6.3	10.8
Fines + Soluble	10.9	2.145	1.464	8.1	13.8

Fibers and pith content

In the conventional analytical method DP-1 (TAPPI modifi ed) of the Cuban Research Institute of Sugarcane Derivatives (ICIDCA) the depithed bagasse in aqueous suspension is subjected to the action of a defi - brator TAPPI. The pith is separated through a set of sieves (sieves No. 5, 12 y 100), the fraction collected on screens No. 5 and 12 corresponds to the "fiber", and the "pith" is retained on No. 100. Fines and soluble elements (organic and inorganic) go to the water used in the analysis, the weight of the fi ber and pith fractions is reported in percentages, and solubles and fines by the difference. Once the washing operation is finished, the fibers on sieves 5, 12 and the pith on sieve 100 are collected on small trays and placed both in the oven at 100-1050C for 24 hours. The sample processing is performed in quintuplicate (Lois, 1986).

Refining degree of pulp,0SR

The Schopper-Riegler test 0SR quickly provides an idea of the refining degree relating to the speed of the drainage of the diluted paper suspension. The refining of pulps is one of the most important stages in the paper production process and influences strongly the sheet forming and its physical properties. It is important to have reliable drainability results, since in the evaluation of pulp quality the physical properties of laboratory sheets are often plotted as a function of drainability. (0SR) and are often reported at a certain 0SR value (Schopper Riegler-value). the comparative values of refining degree pulps obtained from depithed fibers of Horkel and S.M. Caribe depithers are shown. Tests to determine the refi ning degree and draining velocity of paper fi bers by Schopper-Riegler Method of the 0SR were made according to standards ISO 5267/1.

This method is applicable to all types of pastes in aqueous suspension, except for extremely short fiber pastes. The tests were conducted in Schopper-Riegler type Freeness Tester SR-10 in the specialized Quality Control Laboratory of "Research and Production Unit of Pulp and Paper from Sugarcane Bagasse CUBA-9" located at Quivicán in the province of Havana. In total, 90 samples of depithed fi bers of Horkel and S.M. Caribe depithers, respectively, were processed with an interval of three hours each.

THE CHARACTERISTICS OF THE SUBSTRATES

Chemical composition

The chemical composition of sugarcane bagasse and soybean hull is presented. Half of the chemical composition of sugarcane bagasse and soybean hull is cellulose and hemicelluloses. Notably lignin content is quite different between sugarcane bagasse (17.8) and soybean hull (8.4), causing the fungal growth to a certain extent.

Composition of sugarcane bagasse and soybean hull on dry basis

Type	Cellulose	Hemicellulose	Lignin	Protein	Others
Sugarcane bagasse	30.9%	31.9%	17.8%	2.5%	16.9%
Soybean hull	31.1%	21.9%	8.4%	11.9%	26.7%

Protein content of sugarcane bagasse and soybean were obtained from references (Jenkins et al.,1998; Ontario minister of agriculture, food and rural affairs, 2011)



An important factor in solid-state fermentation is the ratio between carbon and nitrogen (C/N). The ratio of C/N is most vital for a specific process to obtain desired products. Sugarcane bagasse has higher cellulosic composition which is ideal for good growth of fungal cultures and enzyme production. However, its low protein content (2.5%) and high lignin concentration limit its efficiency of bioconversion to produce value-added products (El-Sayed et al., 1994). Brijwani et al., (2010) showed that the protein content of soybean hull (11.9%) is not as high as wheat bran (16.29%). However, Soybean hull is still a good source of nitrogen compared with sugarcane bagasse. Mixtures of sugarcane bagasse and soybean hull can, potentially, improve C/N to present ideal conditions for fungal growth and enzyme production and this is explored below.

Bed Porosity

As has been defined, SSF involves a discrete solid phase in which microorganisms grow on the surface of moist particles as well as inside and between them. The space between particles is occupied by a continuous gas phase. And the size, shape, and porosity of substrates could affect the gas phase in the SSF. Availability of

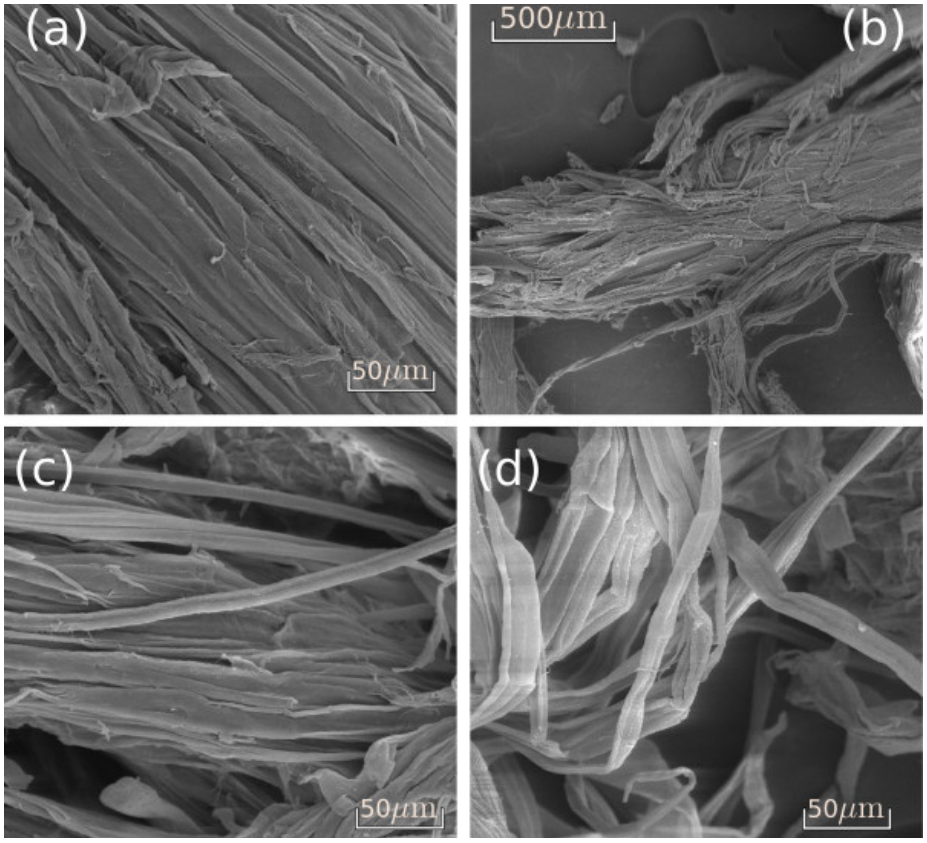
spaces between particles ensures the accessibility of oxygen for enzyme production in aerobic fungal growth (Brijwani and Vadlani, 2011).

In order to assess the likely importance of particle size and type on bed porosity, measurements were made of bulk density and particle density and these were then used to calculate bed porosity for a range of different particle sizes of sugarcane bagasse as well as for soy bean hull particles. The results, presented in there is a substantial difference in the porosity, estimated at dry basis, for different particle sizes of sugarcane bagasse compared with soybean hull (<2 mm). For sugarcane bagasse, with the increase of particle size, the porosity raises gradually from 84.2% to 92.9%. The higher value of porosity means the more open space available between substrate particles. Notably, the maximum difference of bed porosity between soybean hull (<2 mm) and sugarcane bagasse (2-1.4 mm) was close to 18%. These results match those observed in earlier studies that porosity varies depending on several factors such as fibre bonds, moisture, particle size and aggregation.

shows photographs of sugarcane bagasse under a microscope at 50X magnification. For the biggest size of sugarcane bagasse (2-1.4 mm), various particle shapes. Because of the irregularly size particles, particles could not pack the inter-particle void space and block the open pore for air or water accessibility. Therefore, the void spaces between particles are larger than for other particle sizes. As for the smallest one (0.5-0.21 mm), the quality and shape of particles is more homogeneous, causing the amount of open space to reduce. The findings of the current study are consistent

Type	Bulk Dendity (g/mL)	Particle Density (g/mL)	Porosity (%)
Sugarcane bagasse (2-1,4 mm)	0.05	0.704	92.9
Sugarcane bagasse (1.4 mm-0.85 mm)	0.049	0.6	91.8
Sugarcane bagasse (0.85 mm-0.5 mm)	0.058	0.401	85.5
Sugarcane bagasse (0.5 mm-0.21 mm)	0.059	0.375	84.2
Soybean hull (<2 mm)	0.435	1.787	75.6

with those of (Manickam and Suresh, 2011) who showed that the porosity is decreasing with decreasing particle size for corn pitch.



Sugarcane bagasse at different particle sizes under a USB microscope, 2X magnification (a) 2-1.4 mm (b) 1.4-0.85 mm (c) 0.85-0.5 mm (d) 0.5-0.21 mm.

Water evaporation

The water evaporation rate of substrates is related to the efficiency of Solid-state fermentation, especially for the issue of heat and mass transfer during bioprocessing. One of the major barriers is the difficulty in controlling the water content and temperature of the bed in large-scale bioreactors.

For investigating evaporation characteristics of sugarcane bagasse and soybean hull, it could be useful to use dimensionless moisture ratio (MR) to represent evaporation behaviour.

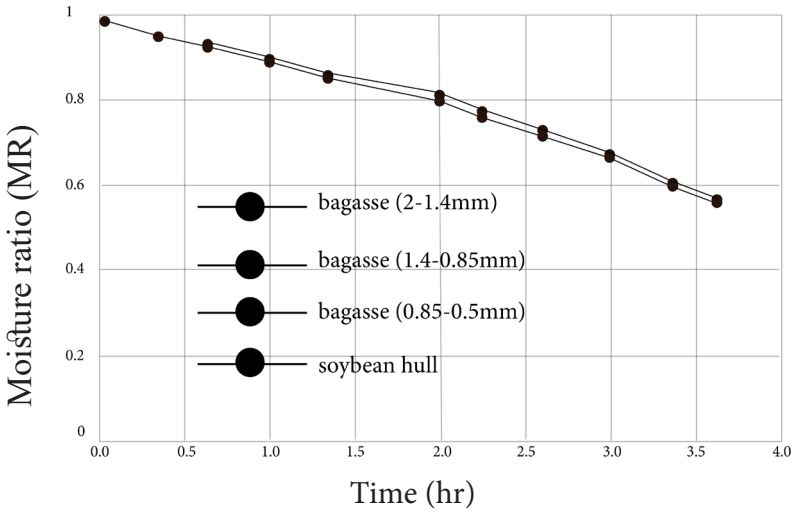
MR=(M-Me)(Mo-Me) **Equation 5-1**

Where M is the moisture content of the product, Mo is the initial moisture content of the product and Me is the equilibrium moisture content.

The values of Me are relatively small compared to M and Mo for long drying times and accordingly one can write:

MR=MM0 **Equation 5-2**

The non-fermented sugarcane bagasse and soybean hull were dried at 30°C in an oven, adopting thin-layer thickness of about 10 mm. The initial moisture content of samples was about 0.75g water per g of dry matter. All samples were put in petri dishes without lids. Using the moisture ratio to generalize the change of moisture content is the most common method in drying process. As shown in Figure 5.2, the moisture ratio versus drying time for sugarcane bagasse and soybean hull at 30°C. According to the results obtained, the effect of various particle size of sugarcane bagasse does not cause significant difference of water evaporation.



The drying curve of sugarcane bagasse and soybean hull

The limitation of mass transport by diffusion plays an important role in solid state fermentation especially when the substrate has a porous structure. Mass transfer inside the substrate particle is limited to diffusion and because of consumption of nutrients by the microorganisms, concentration gradients will go up within the substrate. Therefore, understanding this characteristic of the substrate is one of the crucial factors for the design of solid state fermentation. It has been accepted that the drying characteristics of biological products in the falling rate period can be described by using Fick's diffusion equation. Crank (1975) used various regularly shaped bodies such as rectangular, cylindrical and spherical products, and the form of Equation 5-3 to apply on particles with slab geometry, as is the case of the sugarcane bagasse and soybean hull, by assuming uniform initial moisture distribution (Crank, 1975; M.A. Mazutti et al., 2010).

MR=8/π2 Σ1∞(π=0)1/(2n+1)2exp((2n+1)2 π2 Defft/4L20) Equation 5-3

Where Deff is the effective diffusivity (m2 s−1), L0 is the half thickness of slab (m). For long drying periods, Equation 5-3 can be simplified to retain only the first term of the series and re-writing to a logarithmic form as follows:

ln(MR)=ln(8π2)−π2Defft4L02 **Equation 5-4**

Diffusivities are determined by plotting drying data in terms of ln(MR) versus time in Equation 5-4, providing a straight line with the slope given by:

slope=−π2Deff4L02 **Equation 5-5**

The values of effective diffusivity (Deff) of sugarcane bagasse with various particle size and soybean hull are presented. The effective diffusivities for sugarcane bagasse ranged from 6.82 x 10-11 to 6.36 x 10-11 m2s-1, whereas for soybean hull the value was 5.21 x 10-11. The effective diffusivities of sugarcane bagasse were, on average, 1.26 times higher than those found for soybean hull. A possible explanation for this might be that the diffusion rate is proportional to the porosity of the solids, and as the drying process takes place the structure hinders diffusion, diminishing the values of Deff.

Sample	Effective Diffusivity (m^2s^{-1})
2-1.4 mm of sugarcane bagasse	6.36×10^{-11}
1.4-0.85 mm of sugarcane bagasse	6.82×10^{-11}
0.85-0.5 mm of sugarcane bagasse	6.59×10^{-11}
Soybean hull (<2mm)	5.21×10^{-11}

Effect of washing procedure on sugarcane bagasse

Sucrose is the prime constituent of sugarcane juice. Also, a variety of other carbohydrates is found in mixed juice. (Walford, 1996) reported that the most common consist of the monosaccharides glucose and fructose (3-6%), and the dissacharides, sucrose (81-87%). Oligosaccharides and polysaccharides (0.2-0.8%) may be present depending on the age of the cane when harvested and deterioration during delays. In sugar processing, the first step is to shred sugarcane to prepared cane. The cane juice is then extracted from the prepared cane and collected through a series of solid-liquid separation processes. The residue left after crushing is called 'bagasse'. Sugarcane bagasse is the fibrous material still containing a significant amount of sugar. In sugar processing plant, there are five more crushing stages to extract the remaining sugar from bagasse and the remained residue in the last extraction stage is called 'final bagasse' (Tewari and Malik, 2007). Since the bagasse in the experiments reported in this thesis was collected from a traditional market, the sugarcane was extracted through a simple sugarcane extruder. It was necessary,

therefore, to explore the influence of the remaining sugar in the bagasse on the solid state fermentation.

Several researches showed that microorganisms are able to use sucrose from sugarcane bagasse during solid state fermentation (Kumar et al., 2003; Marcio A. Mazutti et al., 2010). This study was carried out to investigate the influence of washing the sugarcane bagasse on the sugar and FAN yield obtained from sequential solid state fermentation (SSF) and hydrolysis.

The solids (sugarcane bagasse) were either used as non-washed or washed with distilled water before inoculation of solid state fermentation. The amount of distilled water used in the washing process was about 1 L per 25 g bagasse (dry basis). The wash liquid was stored at 4°C for further analysis within 3 days.

After being autoclaved at 121°C for 20 min, 4g of non-washed and washed sugarcane bagasse were then distributed into each of two 9 cm petri dishes and incubated at 30°C for 120 h. The default culture condition was 65 % moisture content using sterile mineral salt water, 10% (w/w) of yeast extract supplemented, 106 spores per gram substrate, and 7-day spores if it was not indicated specially. At the end of solid state fermentation the contents of all Petri dishes were suspended in pH 4.8 citric buffer. The suspension was stored in sealed Duran bottles to elevate enzyme activities in the fermented substrate for hydrolysing the remaining sugarcane bagasse components. All experiments were carried out with agitation using a shaking incubator at 50°C, 160 rpm for 48 h.

it was noticed that there was nearly no growth of T. longibrachiatum on washed sugarcane bagasse. Careful visual observation showed that there were some mycelia formed on the substrate surface, which means that T. longibrachiatum did grow on it, but with a slow rate. However, when non-washed sugarcane bagasse was used for substrate (Figure 5.3b), the growth was slightly improved.

SSF using Trichoderma longibrachiatum on (a) washed and (b) non-washed sugarcane bagasse after 5 days.

The composition analysis of the resulting wash waters showed that reducing sugars, sucrose and FAN were 0.04, 0.14 and 0.01 g per g of bagasse, respectively. Of the nutrient compounds monitored, sucrose is retained in the highest concentration. This means that a large fraction of fermentable sugars remained in the sugarcane bagasse that could be fed to the solid state fermentation.

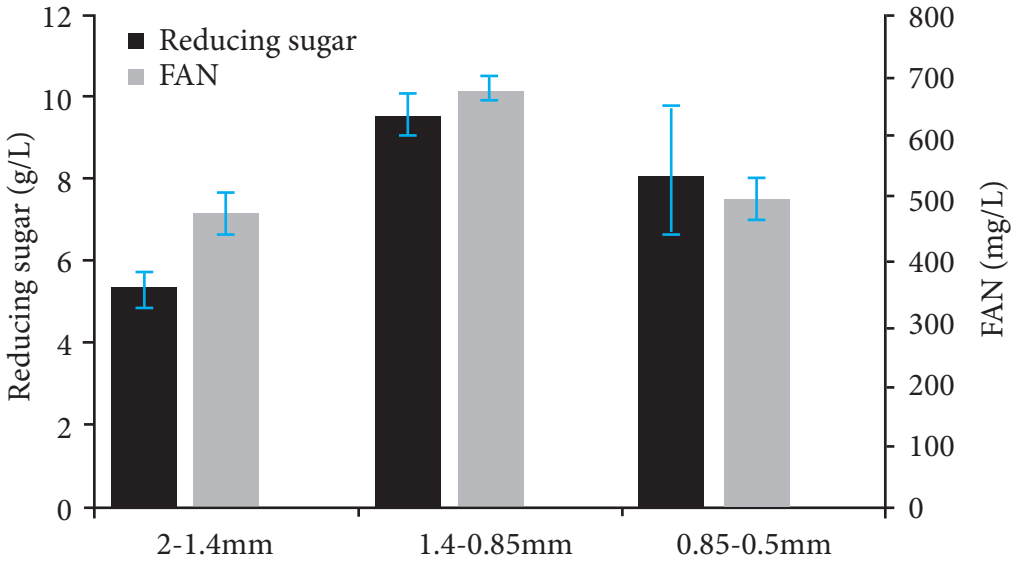
It is clear that non-washed sugarcane bagasse led to a higher sugar and FAN yield after sequential bioprocessing. Data for non-washed process are almost twice as high as those for washed process. A possible explanation for this result might be that abundant fermentable sugars were washed from sugarcane bagasse before inoculation, resulting in insufficient nutrients and poor microbial growth. These

findings may help us to understand the effect of remaining sugars in the bagasse on our sequential bioprocess. A reasonable approach for further experiments is to choose non-washed bagasse to ensure enough sugars and nitrogen for fungal growth.

Effect of particle size on sugarcane bagasse

Particle size of the substrate is related to substrate characteristics and system capacity to interchange with microbial growth and heat and mass transfer during SSF. Smaller particle size could provide larger surface area for microbial growth and it is also beneficial for heat transfer and exchange of oxygen and carbon. dioxide between the air and solid matrix. However, too small particles may lead to substrate agglomeration, which may interfere with microorganism respiration and then result in poor cell growth (Pandey et al., 2000; Xin and Geng, 2010).

Three different particle sizes of sugarcane bagasse were carried out following the method described. the characteristic development of T. longibrachiatum under different particle sizes of substrates. The spores are spread on the surface and inside the solid matrix, and hyphae forms a microscopic network (mycelium) inside the substrate. Varying the growth condition, similar patterns of morphological development are observed. However, the smaller particles may result in agglomeration, causing the void space to decrease. Therefore, the development of fungal growth would be a little different from the others. As shown in the figure, the aerial hyphae intermeshed on the surface of the substrate densely.



shows sugar and FAN production from sugarcane bagasse using T. longibrachiatum under the sequential bioprocessing conditions described. When sequential bioprocesses were carried out with different particle sizes of bagasse, particle size of 1.4-0.85 mm supported maximal reducing sugar and FAN (9.4 g/L and 670.7 mg/L). Generally, the particle size not only significantly affects the water holding capacity of the substrate, but also influences the diffusion of nutrients and the exogenous metabolic products to and from the microorganisms. According to the result reported, the porosity of over 1.4 mm particle size (92.9) is quite similar with the one of 1.4-0.85 mm (91.8). However, larger particle sizes could present less surface area than smaller one. And it could affect the fungal growth or enzyme production. In this case, sugarcane bagasse with 1.4-0.85 mm particle size possibly provided sufficient surface area and aeration to T. longibrachiatum for growth and enzyme production resulting in increased sugar production.

Influence of nitrogen supplement on SSF

For fungi of the genus Trichoderma, better results of enzyme production in SSF have been obtained with organic nitrogen sources, such as peptone, yeast extract or corn-steep liquid, than with inorganic compounds, such as ammonium sulfate or ammonium nitrate, as the sole nitrogen (Sun et al., 2010).

In the current project, the sugarcane bagasse contains 62.8% of total carbohydrates and 0.4% of total nitrogen. The abundant amount of carbohydrates in bagasse could be desirable for filamentous fungi utilisation. The smaller amount of total nitrogen, 0.4%, on the other hand could not provide a sufficient source of nitrogen to promote the fungal growth and facilitate enzyme production. A high C/N ratio could mean that the nitrogen will be consumed before carbon is utilised. In contrast, a low C/N ratio may provide excess nitrogen which tends to become toxic to some microorganisms (Mital, 1997). Therefore, it is necessary to know what level of C/N ratio could benefit nutrients production through T. longibrachiatum. The effect of different amounts of nitrogen source on sugar and FAN production was tested by yeast extract. All of the experiments were carried out in an incubator at 30°C for 120h for SSF and then transferred to 50°C for 48h for subsequent hydrolysis.

Carbon to nitrogen ratio (C/N) is a ratio of the mass of carbon to the mass of nitrogen in a substance. The carbon content and nitrogen content in the sugarcane bagasse and yeast extract were based on referred data (Holwerda et al., 2012; Kruesi et al., 2013).

C/N ratio of mixed-substrates culture medium	
Nitrogen added (%, w/w)	C/N ratio (g g-1)a
0	107.2
1.5	80.9
4.5	54.3
7.5	40.8
10.5	32.7
15	25.2

a Ratio between carbon in sugarcane bagasse and supplemented nitrogen

It was observed that different amount of yeast extract supplemented has a direct effect on the growth of T. longibrachiatum on sugarcane bagasse. Fungi did not grow well in the fermentation with nitrogen added below 7.5% (w/w). It is known that the C/N ratio is one of the most important factors to balance biomass and products production. The excess or lack of nitrogen content in the substrate may inhibit fungal growth and is presumably the reason to hinder enzyme production (Mantovani et al., 2007). In the solid state fermentative process, even minor variations in the C/N ratios may result in quite distinct responses from the biological system, since the local concentrations are greatly superior to those of the submerged fermentation (Bertolin et al., 2003).That a green surface area appeared in plates where the yeast extract supplemented is above 7.5% (w/w). In addition, droplets of condensed water were observed on the internal surface of lids where prolific fungal growth was observed.

shows that reduction in the dry weight of the substrate is directly related to the consumption of the nutrients by the extent of fungal growth. Dry weight loss is increasing in fermentations with nitrogen added contents between 0% and 15% (w/w). The highest dry weight loss (25% of initial dry weight) was observed in the fermentation carried out using 15% of nitrogen supplement. The dry weight loss seems be associated with the fungal growth from visual observation. However, it is worth mentioning that separation of fungal mycelium from the solid particles of the substrate was practically impossible, and therefore quantitative analysis of biomass from the remaining dry fermented substance is very difficult.

Values of effective diffusivities obtained with different environmental humidities on solid state fermentation

Sample	Effective Diffusivity (m^2s^{-1})
Non-fermented, 35%	1.278×10^{-11}
Non-fermented, 75%	4.45×10^{-12}
Fermented, 35%	9.02×10^{-12}
Fermented, 75%	5.86×10^{-13}

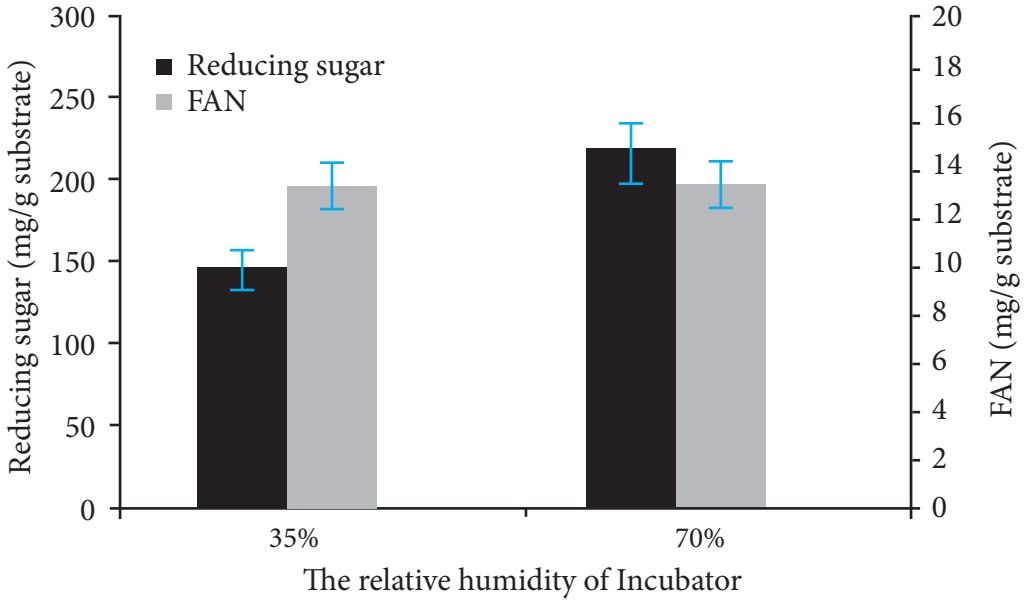
For mass and heat transport during heating process, external and internal transport phenomena can be distinguished. External transport occurs from the particle surface to the surrounding air and internal transport from the inner to the outer layer of the particle. The difference of water concentration between the gas and the solid phase, and the bulk of the air is the driving force for mass transfer (Sun, 2007). When the water concentration gradient is increased in the gas phase between system (petri dish) and environment (incubator), the moisture content of substrate can reduce dramatically due to evaporation of the existing water in the solids through metabolic heat evolution. It is worthwhile to note that the use of high relative humidity does not prevent evaporation from occurring within the bed, but it does minimize evaporation compared to the use of unsaturated air. The reason could be attributed to the metabolic water production during solid state fermentation, which can maintain the desired level of moisture content when the minor evaporation effect occurs under small water concentration difference between system and environment.

As can be seen, which shows petri dishes from above and below, the fungi development during 3 days of fermentation with high relative humidity (75%) occurs on both top and bottom surfaces. In addition, droplets of condensed water were observed on the internal surface of the lid. The low concentration gradient between environment (incubator) and system (petri dish) could leave abundant water vapour inside the petri dish, leading to condensation when it reached the lid. However, in the other experiment with lower relative humidity (35%) lower growth was observed, with very poor growth on the bottom surface

After 5 days of fermentation it could be seen that fungal growth favoured the high relative humidity environment. It was noticed that the entire surface of the substrate was covered with spores and mycelium in the fermentation with higher relative humidity (75%). In contrast, the lower relative humidity case (35%) showed much less growth on the same mixed substrate.

Despite having been inoculated over entire petri dish, two quite distinct areas on the surface of the substrate; a green surface covered by the prolific fungal growth in the centre of the substrate (area 1); and poor development in the outer region of the medium (area 2). The moisture content of the centre area was measured at 56%, whereas the outer region was only 19%. The moisture content of substrate in the centre was therefore almost 3 times greater than that found for the outer region. This visual observation supports the phenomenon observed where the high moisture gradient between petri dish and incubator led to increased moisture content reduction of substrate during solid state fermentation.

Further hydrolysis of fermented solids should be also investigated to understand the effect of humidity level on sequential bioprocessing (SSF and in-situ enzyme hydrolysis).indicates that the sugar yield was enhanced by increasing environmental humidity level from 35% to 75%, and maximum reducing sugar production yield of 263.1 mg/g substrate was obtained when the relative humidity level was 75%. It is acknowledged that the water activity (aw) of the substrate is a key factor affecting microbial activity and enzyme production, an optimal moisture level has to be maintained during solid state fermentation (Molaverdi et al., 2013). Strong evaporation effect and mass transfer work synergistically to promote water vapour diffusion from substrate, leading to low moisture level of the substrate to reduce fungal growth, enzyme activity and substrate deconstruction. However, there is no significant difference between low humidity level and high humidity level on FAN production, 13.4 mg/g substrate and 13.8 mg/g substrate, respectively. This is probably due to the same limited nitrogen source supplied (SB:SH, 6:4) of the substrate for sequential bioprocessing.

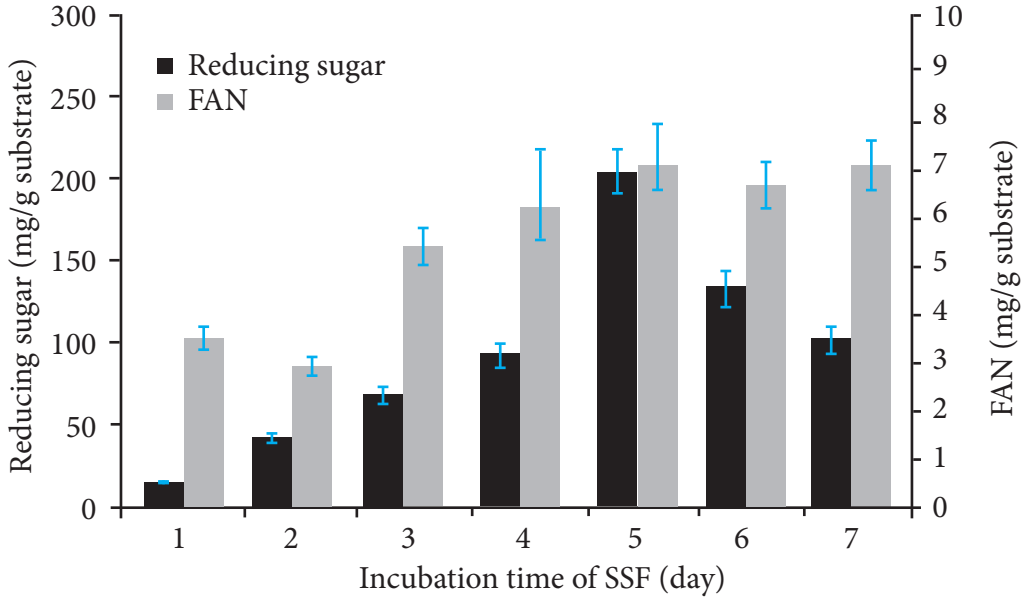


In summary, relative humidity is one of the most important aspects of fungi growth in petri dishes as it has a direct influence on evaporation. A low relative humidity increases evaporation rate from the moist fermented medium. Depending on the process, the results obtained in a preliminary test indicated the necessity of a better control of the medium moisture content by maintaining a high humidity content of the incubation environment. This measure could provide similar and more reliable results for comparison with larger scale experiments.

Effect of incubation time on sequential enzyme hydrolysis

During solid state fermentation, enzyme activities and deconstruction level of substrate are affected by the growth of the microorganism. Therefore, it is crucial to monitor nutrients production to find the optimal time to terminate the fermentation to have a proper enzyme complex and accessible substrate for further hydrolysis. Based on the outcomes of the pervious experiments, the size of sugarcane bagasse was adjusted to 1.4-0.85 mm and mixed with soybean hull in the ratio of 6:4 (SB:SH). Initial moisture content of substrate was set to 65% (w/w), the relative humidity in the incubator was fixed to 75% and the fermentations were carried out at 30°C. The time interval chosen for sampling was every 24 hour

After 1 day of solid state fermentation, further hydrolysis yielded only 5.6 mg reducing sugar/g solid and 3.9 mg FAN/g solid (Figure 5.24). After 5 days of incubation, the reducing sugars and FAN, after subsequent hydrolysis, were 226.3 mg/g and 7.7 mg/g respectively. Beyond 5 days of solid state fermentation, sugar yield started to decrease and further incubation times were markedly affected. It is believed that sugar production was considered to be associated with cellulase, beta-glucosidase and hemicellulase activity that degraded cellulose and hemicellulose remaining after SSF. The decreasing pattern, however, suggests that the synergistic effect of lignocellulosic enzymes might reach highest level during 5 days of fermentation and thus hit the highest point of further hydrolysis performance. As for FAN production, it was a result of the activity of both extracellular protease released during the fermentation and intracellular protease from autolysis (Wang et al., 2010). FAN production rose gradually until 5 days of SSF and then reached a plateau around 7.8 mg/g substrate. This is probably due to the limited nitrogen content of the substrate and the inhibition of enzymes by the product.



Effect of SSF incubation time on Sugar and FAN production via sequential bioprocessing (SSF + hydrolysis)

CLIMATIC REQUIREMENT

Temperature for different critical stages of sugarcane:

The different critical stages are germination, tillering, early growth, active growth and elongation. Optimum temperature for sprouting (germination) of stem cuttings is 32° to 38°c. It slows down below 25°, reaches plateau between 30°-34°. Temperatures above 38° reduce the rate of photosynthesis and increase respiration. For ripening, however, relatively low temperatures in the range of 12° to 14° are desirable.

Reduction in yield of sugarcane due to rise in temperature

The sugarcane productivity and juice quality are profoundly influenced by weather conditions prevailing during the various crop-growth sub-periods. Sugar recovery is highest when the weather is dry with low humidity; bright sunshine hours, cooler nights with wide diurnal variations and very little rainfall during ripening period. These conditions favour high sugar accumulation. The climatic conditions like very high temperature or very low temperature deteriorate the juice quality and thus affecting the sugar quality. Favourable climate like warm and humid climate favour the insect pests and diseases, which cause much damage to the quality and yield of its juice and finally sucrose contents.

Recommendation for cultivation of crop in view of climate change Abiotic and biotic stresses

In the tropical region, sugarcane gets more or less ideal climatic conditions for its growth. It is cultivated with better package of practices and higher irrigation levels. The growing season is long with more equitable and favourable conditions. Floods, water logging, diseases such as red rot, wilt, smut etc. are the main problems for sugarcane cultivation in the region. Moisture stress during the early part of the cane growth mostly during March to June, is an important problem. In the coastal areas, red rot has become a major threat. Among the pests, early shoot borer, particularly in the late planted crops, and woolly aphid are considerably serious in this region. In sub-tropical region, the extreme of climate is the characteristic feature. During April to June, the weather is very hot and dry and the temperatures are extremely high. December and January are the very cold months with temperature touching sub-zero levels in many places. The major portion of the zone

i.e., the North-West zone comprising the areas in Haryana, Punjab and Western U.P., has very low temperature in December-January which often causes frost. Because of extremes of weather, the active sugarcane growth is restricted to 4-5 months only. In eastern U.P., Bihar and West Bengal, sugarcane suffers due to floods and water logging during monsoon months. Several pests and diseases, particularly red rot and top borer and pyrilla are common and serious. The cane yields are lower in the sub-tropics due to short growing season, moisture stress, more pest and disease problem, floods and water logging, delayed planting after wheat and very poor ratoons. The management of these stresses will necessitate the development of better cultivation and integrated diseases and insect-pests management modules (Source: Vision-2030-IISR).

Genetic breakthrough for yield improvement from ICAR / SAUs/ International

Organizations: There is no commercially grown transgenic sugarcane. Research and development of transgenic sugarcane has been identified in: Australia, Argentina, Brazil, Cuba, Egypt, India, Indonesia, Mauritius, Myanmar, South Africa, USA, Venezuela.

Advance tools to be applied if any like transgenic, genomics etc.

The work on transgenic in sugarcane in India is recently stated at SBI, Coimbatore. "We have used the molecular technologies in introgression of wild species and developed sugarcane transgenics," Dr. V. Nair, Director, SBI, Coimbatore said, and conceded that cane agriculture faced serious challenges in terms of sustainability. High cost of production, depleting natural resources, climate change, non-availability of labour, emerging new pests and diseases have impacted cane productivity and

sustainability. He stressed the need for gearing up to meet such challenges – both in technology as well as policy levels. Voicing concern over static cane productivity, the Director said, "varietal decline and depletion of soil fertility have resulted in yield decline". Further studies conducted in India, Mauritius, South Africa and Trinidad showed a 30 per cent and more loss in productivity for every two degree centigrade increase in temperature. Transgenic sugarcane can increase yields, reduce production costs, improve sugar quality and reduce the environmental impact of sugarcane cultivation but each transgenic event must be analysed separately, because the impact (benefit and risk) of each trait will be different. Strong and reliable regulatory agencies are needed.

Seed Scenario

The normal practice in Sugarcane growing States of country is to use commercial crop of sugarcane for seed purposes. Sugarcane is vegetatively propagated and required huge quantity of seed. The accounting of different classes of sugarcane seed i.e. breeder, foundation and certified are not being maintained by the different sugarcane growing States therefore the exact quantum of sugarcane certified seed distributed by different agencies in major sugarcane growing state could not be assessed and resulted in failure of assessment of SRR in sugarcane. The important cane seed production advanced technologies areavailable as under:

Tissue Culture

The tissue culture technique in sugarcane can be used for rapid multiplication of newly developed high yielding, high sugar, disease resistant varieties and rejuvenation of outstanding varieties under cultivation. The micro propagation technique used in this technology with the advantages of (i) Production of true to type plantlets, rapid multiplication (ii) independent of seasonal constraints (iii) maintaining and improving the productivity of outstanding varieties in the field (iv) production of disease free planting material from apical meristem. Polythene Bag Technology means raising of seedlings through budchip/ single bud technique is the major frontier seed multiplication technique in sugarcane.

Table: Prominent sugarcane based cropping system in tropical and subtropical regions of the country recommended.

Sub tropical	Tropical region
Paddy- Autumn Sugarcane-ratoon-wheat	Bajra-Sugarcane(pre-seasonal)-Ratoon- wheat
Greengram- Autumn Sugarcane-ratoon-wheat	Paddy-Sugarcane-Ratoon- Finger millet
Maiz- Autumn Sugarcane-ratoon-wheat	Paddy-Sugarcane-Ratoon- Wheat
Kharif Crops-Potato-Spring Sugarcane-ratoon-Wheat	Paddy-Sugarcane-Ratoon- gingelly Kharif
Crops-Mustard-Spring Sugarcane-ratoon-Wheat	Paddy-Sugarcane-Ratoon- urd.
Kharif Crops-Pea/Coriander-Spring Sugarcane-ratoon	Cotton-Sugarcane-Ratoon–wheat-Wheat
Kharif Crops-Wheat-late Planted Sugarcane-ratoon- Wheat	Sugarcane-Ratoon-Kharif rice-Winter rice.

METHOD OF PLANTING SUGARCANE

Method of planting

Sugarcane can be planted by improved method of planting like, deep furrow, trench methods, ring pit method and paired row method instead of furrow system.

Resource Conservation Technology in Sugarcane

Application of nitrogen fixing (Azospirillum and Gluconacetobacter) and phosphate solubilizing (Phosphobacteria) bio-fertilizers were found to reduce the requirement of chemical fertilizers to the extent of 25%. Reduction in the dose of chemical fertilizers reduces soil degradation (Source: http://www.sugarcane.res.in). Trash mulching of dry leaves, drip irrigation for water saving and mechanization through Ratoon management device (RMD), sugarcane cutter planter, trench opener, power weeder etc. are successfully using for saving for man power as well as time.

Seeding technologies –seed rate, distance, depth, plant population

Seed rate

Seed rate in sugarcane varies from region to region. Generally higher seed rate are used in north western India (Punjab, Haryana and Rajasthan) because of the lower germination percent and also adverse climatic condition (very hot weather with desiccating winds) during tillering phase. A northern region seed rate generally

varies from 35,000 three budded setts per hectares while in southern region it range between 25,000 to 40,000 three budded setts.

Fertilizer management – recommended dose for different ecologies, micro nutrients, organic manure , application method

An average crop of sugarcane yielding 100 t/ha removes 208kg of N, 53kg of P, 280kg of K, 30 kg of Sulphur, 3.4kg of iron, 1.2 kg of manganese, 0.6 kg of copper respectively from the soil. Hence, soil has to be replenished to maintain the productivity of sugarcane with the said quantities of nutrients.If the soil test value is below the critical value, apply sulphate form of Zn, Cu, Fe and Mn through soil application and foliar spray (The total concentration of salt should be 0.5% for young crop and 2.5% for a grown up crop). The recommendation of NPK for sugarcane crop varies from state to state and varies from region to region. The recommendation of Nitrogen is from 70-400 kg/ha Phosphorus 27-74 kg/ha and Potassium 25-141 kg/ha.

The recommended dose of bio-fertilizers for sugarcane crop is 10-12 kg/ha Acetobector, Azotobector, Azospirillum (or Gluconacetobacter) and PSB are the major bio fertilizers which are being used in Sugarcane crop.

Water management: application and conservation methods, their water useefficiency, water requirement of crops, critical stages for irrigation and probable losses if not applied:

In tropical area, irrigations are to be given once in 7 days during germination phase (1 –35 days after planting), once in 10 days during tillering phase (36 – 100 days after planting), again once in 7 days during grand growth phase (101 – 270 days after planting) and once in 15 days during maturity phase (271 days after planting up to harvest) adjusting it to the rain fall pattern of the area. About 30 to 40 irrigations are needed. Whereas in subtropical area about 7-10 irrigations are being given to the sugarcane crop. Sugarcane is a high water requirement crop. About 250 tonnes of water is needed to produce one tonne of sugarcane. Methods like alternate furrow irrigation, drip irrigation and trash mulching could be of use to economize irrigation water during water scarcity periods. Foliar spraying of a solution containing 2.5% urea and 2.5% muriate of potash 3 or 4 times at fortnightly intervals during drought periods would help to reduce the impact of drought on the crop.

Water requirement and applying irrigation at critical stages of growth

As mentioned earlier, critical stages are those during which sugarcane is affected severely due to water stress and the loss cannot be restituted by adequate water supply at later stages. These stages are: sprouting (germination), formative stage

or tillering, ripening and initiation of sprouting in ratoons. In case of limited water availability, one may sustain sugarcane productivity by irrigating at critical stages of growth. (Sustaining sugarcane productivity under depleting water resources

Weed Management – important weed flora, herbicides recommended with dose application time, and different methods (mechanical , biological etc.):

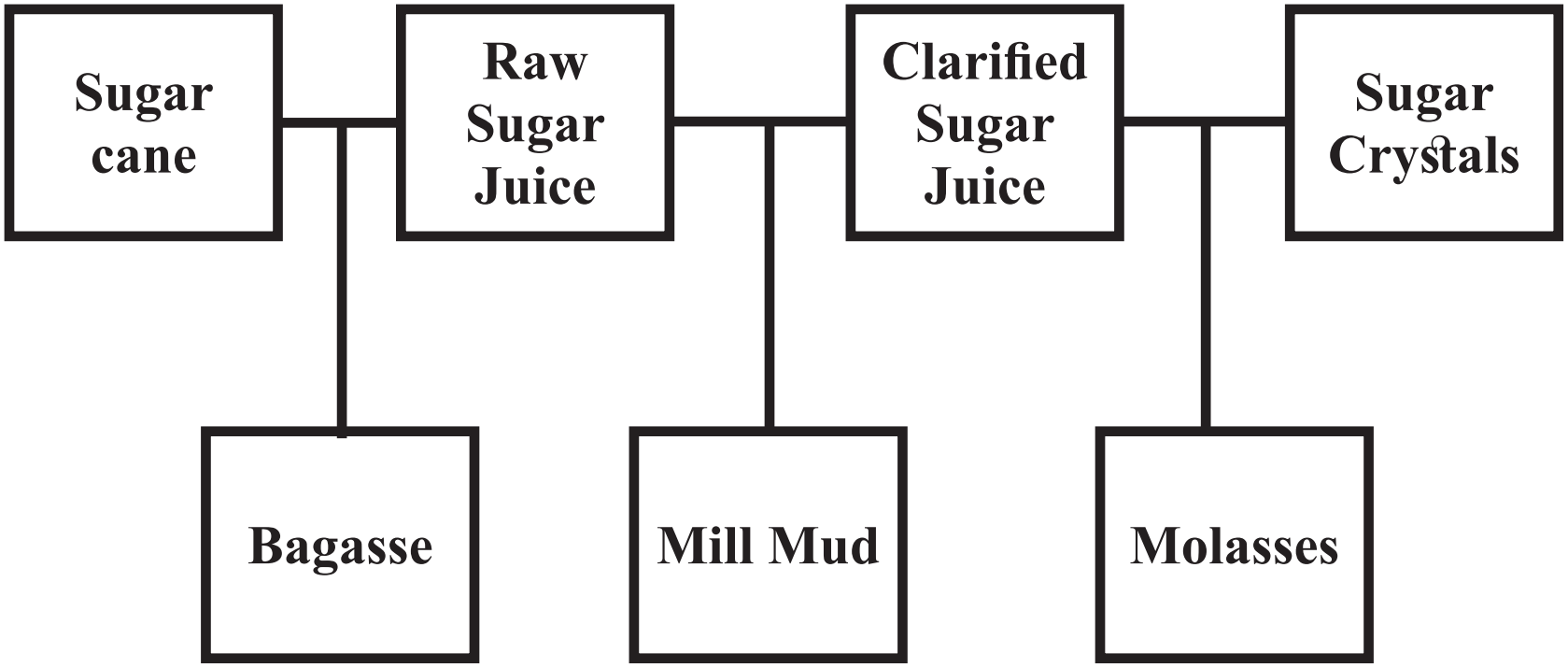
In sugarcane weeds have been estimated to cause 12 to 72 % reduction in cane yield depending upon the severity of infestation. The nature of weed problem in sugarcane cultivation is quite different from other field crops because of the following reasons:

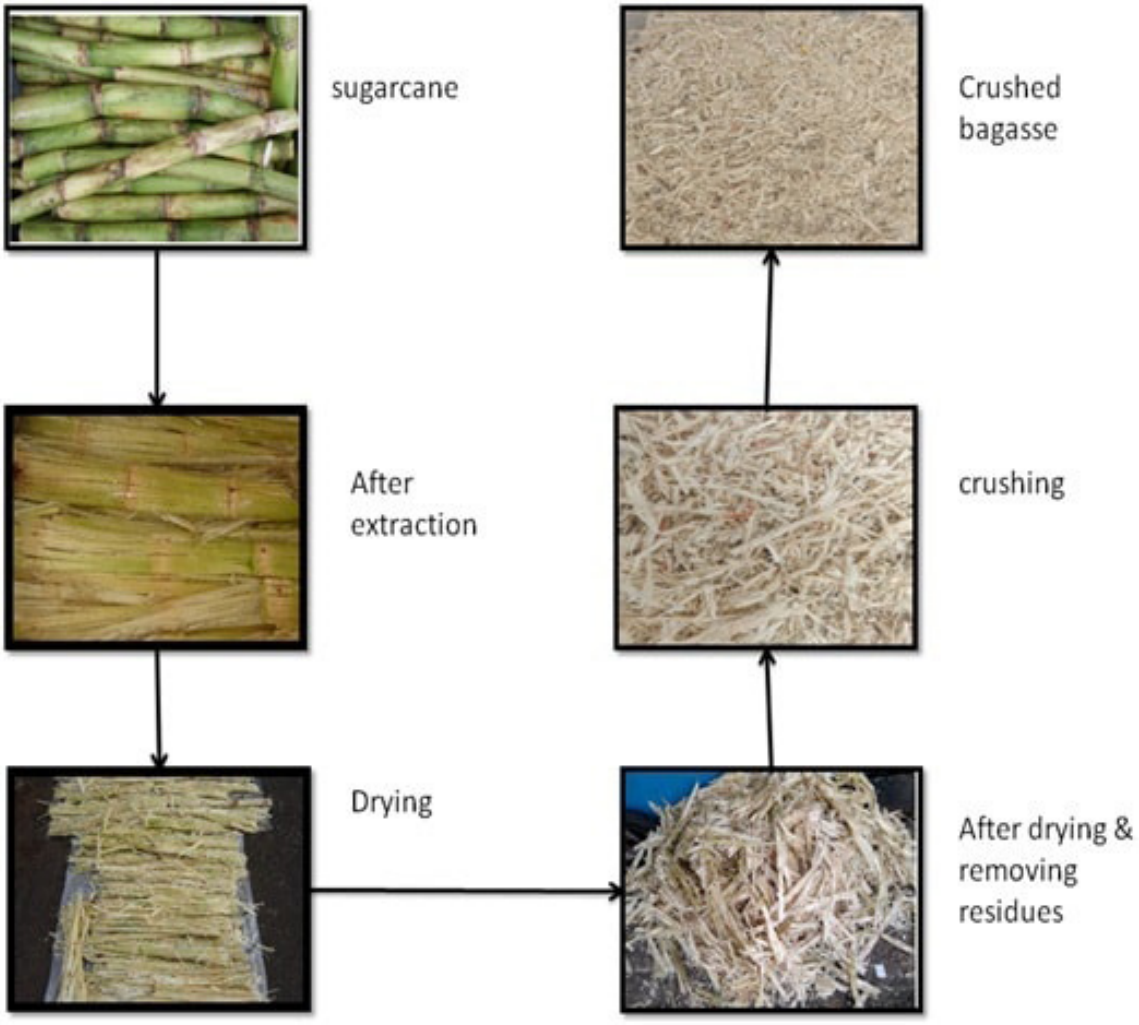
- Sugarcane is planted with a relatively wider row spacing.
- The sugarcane growth is very slow in the initial stages. It takes about 30 – 45 daysto complete germination and another 60-75 days for developing full canopy cover.
- The crop is grown under abundant water and nutrient supply conditions.
- In ratoon crop very little preparatory tillage is taken up hence weeds that have established in the plant crop tend to flourish well.

The major weeds are Sedges- Cyprus rotundus; Grasses-Cynodon dactylon, Sorghum helepense, Panicum spp, Dactylocternium aegyptium, Broad leaved weeds.

FLOW CHART, BAGASSE, MILK MUD, MOLASSES

PRODUCTION




sugarcane
After extraction
Drying
Crushed bagasse
crushing
After drying & removing residues

Result

These objects have been achieved by providing in a process for the production of paper pulp from sugar mill bagasse which comprises wet bulk storing partially depithed bagasse,

The objects of the present invention have also been achieved by a preferred sequence of process steps, the combination of which effects chemical and morphological benefits leading to unexpectedly and particularly good results obtainable by this invention. This process comprises one or more, and preferably all, of the fol lowing steps.

In one product aspect, this invention relates to paper pulp suitable as the sole pulp furnish for newsprint, obtained from sugar mill bagasse by the above processes.

- First our project members collected the sugarcane bagasse from the market.
- Then to dry the collected bagasse on the college terrace.
- Then to crush the bagasse with the bamboo and collected the crushed bagasse.
- Then we boiled the crushed bagasse on the steel bucket on a boiling temperature.
- After that we grained the bagasse on the mixy but it is not properly grained and again we repeated the process on the grainder and we got the required pulp.
- Then we made a moulded mesh on the paper size and applied the pulp on the moulded mesh.
- Then to dry the sample on the college terrace.
- After the sample is dryed well and it is not broken.
- Then we started the mould work by visting the company and to ask manager rate for one mould.
- He is asked one mould rate is 30,000. our project budget is 12,000.
- So our project members discuss and to take the decision to make mould on a white cement.
- If we are make the mould on the white cement and dry the mould on the college terrace.

- Then we are make the two types of mould it is egg tray molud and mushroom tray.
- After the dryed mould is hard and not broken.
- Then to apply the pulp on the mould and dry on the college terrace.
- After the dryed it is fixed on the mould and not properly come on a mould.
- Then to apply the oil on the mould and apply the pulp on the mould and dry on the college terrace.
- After the dryed and it is normally fixed on the mould and it is not come properly on the mould and it was broken
- Then we are apply the petroleum gel on the mould and apply the pulp on the mould and dry on the college terrace.
- After the dryed and it is not fixed on the mould and not broken.
- After that tray was ready.
- we the project member made the egg tray and mushroom tray.
- That’s also very clearly finishing the egg tray.
- We made the egg tray.
- Then we are prepared for other trays.

Collected the sugarcane bagasse from the market.

Collected the crushed bagasse.

Boiled the crushed bagasse on the bucket

We grained the bagasse on the mixy

We repeated the process on the grainder

We got the required pulp.

But it is not properly grained

We did not got the correct result

Applied the pulp on the moulded mesh.

But again not able to get correct result

Dry the sample

The sample is dryed well and it is not broken.

The decision to make mould on a white cement

Egg tray molud

Egg tray

Mushroom tray molud

Mushroom tray

TYPES OF TRAYS

FOOD TRAYS :

VEGETABLE TRAYS:

FRUITS TRAYS :

MUSROOM TRAYS:

Egg Trays