ICMA
Pakistan

Synopsis of Sugar Industry

DISCLAIMER

The purpose and scope of this book is to provide an insight on the production process of sugar manufacturing and allied matters. All the material included in this book is based on data/information gathered from various sources. Although, due care and diligence has been taken to compile this document, the contained information may vary due to any change in any of the concerned factors, and the actual results may differ substantially from the presented information. ICMA Pakistan does not assume any liability for any financial or other loss resulting from this book and as such the content of this book should not be relied upon for making any decision, investment or otherwise. The content of the book does not bind ICMA Pakistan in any legal or other form.

Author

Mr. Muhammad Arif Nara, FCMA

Dedication

The book is dedicated to my mother, Zulekha Bai daughter of Haji Abdul Ghani Baig Mohammad Bawany and wife of Mohammad Ishaq Nara.

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Foreword

The Pakistan's economy is very much relying on the success of agricultural and manufacturing sectors. The research and periodical study of various components of the manufacturing sector is imperative for the industrial development of economy and progression of society as it identifies obsolete processes, outdated practices and technological advancement. It would help the businesses to review their strategy to achieve quality, operational efficiency and economies of scale while for sick sugar manufacturing firms, the Synopsis will serve as premier guideline to revive their entire setup.

I am delighted to present **'A Synopsis of Production Process in Sugar Industry of Pakistan'** authored by a very senior member of our Institute, Mr. Muhammad Arif Nara under the aegis of Research and Publication (R&P) Committee of the Institute of Cost and Management Accountants of Pakistan. Based on his over 40 years accumulated experience in the area of Management Accounting in sugar industry of Pakistan, has successfully narrated the complete production process being used by the sugar mills – from harvesting to sugar cane production; and from cane crushing to production of sugar. The intellectual inputs of members of R&P Committee based on their vast experience in Management Accounting added enormous value to the 'Synopsis'.

ICMA Pakistan, being a national Institute is a trusted name in the field of professional education, corporate trainings, industry research and technical support to businesses for the promotion of best practices and to ensure corporate governance within the country. To fulfill its national responsibility towards upbringing of economy, the Institute is working very closely with the ministries, government departments, industry, trade, businesses and regulatory authorities such as SECP, SBP, etc for the betterment of the economy.

I, once again, congratulate Mr. Muhammad Arif Nara and Research & Publication Committee of the Institute for amicably accomplishing the task and presenting such a useful publication for the benefit of professionals, industrialists, businessmen, researchers and students.

Zia ul Mustafa, FCMA
Chief Executive and President

Dated: April 29, 2014

Preface

Pakistan is the 6th largest producer of sugarcane and 12th largest producer of sugar in the world. The sugar industry of Pakistan is the second largest agro-industry after textiles. Sugarcane is cultivated in Pakistan in around one million hectares of agricultural land, which is supplied to more than 80 sugar mills in different parts of the country for sugar production.

Sugar is an important cash crop, which, besides sugar production, is also used in the production of pharmaceutical ethanol, fuel ethanol, bagasse for paper and chip board manufacturing, and press mud used in organic fertilizer. The sugarcane is also beneficial for beverage, confectionary, pharmaceutical, animal feed, electricity generation (co-generation), chemical and fertilizer industries as well as for environmental purposes.

This book on sugar production process is a worthwhile contribution of Mr. Muhammad Arif Nara, FCMA, which presents useful facts and figures with regard to sugar production in the world and Pakistan. The book also presents a “SWOT Analysis’ of the sugar industry in Pakistan as well as identifies the Key Performance Indicators (KPIs), in addition to the Integrated Computerized Accounting System used by the Sugar Mills for their accounting transactions.

I am thankful to the Research and Publications Committee and the Secretariat for their efforts in developing this publication on such an important topic of national relevance. I hope that the book would provide a useful source of reference not only for our members but also for the students. I am sure that this book would be warmly received and appreciated by the members and other interested readers.

In the end I would like to suggest to the government to encourage the sugar mills to adopt modern technology for efficient and cost reduction operations.

Shahzad Ahmad Awan, FCMA
Chairman, Research & Publications

About the Author

Muhammad Arif Nara, FCMA
Former Honorary Secretary, ICMA Pakistan

Mr. Muhammad Arif Nara has a vast and diversified experience of Cost & Management Accounting for more than 50 years. He has worked as an Advisor Finance & Business & Project Valuation in Al-Habsha Sugar Mills PLC, of 8,000 TCD at Adees Ababa, Ethiopia for 2 months in 2012, as an Executive Director in Pakistan Institute of Public Finance Accountant from September 1, 2007 to November 1, 2008.

He worked for seven years in TNT Express World Wide (Dutch Courier Company) as Controller for Pakistan. He also worked for three years in Sugar Mills of Punjab as General Manager / Director Finance. He worked for two years as Director Education of the Institute of Cost and Management Accountant of Pakistan (ICMAP) from March 1997 to December 1998. Mr. Nara Designed New Education Program (Curriculum) for the Millennium. Worked for two years in Hashwani Hotels Limited (Owner & Operators of Marriott Hotels at Karachi and Islamabad) as General Manager Finance from 1995 to 1997 for the corporate Office, Overall Control & Supervision of Accounts, Finance, Corporate and Tax Matters.

Mr. Nara worked for about two years in Tawakkal Group of Companies as a Financial Adviser for Acquisition of Projects under Privatization Program of Pakistan, Sri Lanka, Iran, Egypt and Poland. He visited these countries for personal discussions, negotiations, project surveys, Appraisal and Financing through private placements public flotation. During this tenure he was also Director of Baluchistan wheels Limited, the only Automotive Steel Rim manufacturing Plant in Pakistan acquired from Government of Pakistan under Privatization program. Mr. Nara worked for five years as Dy. Managing Director of Adamjee Floorings Limited, a PVC tile manufacturing plant from 1988 to 1993. He worked for ten years in Sind Sugar Corporation limited from 1977 to 1987. Mr. Nara was appointed as Chief Accountant with additional charge of Agriculture Manager of Dadu & Thatta Sugar Mills during the first four year period and was involved in Project Management, System Designing & Operation. Subsequently he was Promoted as Chief Internal Auditor of the two Sugar Mills and then posted as General Manager of Thatta Sugar Mills.

He worked for fourteen years from 1963 to 1976 in Bawany Group of Industries on Senior Management Position in Accounting / Finance Division with postings in Sugar Mills, Jute Mills and Textile Complex comprising Spinning, Weaving Processing, Hosiery & Silk goods manufacturing etc. He acquired full knowledge of Costing, Financial Management and Taxation. At the time of leaving he had attained the position of Chief Accountant. During the tenure he was also sent on deputation to regional office of the group, Singapore as Financial & Marketing Manager for two years.

Qualification:

- Fellow Member of the Institute of Cost & Management Accountant of Pakistan since 1978.
- Master Degree in Economics from the University of Karachi, Pakistan.

Gold Medal & Excellence Awards:

- Awarded Gold Medal by ICMAP at the Golden Jubilee Conference (50th Anniversary) for the contribution to the profession.
- Awarded Excellence Award by ICMAP on 60^{th} and 61^{st} Anniversary of Management Accountants' Day.

Visiting Faculty:

- Experience of teaching Accounting and Cost Accounting subjects to the students of Graduation, Cost and Management Accounting and Financial Accounting in ICMAP 1988-2005 & 2009 and in Muhammad Ali Jinnah University 2006-2009, also in PAF-KIET.
- Attended course on Quantitative Technique – Managerial Effectiveness and various Seminars and Conferences in the field of Accounting, Taxation and management.

Affiliations:

- Appointed as member of International Federation of Accountants (IFAC) Board, New York, on Professional Accountant in Business (PAIB) - Tenure January 2007 to December 2009. Honorary Secretary - ICMAP 2006-2008.
- Member Education Committee on South Asian Federation of Accountants (SAFA) 2006-2008.
- Member National Council - ICMAP 2006-2008.
- Member Board of Governor PIPFA 2006-2007.
- Chairman, Karachi Branch Council of ICMAP 1992, 1995 & 1996.
- Vice Chairman of Karachi Branch Council of ICMAP 1989, 1990.
- Member Karachi Club.
- Life Member Memon Professional Forum.
- Member Board – CMA Foundation of ICMA Pakistan.

About the Assistant to Author

Muhammad Hanif Abdul Aziz, FCMA
Member ICMA Pakistan

Mr. Muhammad Hanif Abdul Aziz has a vast experience of Finance, Accounting, Corporate Secretarial jobs, Personnel & Human Resource Department for more than 30 years.

Currently he is working as a Chief Financial Officer & Company Secretary of a Public Limited sugar mill listed on Karachi Stock Exchange. This mill was established in 1967 and is one of the largest in the province of Sindh. In this capacity reports to Chief Executive and is responsible for overall administration of Finance, Accounting and Corporate Secretarial job besides shouldering additional responsibility of Personnel & Human Resource and Purchase Department.

He has also worked as a Chief Financial Officer/Company Secretary in M/s. Duty Free Shops Limited (an unlisted public company) reporting to expatriate Chief Executive Officer. The Company was privatized in September 1999 by Government of Pakistan and is 51% shares along with management control were taken over by M/s. Dufry's (Formerly Weitnauer Group of Companies) of Switzerland which is present in more than 25 countries of the world.

He has worked as a Financial Controller / Company Secretary of W. Woodward Pakistan Private Limited (a multinational pharmaceutical company) reporting to the Chairman and Chief Executive and Worked as "Senior Internal Auditor" in Caltex Oil Pakistan Limited (An American Oil Marketing Company).

Qualification:

- Fellow member of Institute of Cost & Management Accountants of Pakistan in November 1988. Secured First Position in part II & III.
- Fellow member of Institute of Corporate Secretaries of Pakistan
- Associate Member of The Institute of Taxation Management
- Bachelor of Commerce

Chapter 1

Sugar Industry

An Overview

Introduction

Sugar market is one of the most protected markets for agricultural products world wide. In almost every sugar producing country the sugar market is regulated in some way. With an increasing liberalisation of agricultural trade in the „Millennium Round" of the WTO trade negotiations, the question of international competitiveness is of increasing importance. Based on empirical studies, in this article the competitiveness of sugar production in the most important sugar producing countries is analysed, including the whole production process from beet or cane production in the field to sugar processing in the factory. Special emphasis is focused on the different location factors and their influence on competitiveness, so that finally, conclusions can be drawn on future development of the world sugar market and the different sugar production locations can be drawn for a liberalisation scenario.

From the countries included in this study, at present only Brazil, Australia, Thailand and partly South Africa would be able to produce sugar under world market conditions.

While Brazil and Australia profit from favourable natural, economical and political location factors, in Germany high opportunity costs as well as high environmental and social standards predominate the advantages of high efficiency in the sugar industry. In the United States partly disadvantageous climatic conditions together with high opportunity costs are responsible for the insufficient international competitiveness of sugar production. Low productivity in Thailand and South Africa is overbalanced by low wages as well as comparatively low environmental and social standards. Without standardized environmental and social regulations, a liberalisation of the world market would force movements of sugar production from beet to cane areas with favourable natural, economical and political conditions.

History of Sugar

6000 BC

Sugar cane is already known in eastern Asia, from where it spreads to India and Persia.

600 BC

The Persians develop a sugar processing method: hot sugar cane juice is poured into conical clay or wooden vessels. Substances that do not contain sugar drip through an opening at the tip of the cone in the form of a syrup, leaving behind the crystallising sugar compound. Sugar loaf is the result.

1100 AD

Central Europeans experience sugar for the first time thanks to the Crusades. An account of a voyage contains the following sentence: “In the fields of the plain at Tripoli we found a honey reed, which the inhabitants call ‘zucra’”.

Initial imports bring sugar to Europe, where it quickly becomes very popular among kings and princes.

From about 1500 AD

Sugar cane is cultivated in large plantations worldwide and is shipped to Europe. Sugar is still an expensive commodity.

1747 AD

Andreas Sigismund Marggraf discovers that the field mangel contains the same amount of sugar as sugar cane.

1801 AD

After Marggraf’s pupil and successor Franz Carl Achard processes sugar from beets for the first time, the world’s first factory for producing beet sugar is built at Cunern/Silesia.

From about 1850 AD

The competition between cane and beet sugar causes a drastic fall in price and sugar becomes an everyday commodity.

Origin of Sugar Cane

Before the birth of Jesus of Nazareth, sugarcane (from which sugar is made) was harvested on the shores of the Bay of Bengal; it spread to the surrounding territories of Malaysia, Indonesia, Indochina, and southern China. The Arabic people introduced “sugar” (at that point a sticky paste, semi-crystallized and believed to have medicinal value) to the Western world by bringing both the reed and knowledge for its cultivation to Sicily and then Spain in the eighth and ninth centuries. Later, Venice—importing finished sugar from Alexandria—succeeded in establishing a monopoly over this new spice by the fifteenth century; at that point, it started buying raw sugar, and even sugarcane, and treating it in its own refineries. Venice’s monopoly, however, was short-lived.

In 1498, Portuguese navigator Vasco da Gama returned from India bringing the sweet flavoring to Portugal. Lisbon started to import and refine raw sugar, and, in the sixteenth century, it became the European sugar capital. It was not long before the sweetener was available in France, where its primary function continued to be medicinal, and during the reign of Louis XIV, sugar could be bought by the ounce at the apothecary. By the 1800s, sugar (though still expensive) was widely available to both upper and middle classes.

Raw Materials

Sugarcane cannot readily be separated into the components. In the sap of some plants, the sugar mixtures are condensed into syrup. Juices of sugarcane (*Saccharum officinarum*) and sugar beet (*Beta vulgaris*) are rich in pure sucrose, although beet sugar is generally much less sweet than cane sugar. These two sugar crops are the main sources of commercial sucrose.

The sugarcane is a thick, tall, perennial grass that flourishes in tropical or subtropical regions. Sugar synthesized in the leaves is used as a source of energy for growth or is sent to the stalks for storage. It is the sweet sap in the stalks that is the source of sugar as we know it. The reed accumulates sugar to about 15 percent of its weight. Sugarcane yields about 2,600,000 tons of sugar per year.

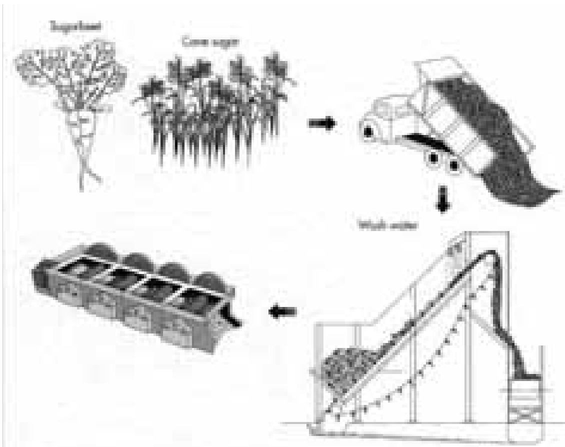
The sugar beet is a beetroot variety with the highest sugar content, for which it is specifically cultivated. While typically white both inside and out, some beet varieties have black or yellow skins. About 3,700,000 tons of sugar are manufactured from sugar beet.

Other sugar crops include sweet sorghum, sugar maple, honey, and corn sugar. The types of sugar used today is white sugar (fully refined sugar), composed of clear, colorless or crystal fragments; or brown sugar, which is less fully refined and contains a greater amount of treacle residue, from which it obtains its color.

Sugar is a broad term applied to a large number of carbohydrates present in many plants and characterized by a more or less sweet taste. The primary sugar, glucose, is a product of photosynthesis and occurs in all green plants. In most plants, the sugars occur as a mixture.

Planting and Harvesting

Sugarcane requires an average temperature of 75 degrees Fahrenheit (23.9 degrees Sugarcane takes about seven months to mature in a tropical area and about 12-22 months in a subtropical area. At this time, fields of sugarcane are tested for sucrose, and the most mature fields are harvested first. In Florida, Hawaii, and Texas, standing cane is fired to burn off the dry leaves. In Louisiana, the six- to ten-feet (1.8- to 3-meter) tall cane stalks are cut down and laid on the ground before burning.



Sugar and Nutrition

Sugar is a food product, whose nutritional value has been tested by recognized nutritionists and doctors. Neither a person's health nor vitamin supply is endangered by the amount of sugar typically consumed in Germany. The top American health authority also classifies sugar as a safe food.

In March 2000, the German and Austrian Nutrition Societies and the Swiss Society for Nutrition Research published the "D-A-CH Reference values for nutrient intake", thus updating the previous recommendations for healthy eating to reflect the latest scientific findings. According to the current recommendation by the nutritionists: "Sugar should be used in moderation." The experts at both the World Health Organization (WHO) and Food and Agriculture Organization (FAO) have thus distanced themselves from the prior recommendation to strictly limit sugar intake.

Dental cavities (caries)

The idea that there is a direct correlation between sugar consumption and dental cavities is no longer supported by current scientific findings. Despite the fact that sugar consumption in Germany has remained constant, as it has in other developed countries, the incidence of dental cavities in children and young people has been declining sharply for several decades. Dental cavities occur when several events coincide: a coating on uncleaned teeth, acid-producing bacteria resident in the coating, fermentable carbohydrates and sufficient time for the acid or bacteria to attack the teeth. It is irrelevant whether the carbohydrates stem from fruits, honey, food containing sugars, snacks containing starch or breakfast cereals. The decisive factor is how long they remain on the teeth. Brushing with fluoride toothpaste soon after eating to remove residual food from the teeth is the most effective way to prevent cavities.

Obesity

The main cause of excess weight is energy imbalance. People who regularly burn less calories than they consume store excess fat that causes weight gain. Lack of exercise and excess energy intake are currently the main reasons for being overweight. On the other hand, individual foods do not play a role. However, it is known that when using energy from the food we eat, our body digests carbohydrates first - and sugar is a carbohydrate - while it finds it very easy to completely store fats. Even when there is a very large supply, all carbohydrates, including sugar, are the body's preferred source of energy. They may be stored in the form of glycogen, but are not converted to body fat. Only extremely high quantities of carbohydrates cause new fat to form in humans.

Furthermore, a study in Scotland that examined 11,000 adults determined that there was an inverse relationship between body weight and sugar consumption. The more sugar the participants consumed, the less likely they were to be overweight.

Diabetes

Like other carbohydrates, sugar supplies cells with energy. Diabetics may therefore include sugar in their diet if they limit their intake to no more than one-tenth of their total energy supply.

Essential nutrients

Several studies, undertaken to address the concern that high amounts of sugar could block the absorption of essential nutrients from food, concluded that there was no cause for alarm.Sugar is converted to glucose in the body, which is consumed by the cells when it is in turn converted to energy. Body cells cannot distinguish a glucose molecule originated in bread, an apple or the sugar in a beverage.

World Sugar Market

The significance of the world sugar market on the one hand results from a largely inelastic demand in the industrialised countries, and on the other hand from a production area that is limited to a great extent because of the climatic requirements of beet and cane. Sugar is produced in about 120 countries with different levels of economic development. In 1998 the world sugar production of 130 million tons exceeded the consumption by about 5 million tons and led to an increase of world sugar stocks to about 40% of the consumption (WVZ, 1999). In general, the world market for sugar is only of marginal importance, as only around 30 % of the world sugar production is exported and in almost every country the domestic sugar market is protected. Additionally, around one third of world sugar exports (35 million tons AGRA-EUROPE, 25/99) is based on preference agreements or long-term contracts (ISO, 1997; VSZ, 1991). Consequently, only around 20% of the world sugar production is traded under free market conditions.

By far the biggest sugar producers in the world are Brazil, the EU and India, whereas they play different roles on the world market, because of the different importance of their domestic consumption. The USA, Thailand and Australia on the other hand take different positions on the world market as exporting or importing countries despite their similar production volume. More than 80% of the world sugar exports are realised by only ten of the most important sugar exporting countries (Brazil, 2 EU, Australia, Thailand, Cuba, South Africa etc.), whereas the demand is determined by a lot of small importing countries.

World Sugar Production

Sugar is produced in 120 countries. Global production now exceeds 165 million tonnes a year. Approximately 80% is produced from sugar cane, which is largely grown in tropical countries. The remaining 20% is produced from sugar beet, which is grown mostly in the temperate zones of the northern hemisphere. 70 countries produce sugar from sugar cane, 40 from sugar beet, and 10 from both. The 10 largest sugar producing nations represent roughly 75% of world sugar production. Brazil alone accounts for almost 25% of world production. Its share is increasing although the country's output has witnessed some setback since the 2008-2009 crisis.

World Sugar Consumption

At the beginning of the 20th century, a world population of 1.6 billion people consumed roughly 8 million tonnes of sugar, i.e. 5,1 kg per capita. Considerable expansion took place until 1980, when world sugar consumption reached nearly 90 million tonnes, i.e. an annual growth rate of 3.1%. After going through a sluggish growth in the 1990s, which hardly exceeded 2,2% per annum, sugar consumption has grown at an healthy rate since the early 2000s, notably in Asia (+4,9% p.a.), the Middle-East (+4,6% p.a.) and Africa (+4,1% p.a.).

Today, a world population of 7 billion people, of which 4,0 billion are concentrated in Asia, consumes roughly 165 million tonnes of sugar, that is 23 kg per capita on average, with the lowest level seen in Bangladesh (8 kg) and the highest in Israel, with 66 kg. The 10 largest sugar consuming nations represent roughly two-thirds of total world consumption. White sugar consumption in developed countries can be considered as saturated (flat/ low population growth and maturity of food markets), whereas developing countries are considered as growing markets, particularly in Asia, and, to a lesser extent, in the Middle-East and Africa.

World Sugar Trade

Sugar trade accounts for between 20% and 25% of world demand. This share is higher than for the main agricultural commodities, grains, where this ratio ranges from 10% to 20%.

In the past, sugar trade was carried out mainly between governments through long-term agreements. Over the last twenty years, sugar trade has been liberalized in many countries; the bulk of inter-state trade agreements no longer exist.

In 2011, total trade flow amounted to 51 million tonnes, of which 46 million tonnes traded in the so-called free market, comprising 30 million tonnes of raw sugar and 16 million tonnes of white sugar, and 4;5 million tonnes under preferential agreements, such as the Cuba -China Protocol, the EU preferential access granted to African-Caribbean and Pacific countries (ACP) and EBA (Everything But Arms) countries, and the US import quota.

On neither side of the world sugar trade (raws or whites) are there any real multinational companies producing and selling sugar in all continents. Trading houses are the only true global players. As an effect of progressive trade liberalization and the new direction of the sugar policies, the world sugar economy and trade have become increasingly sensitive to world prices. Competition has increased worldwide between sugar processors. In the recent past, the five largest sugar exporters have represented 80% of total world sugar exports. Sugar is increasingly traded as a raw material (raw sugar) rather than a finished product (white sugar).

World Sugar Statistics

World Sugar Consumption

Sugar is an important global trading commodity. In countries with a moderate climate, especially Western, Central and Eastern Europe, as well as the United States, China and Japan, sugar is produced from sugar beets, whereas in tropical and subtropical areas it is extracted from sugar cane. The most important sugar producing countries are: India, Brazil, Thailand, China, Australia, Mexico, Cuba and the United States. In total, sugar is produced in 127 countries around the world. Seventy-nine countries produce sugar from sugar cane, thirty-eight only from sugar beets, and ten from both plants.

In 2013/14 total amount of raw sugar produced globally is expected to reach 180.837 million tonnes . Global Consumption is expected at 176.335 million tonnes.The Sugar consumption by country is as follows:

Country	1962	2005	2011	2013
Europe	30.7	38.8	37.9	40.73
North and Central America	33.1	37.2	35.8	38.47
South America	31.0	48.1	52.3	56.20
Asia	5.3	16.2	18.3	19.67
Africa	9.5	15.2	15.4	16.55
Oceania	50.9	49.4	48.5	52.12
World	15.9	22.5	23.7	25.47

Table : Consumption of White Sugar per head in Kg.

Sugar Consumption in Pakistan

The sugar industry in Pakistan is pre-dominantly owned by the private sector, mostly in hands of influential families, having political connections. Out of 86 sugar mills, 44 mills (51%) are located in Punjab, 33 mills (38%) in Sindh and 09 mills (11%) in NWFP. About 43% (37) of sugar mills in Pakistan are listed on Stock Exchange whereas 57% (49) are in Non-Listed sector.

Province	Listed	Non-Listed	Total	Share In Total
Sindh	17	16	33	38%
Punjab	16	28	44	51%
N.W.F.P	04	05	9	11%
Total	**37**	**49**	**86**	**100%**

Table : Number of Sugar Mills in Provinces of Pakistan

(Value in Tons)

Province	Listed	Non-Listed	Total	Share of Listed	Share of Non-Listed
Sindh	89,200	84,000	173200	15%	14%
Punjab	135,500	236,700	372100	23%	40%
N.W.F.P	23,300	29,200	52600	4%	5%
Total	**248,000**	**349,900**	**597900**	**41%**	**59%**

Table : Break-Up of Installed Capacity (TCD) by Listed and Non-Listed Sugar Mills

Sugar Industry in Pakistan

Though production and use of sugar is recorded in 520 BC and long before, the growth of the modern form of white sugar industry in the Indian Sub-continent could be traced to early ‘30s. The number of sugar mills rose from 29 in 1931 to 139 in 1939. World War II established the need and supply of sugar as an important commodity. While the European industrial base was being diverted to the war machinery, Asia had the chance to improve its sugar industry and supplies to war torn countries of Europe.

At the time of partition in 1947 only seven sugar mills, existed in the territories of Pakistan, 5 in East Pakistan now known as Bangladesh and only 2 in West Pakistan now known as Pakistan. These two sugar mills namely Rahwali Sugar Mills and Frontier Sugar Mills established in 1936 and 1938 had a capacity of 5000 tonnes each of producing white sugar. During 1954-56 three more sugar mills were established with a capacity of 10000-15000 tonnes. By 1955-56, the sugar production capacity in Pakistan was around 45,000 tonnes.



Pakistan is the sixth largest sugar producer in the world. Its 86 sugar mills has the capacity of producing 7.0 million tonnes of sugar annually, indeed with full capacity utilization that would need supply of 80 million tonnes of sugarcane, the best being 53 million tonnes in 2007-08. The surplus installed capacity is causing concern particularly in low supply season. The total outlay at current cost is US$ 1.50 billion. Present annual sugar consumption of the country has crossed 4 million tonnes valued at US$1.8 billion.

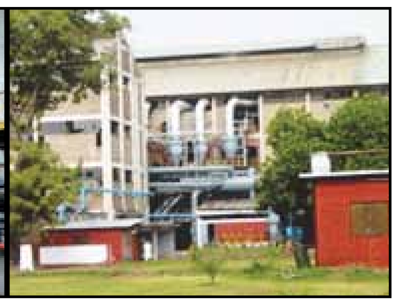
Being the second biggest agro-based industry, it is a source of revenue to the Government of Pakistan by about Rs. 22.0 billion, to the growers by Rs. 110-135 billion and to the vendors, other contractors, transporters and suppliers by about Rs. 20.0 billion, besides providing direct and indirect employment to 1.20 million people particularly in the rural areas of the country.

In Pakistan's under developed rural areas, establishment of a sugar mills is seen as a sign of prosperity to the area, as with a sugar-mill comes a new communication system, roads, colonies, schools, hospitals, electricity and above all fresh opportunities of trade and employment for every cadre of society.

Thus the sugar industry is of both economical and strategic importance to the country. Its viability has been hampered by the governments' imprudent policies made without prior consultation with the industry. This particularly applies to its sugarcane price-fixing policy.

With an abrupt change in the economic activities and urbanization, the demand for white sugar was on the increase. This was attributed to the manufacture of soft drinks, confectioneries and bakery products etc. The number of sugar mills was also on the





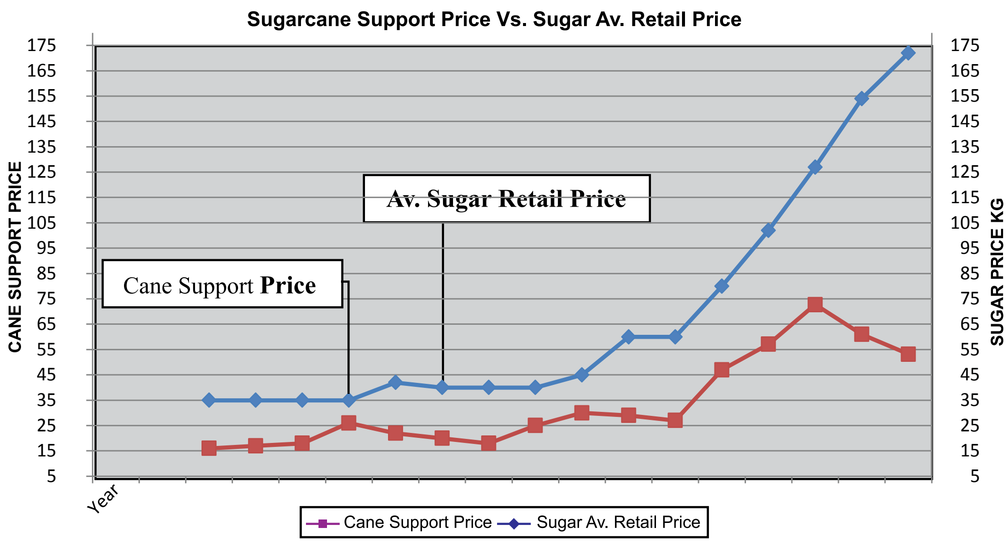
increase to meet the demand.

The system of supply of sugarcane to the mills has also revolutionized during these years from camel back and bullock carts to locomotives on narrow gage railway lines, tractor trolleys and now to large size trucks. Network of access roads financed and maintained with the help of road Cess Funds on sugarcane being collected from sugarcane suppliers and milers, modernized the supply line to sugar mills, few having reached now 12,000 tonnes crushing capacity per day, whereas sugarcane production is lacking behind due to low yield forcing the capacity utilization down to 50% in bad harvests.

By 1980 there were 35 sugar mills in the country capable of providing 1.0 million tonnes. Ten more sugar mills were installed by 1990 with the production capacity having reached 2.0 million tonnes. Population and per capita increase always kept the demand high and number of sugar mills increased to 86 in 2009.

Sugarcane Payment System in Pakistan

The Government of Pakistan supports cane production by setting a market minimum support price announced before or after planting. The support price is set below the local



demand price. As a result mills renegotiate the procurement price. The crop price increases up to 50% whenever the crop cycle is at its low ebb.

The sugarcane support price has increased from Rs. 40/- per 40 kg in 2004-05 to Rs. 80/- per 40 KG within the recent 4 years causing the sugar production price increase simultaneously.

2009-10 is yet to see another 25% increase in the support price of sugarcane in an effort of price incentive to the farmers for increase in plantation which will directly affect the existing production cost of sugar proportionately.

Throughout the entire crushing season the price issue remains a volatile issue between the growers and the millers. The growers refuse to sell the cane at the official price and millers in some areas of Punjab and Sindh delay the start of crushing season. The milling sector ends up bearing the bulk of the risk when the circumstances change. While the support price varies significantly when there is shortfall during a particular harvest, there is no similar level of adjustment when the harvest is good and cane is in abundant supply. Further, this situation is exacerbated by untimely sugar imports contributing to the destabilization of domestic price, always under pressure due to fluctuating harvests.


Continued efforts are underway led by the Pakistan Sugar Mills Association to persuade the Government of Pakistan to consider adoption of a more reliable sugarcane payment system linking the price of cane with the sugar content as being used in Australia and other countries of the world, based on cane quality, a fair deal to growers and millers as well.

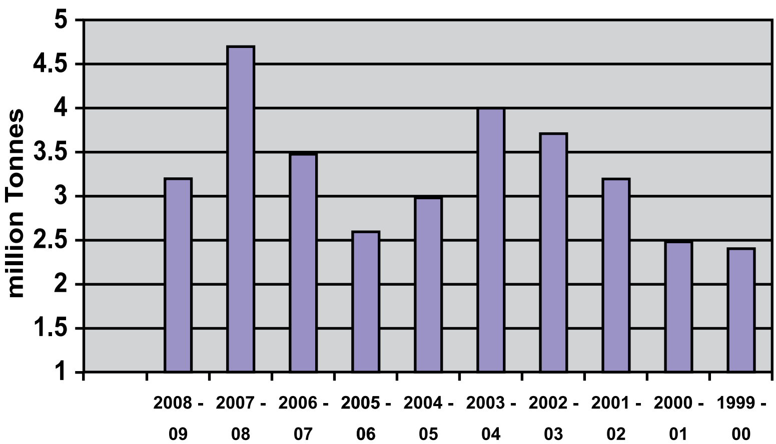
Sugar Production

At present in Pakistan sugarcane is the only crop that gets paid by weight and not by quality. The system does not provide for any incentive to the grower to improve his crop particularly towards the most crucial aspect, the sugar content.

Unless such mechanism is adopted in Pakistan further expansion in the production will remain in jeopardy while all potentials exist to improve yield and recovery and utilize the already built production capacity. The present system of increasing the sugarcane support price only encourages the farmer plantation expansion at the cost of other competitive crops that proves only temporary phase.

The following sugar production data for the last decade depicts the rise and fall of the domestic sugar production clearly indicating fall back during certain harvests while the consumption remains on continuous rise. Every bad harvest provides reason for further increase in the sugarcane price as a temporary measure, but a permanent feature.

Year	Sugar Production Tonnes
2008-09	3,190,702
2007-08	4,740,913
2006-07	3,516,218
2005-06	2,588,177
2004-05	2,922,126
2003-04	3,997,010
2002-03	3,652,745
2001-02	3,197,745
2000-01	2,466,788
1999-00	2,414,746



Sugarcane Crushing, Sugar Production & Recovery %

Pakistan

Year	No of Mills	Cane Crushed Tonnes	Sugar Made Tonnes	Recovery (%)
1990-91	51	22,603,696	1,908,838	8.44
1991-92	53	24,795,815	2,296,698	9.25
1992-93	61	27,274,806	2,375,289	8.71
1993-94	63	34,181,899	2,900,523	8.49
1994-95	66	34,193,290	2,983,101	8.72
1995-96	66	28,151,434	2,449,598	8.70
1996-97	68	27,152,918	2,378,751	8.76
1997-98	71	41,062,268	3,548,953	8.64
1998-99	71	42,994,911	3,530,931	8.21
1999-00	69	28,982,711	2,414,746	8.33
2000-01	65	29,408,879	2,466,788	8.39
2001-02	69	36,708,638	3,197,745	8.71
2002-03	71	41,786,689	3,652,745	8.74
2003-04	71	43,661,378	3,997,010	9.15
2004-05	71	32,101,739	2,922,126	9.10
2005-06	74	30,090632	2,588,177	8.60
2006-07	77	40,483,977	3,516,218	8.69
2007-08	78	52,776,922	4,740,913	8.98
2008-09	82	33,139,418	3,134,145	9.46
2009-10	83	34,611,003	3,133,494	9.05
2010-11	84	44,511,571	4,119,421	9.25
2011-12	86	48,248,535	4,670,380	9.64
2012-13	86	50,089,483	5,030,129	10.0

Punjab

Years	No of Mills	Cane Crushed Tonnes	Sugar Made Tonnes	Recovery (%)
1990-91	24	12,094,630	933,721	7.72
1991-92	25	11,745,224	1,012,297	8.62
1992-93	32	13,433,045	1,103,531	8.22
1993-94	34	20,066,265	1,634,154	8.14
1994-95	36	20,975,836	1,771,084	8.44
1995-96	37	16,992,633	1,375,789	8.10
1996-97	37	16,293,237	1,292,912	7.94
1997-98	39	25,905,541	2,065,886	7.97
1998-99	39	26,081,066	2,033,356	7.80
1999-00	37	16,829,610	1,315,637	7.82
2000-01	35	18,068,437	1,437,450	7.96
2001-02	37	25,252,609	2,152,175	8.52
2002-03	38	27,583,062	2,351,102	8.52
2003-04	38	28,604,925	2,599,490	9.09
2004-05	38	22,776,832	2,046,633	8.99
2005-06	40	19,340,641	1,566,047	8.10
2006-07	41	26,601,603	2,268,174	8.53
2007-08	42	33,063,564	2,952,784	8.93
2008-09	45	20,677,089	1,963,957	9.50
2009-10	45	20,972,969	1,858,161	8.86
2010-11	44	27,875,311	2,576,615	9.24
2011-12	44	32,203,007	3,116,348	9.68
2012-13	44	31,980,732	3,172,408	9.92

Sindh

Years	No of Mills	Cane Crushed Tonnes	Sugar Made Tonnes	Recovery (%)
1990-91	22	9,597,884	902,311	9.40

1991-92	22	11,956,718	1,187,576	9.93
1992-93	24	12,723,563	1,175,195	9.24
1993-94	24	13,031,888	1,172,507	9.00
1994-95	24	12,037,995	1,107,880	9.20
1995-96	24	10,341,372	1,008,127	9.75
1996-97	27	10,314,835	1,028,169	9.97
1997-98	27	13,853,107	1,374,477	9.92
1998-99	29	15,095,412	1,353,012	8.96
1999-00	25	10,856,757	996,317	9.18
2000-01	25	10,493,428	968,175	9.23
2001-02	27	10,162,607	940,959	9.26
2002-03	28	12,415,817	1,158,674	9.33
2003-04	28	12,990,824	1,221,268	9.40
2004-05	28	7,915,416	754,458	9.53
2005-06	28	9,182,553	902,907	9.83
2006-07	29	11,626,978	1,062,411	9.14
2007-08	29	16,737,003	1,561,378	9.33
2008-09	30	10,148,603	976,420	9.62
2009-10	31	11,484,422	1.095,104	9.54
2010-11	33	13,600,800		
2011-12	34	13,040,210	1,267,050	9.72
2012-13	34	14,750,048	1,547,547	10.50

Khyber Pakhtukhwa

Years	No of Mills	Cane Crushed Tonnes	Sugar Made Tonnes	Recovery (%)
1990-91	05	911,182	72,806	7.99
1991-92	05	1,093,873	96,824	8.85
1992-93	05	1,118,197	96,562	8.64
1993-94	06	1,083,745	93,861	8.66
1994-95	06	1,179,458	104,136	8.83

1995-96	05	817,429	65,682	8.19
1996-97	04	744,845	57,669	7.74
1997-98	05	1,303,619	108,589	8.33
1998-99	05	1,818,433	144,563	7.95
1999-00	05	1,296,344	102,792	7.93
2000-01	05	847,015	61,163	7.22
2001-02	05	1,293,422	104,611	8.09
2002-03	05	1,787,810	144,917	8.11
2003-04	05	2,065,629	176,252	8.53
2004-05	05	1,409,491	121,034	8.59
2005-06	06	1,567,438	119,223	7.69
2006-07	07	2,255,395	185,634	8.23
2007-08	07	2,976,356	226,751	7.62
2008-09	07	2,313,725	193,768	8.37
2009-10	07	2,153,612	180,229	8.37
2010-11	07	3,035,460	262,120	8.64
2011-12	07	3,005,318	286,982	9.55
2012-13	07	3,358,702	310,174	9.23

Consolidated Sugar Production in Pakistan From Cane, Beet & Raw (in Tones)

Year	Sugar Cane	Beet	Raw	Total
1990-91	1,908,838	23,312	---	1,932,150
1991-92	2,296,698	29,009	---	2,325,707
1992-93	2,375,289	18,916	---	2,394,205
1993-94	2,900,524	21,933	---	2,922,457
1994-95	2,983,104	18,370	---	3,001,472
1995-96	2,449,598	20,435	---	2,470,034
1996-97	2,378,751	14,610	---	2,393,361
1997-98	3,548,953	06,267	---	3,555,220

1998-99	3,530,931	10,831	---	3,541,763
1999-00	2,414,746	14,618	---	2,429,364
2000-01	2,466,788	17,276	531,930	3,015,994
2001-02	3,197,745	29,172	22,111	3,249,029
2002-03	3,652,748	22,066	1,945	3,676,759
2003-04	3,997,010	23,797	---	4,020,806
2004-05	2,922,126	11,373	182,302	3,115,801
2005-06	2,588,177	8,934	401,396	2,988,507
2006-07	3,516,218	7,865	2,860	3,526,943
2007-08	4,740,913	5,532	5,929	4,752,374
2008-09	3,134,145	947	---	3,135,092
2009-10	3,133,494	4,641	---	3,138,135
2010-11	4,119,421	13,535	8.94	4,172,632
2011-12	4,670,380	18,216	0	4,688,596
2012-13	5,030,129	33,028	0	5,063,157

Sugarcane Support Price - Mill-Gate Delivery (Per 40 Kg)

Year	Punjab	Sindh	NWFP	Quality Premium
1990-91	15.25	15.75	15.25	0.19
1991-92	16.75	17.00	16.75	0.22
1992-93	17.50	17.75	17.50	0.22
1993-94	18.00	18.25	18.00	0.22
1994-95	20.50	20.75	20.50	0.27
1995-96	21.50	21.75	21.50	0.27
1996-97	24.25	24.50	24.25	0.27
1997-98	35.00	36.00	35.00	0.32
1998-99	35.00	36.00	35.00	0.50
1999-00	35.00	36.00	35.00	0.50
2000-01	35.00	36.00	35.00	0.50
2001-02	42.00	43.00	42.00	0.50 (Indicative price)

2002-03	40.00	43.00	40.00	0.50
2003-04	40.00	41.00	40.00	0.50
2004-05	40.00	43.00	40.00	0.50
2005-06	45.00	60.00	45.00	0.50
2006-07	60.00	67.00	65.00	0.50
2007-08	60.00	67.00	65.00	0.50
2008-09	80.00	81.00	80.00	0.50
2009-10	100.00	102.00	100.00	0.50
2010-11	125.00	127.00	125.00	0.50
2011-12	150.00	154.00	150.00	
2012-13	170	172	170	0.5
2013-14	170	172	170	0.5

Average Sugarcane Area, Production and Yield T / Ha

Projected 1947-2010

Years	Area ('000 hectares)	Yield / Ha	Sugarcane Production ('000 tonnes)
1947-1950	202	33.54	6,775
1951-1955	245	29.36	7,193
1956-1960	366	28.19	10,319
1961-1965	469	33.79	15,849
1966-1970	582	38.34	22,312
1971-1975	608	35.60	21,647
1976-1980	757	36.98	27,994
1981-1985	897	37.44	33,580
1986-1990	823	39.68	32,656
1991-1995	927	44.12	40,902
1996-2000	1,030	46.96	48,371
2001-2005	1,009	47.91	48,343

2006-2010	1,063	51.10	54,365
2011	987	56.13	55,442
2011-2012	1,046	58	55,480
2012-2013	1,128	57	63,719

Low yield in Pakistan

Low yield in Pakistan is mainly due to the following reasons:

1. Shortage of Irrigation water
2. Cultivation of unapproved cane varieties
3. High input prices
4. Unavailability of inputs at required stage of cultivation
5. Poor crop management practices
6. Lack of facilities for cane research & development
7. Weed infestation
8. Conventional planting methods or late planting
9. Early and late harvesting
10. Lack of Credit facilities
11. Excessive rationing
12. Poor drainage

Pakistan's share in the total world production of sugarcane is around 3 percent. The average sugarcane production in Pakistan is around 51 million tons. Pakistan's share in total world production of sugar (157 million tons in 2008-09) was only 2.15 percent. Average sugar production in Pakistan during last ten years (2001 –2009) is around 3.37 million tons. The recovery percentage of sugar from cane is on a lower side as compared to International standard. The average sugar recovery in Pakistan is 8.79% as compared to world standard of over 10.50%. The average cane recovery of Sindh for the last five years (2004-2008) is 9.45% as against 8.64% of Punjab and 8.03% of NWFP. There are a number of factors leading to low recovery rate by the mills.

Chapter 2

Procurement

Survey

Why survey is done

To run any industry basic data of available raw material is very important, especially seasonal factories. For sugarcane factories it is even more important because:

- Its raw material grows in fields.
- Quality of raw material plays very important role
- Variety of raw material role is the key of profit or loss in the sugar industry.

For example during the month of December it is just possible that in any area or field of a mill there may be two varieties one having recovery 10.00%+ (***say variety "X"***) and other variety having recovery between, 8.00% to 8.50% (***say variety "Y"***).

What does it mean? If mills crush 8,000.00 MT a day and in its area sugarcane variety is Y is available which has recovery about 8.5% than production will be 680.000 MT, whereas, if the variety is good (variety X) the production will be 800.00 MT if the recovery is 10.00% only whereas, expenses are the same (cost of cane, manufacturing cost + etc) and if we calculate the production difference in monetary impact it is as under:

	VARIETY "X"	**VARIETY "Y"**
Cane 8000.00 MT	Rs. 3,44,00,000.00 Cost of cane @ Rs. 172.00	Rs. 3,44,00,000.00 Cost of cane @ Rs. 172.00
Production + Revenue @ Rs. 50.00/Kg	800.00 MT (10%)	680.00 MT (8.50%)
	Rs. 4,00,00,0000.00 Revenue @Rs. 50.00 per Kg Sugar Rate	Rs. 3,40,00,000.00 Revenue @Rs. 50.00 per Kg Sugar Rate

Table : Sugar rate Rs. 50.00 per Kg/Cost of cane Rs. 172.00 per 40 Kg

- Sugarcane is grown twice a year and life of cane is different at the time the mill starts its season, further Ratoon crop is also kept by growers and it is interesting that even some varities have different recoveries according to their age.

- Sugarcane crop starts maturing from November onwards and recoveries of November, December, January, February and March are very different and it is only possible after survey that we come to know varietal composition of the area.

Survey is done to know what is in our hands i.e. Quality of cane, Varieties, Quality and its status. It is impossible to take a right decision unless we know what is in our hands and it is possible only when we survey the cane fields.

Survey is generally done two times

First Survey is done mostly in the month of May and June. This survey is called area Survey. In this survey only area under sugarcane and its variety is surveyed. Second Survey is done in the month of August-September when crop attains its height and staff is in a position to ascertain its yield.

Apart from running Mills Survey plays a vital role of Mills owner is to decide about what he has to do in field to grow good varieties to make Mills profitable.

Indenting

After the Survey figures are completed and computed, total available cane is classified as early maturing varieties total cane available, mid maturing varieties total sugarcane surveyed and late maturing varieties total cane available in field.

Then assessment is done to find out weather we are in a position to run the whole season with early maturing varieties available in survey or have to add other varieties for running the mills.

This needs a very careful study and experience because a lot of factors are involved in it, for example early maturing variety may be sufficient quantity but the number of growers is less, and it becomes difficult and some times impossible as the harvesting capacity of those growers may not be sufficient to meet the daily requirement of the mills.

Actually indenting is done to procure best possible cane in best possible smooth way i.e. better recovery cane minimum yard balance to reduce losses and maximum possible satisfaction of the grower, i.e. judicious policy because it is not compulsory that cane always be in sufficient quantity to run the mills, at times, due to any reason crop may decrease and if policy is not judicious, growers may remind when we go for cane to him but it never means compromising mills results. Policy must always be clear to every body. No confusion.

Summary: There must be a system same and clear to every grower. If there is free indenting for any variety, it must be on merit and for everybody, and policy maker must have long term interests of the mills in mind.

Checking of cane at the time of harvesting

It is not enough only to issue indent for cane. The field staff must ensure that only the variety mentioned in the indent is being harvested. Further, harvesting is clean and free from tops and trash.

Checking of cane at the time of supply

Although field staff will ensure harvesting according to indented variety but here must be one more step of cane checking in field i.e. when cane is loaded and transported to mills it must first go to concerned field office where it is again checked i.e. to see if the variety is as per indent, it is clean, and free from Tops and Trash. Then the concerned office staff will write it on the indent (filled the columns provided on indents) and will sign it.

Token at Mills

It is good to trust but better to check again. When cane reaches mills, it is again checked that all information written on indent is correct and cane loaded on vehicle is according to that then token be issued to the vehicle as per mode of transport (It is necessary because it is possible that Tractor Trolly may change after checking at cane field office).

Cane enters Mills on its turn

Token is issued to control / manage the cane - yard properly, its essential to observe discipline and no favour to anybody. It helps in peaceful running of mills. One more step of checking by independent team (not under the cane department) will help mills management achieve better results i.e.,

- Team checking every single vehicle that cane is as per indent
- An independent cane testing lab, capable of doing at least 80% of cane vehicles analyzed. Daily analysis be examined by Cane Head, Chemical Head, Mechanical Head, Lab Incharges, Head of Project and Owner at Head Office.

Gross weight

After the cane loaded vehicle is entered in to mills, its gross weighment is done.

Unloading

Then cane is unloaded Mechanically or manually or both whatever system is available.

Tare weight

After unloading the tare weight is done and weight note or CPR (Cane Purchase Receipt) is given to grower.

Vehicle out after tare weight

Then vehicle goes out of mills. Proper record of all stages is maintained.

Payment as per policy of the mills

Its very important for the Mills to have a proper declared cane payment policy. It builds trust. Cash payment to growers is always troublesome. Payment must be through banks. No cash payment to anybody.

Chapter 3
Cane Preparation

Introduction

The object of cane-preparation is to cut cane into short pieces for feeding the mills as also to rupture the cells, without extracting juice. The preparatory devices commonly employed and installed before the milling tandem, are classified into three types:

1. Knives which cut the cane to pieces.
2. Shredders which shred cut cane into long fine pieces.
3. Fibrizer system combining the features of both (i) & (ii).

Percentage of cells opened to the total, which is indicative of the extent of cane preparation, is (a) 50-60% in the case of two sets of knives running in the direction of carrier, (b) 85-90% with a combination of knives and shredder, while for unigrator or fibrizor it would be 75-80%. In the case of knives running in opposite direction to the flow of cane, the preparation index can be 65-70% depending on whether one or both the sets are revolving in reverse direction.

Cane Kicker or Equalizer

The cane kicker is installed on the carrier to prevent excessive cane being fed to cane leveller which causes jamming of the leveller set. It consists of a steel shaft directly coupled to a motor with arms or knives mounted on it, running normally at 50-100 rpm. in reverse direction to the flow of cane on the cane carrier. When arms or angles are secured to the shaft, the r.p.m. and power requirement are low but when knives are fitted and r.p.m. about 100 or so the power requirement is higher since some cutting action is also envisaged along with maintaining uniform feed to knives which forms the main function of this piece of equipment. In some factories before a shredder or a fibrizer an equaliser or leveller of the same design as a cane kicker is installed after the cane has passed through first one or two sets of knives to ensure even distribution of feed.

Cane Knives

Cane preparation by knives essentially consists of disintegrating the hard rind, and nodes, and breaking the cane to short pieces which in effect increases the mill capacity and efficiency of juice extraction. It consists of forged steel shaft with cast steel hubs to which are secured knives in different planes. The shaft supported on double row ball bearings is coupled to a motor and revolves at about 600 rpm. Different designs of knives are adopted, some of which are of reversible blade types, while some are of bent or circular type. The knives are made of shock-resisting steel with stellited edges. The knives are enclosed in M.S. hoods attached to cane carrier frame and provided with bolted doors on top. The pitch of the knives, i.e. the distance between two successive circles of knife rotation, is usually about 50 mm. but is reduced to 25 mm. or lower, while handling hard and thin canes in some sugar producing regions, by increasing the cutting planes. The first set of knives known as leveller is installed over the carrier with clearance between the tips of knives and the carrier of 50-150mm. As it has to chop whole cane; while with the 2nd set of knives which cuts the partially cut cane from leveller the clearance is 30-50mm. This unit, known as cutter, is located at a distance of about 5-6 m. from the leveller set on the carrier. The efficiency of knives, decided by the proportion of cut cane, is dependent to a large extent on the clearnace, which can be varied by adjusting position of knives and the motor.

Conventional practice of arranging the rotation of both the sets of knives in the direction of the moving cane carrier is not followed now a days and instead either the cutter or in some factories both the cutter and levellers are run in the reverse direction i.e. opposite to the movement of the carrier. Reversing the direction of knives involves higher power consumption but gives better cane preparation and requires modification of hood design.

The power requirement of knives is dectated by the extent of preparation expected from each set and will in turn depend on (i) The clearance between lowest extremities of knives and the plane of carrier, (ii) fibre of cane and quantity of cane passing, (iii) direction of rotation since reverse running involves higher power consumption compared to conventional running in the direction of the passage of cane.

The maximum power peaks cane be 400% of the mean power for whole cane and 250% of the mean power for chopped cane as per experience in Australian Sugar Industry. The normal practice is to install about 20 h.p./tfh. for levellers and 30 h.p./t.f.h. for cutters about 200% higher than the mean power load.

The power peaks can be minimised by installing ‘kicker’ at the cane carrier before leveller and an equaliser before second set of cutters, when it is running in opposite direction to the cane carrier.

Shredder

Shredder is essentially a hammer mill adapted to the function of sugarcane pulverising and swing hammer type shredders of different designs are common in sugar producing countries including India. On forged steel shaft are fitted a number of steel discs to which are attached hammers with hard faced tips, and provided with hardened bush at the pin. The hammers revolve on pivots. Shredders are housed in thick steel plates, with inspection door provided at the discharge end. As the shredder starts rotating the hammers are thrown out radially by centrifugal force. The shredders rotate at 1000-1200 rpm. and are usually directly coupled through flexible coupling to electric motor or driven by steam turbines, the total installed power being about 20-26 HP. per t. fibre per hour, while actual mean-power consumption is 30-50% lower than this.

Feed to Shreddar is from top which gets pulverised between the anvil bars and rotating hammers. As the name indicates, this equipment shreds or tears the cane to pieces or rather pulverises it into long fluffy material with high bulk density, which in effect increases the capacity and extraction of the mill. One percent gain in extraction with Searby type shredder has been reported from Hawaii for 15 roller tandem.

It is necessary that the feed to the shredder (after cane has passed through two sets of knives) is regulated by installation of equaliser before the same. In Australia and South Africa heavy duty Shredders are employed, with hammers weighing about 15-20 kg. each and subsequently very high power consumption, nearly double that with Shredders operating in India. The obvious benefit is very high preparation Index of 90 or above with consequent increase in extraction.

It must be clearly realised that the knives can disintegrate the cane to fine and short pieces, but the preparation is not uniform and some uncut pieces are noticed after the cane has passed through knives. The shredder preparation results in long slivers, with a high degree of cell rupture; which is uniform and thorough. Shredder is always preceded by usual two sets of knives viz. leveller and cutter which cut the cane prior to feeding the shredder which is located at the head of milling tandem.

Unigrator or Fibrizer

This ingenious preparatory device, which combines the functions of cutter knives and shredder, was developed by Victor Ducasse in 1971 and has gained popularity in recent years in Indian Industry.

The rotor consists of a heavy duty special steel shaft on which are mounted a series of sturdy hubs. The special knives have cutting edges and two hammers projecting in opposite direction which act as hammers. The cutting knives are secured to the hubs and serve the dual function of cutting and shredding cane which has passed through the leveller set. The casing of the rotor assembly has two side walls, a top cover and chute fitted with spring loaded anvil whose position is adjustable. Special features of this machine are:

1. fibrizer revolves in direction opposite to the flow of cane,
2. the casing is so designed as to first ensure cutting action on the cane, which is thrown into rear chute and anvil where shredding is brought about,
3. unlike shredder the chopper is preceded by only leveller,
4. total h.p. for the leveler fibrizer combination is 35-40 H.P./tf/hr. and rotation speed is 1000 r.p.m. New designs of fibrizers known as ‘mincer’ or ‘comber’ incorporate the two major features of ‘unigrater’ viz., grate at the rear discharge chute and blades combining the features of hammers and knives.

The results reported with these machines developed indigenously appear to be promising. Influence of cane preparation-It is now an established fact that fine cane preparation is key to efficient milling in as much as it exerts influence on mill extraction as well as through put. Fine preparation calls for higher power requirement for the preparatory devices like shredders and fibrizers, but results in reduction of power consumption at mills. In Australia great stress is laid on cane preparation by employing heavy duty shredders and the power consumed for cane preparatory devices is very high around70-90% of the total power for mills whereas in Indian sugar mills the installed hp. for cane preparation is about 40-50% of the power of mill turbines.

Mills

The disintegrated cane is fed to the first mill commonly known as crusher, of the series of three-roller mills-forming a mill train in which the subsequent mills perform the function of expressing the juice from bagasse soaked in water or imbibition fluid. In some old designs the first juice extraction of the prepared cane is carried out in a two roller crusher followed by three roller mill. Modern milling tandem comprises four, five or six-three roller mills, each roller being 760 mm. - 1100 mm. dia and 1520 mm. - 2200 mm. length respectively, usually the length being about twice the diameter. In India most of the modern mills are of 760 x 1520 mm size or 850 x 1700 mm size. The modern mill head stocks in which the rollers are housed are cast-steel or M.S.fabricated and of robust construction. These are of king boltless type, with top and side caps of cast steel. The roller shells are of coarse grain cast iron, provided with circumferential V grooves. The shells are shrunk on cast steel shafts of high tensile strength, with square ends. The bed plates are of C.I. or Meehanite construction while the V shaped juice troughs below the mills are of copper or aluminium. The roller bearings are white metal or gunmetal lined and provided with water-cooling arrangement. Each mill is equipped with hydraulic accumulators for top roller journals, for regulation of load on mills. Cast steel trash plate mounted on trash beam, below the bottom rollers serves to guide the bagasse from feed roller to discharge rollers. Scrapers with C.I. tips maintain the grooves clean, the one for top roller being of floating type. The drive for mills comprises a steam turbine connected to a system of gears for reducing the speed from 5000-9000 r.p.m. to ultimate 4-5 r.p.m. for the mills, the top roller of the three-roller mill being coupled to the transmission heavy gears through a tailbar, while the bottom rollers receive their motion by pinions connected to top roller pinion. As the turbine drive, (a) gives good starting torque.(b) permits of fairly wide variation in the speed of the mills, and(c) is suitable for higher steam pressures (21-31 kg/cm2). (d) besides being compact and requiring less maintenance it has now replaced the former steam engines. Furthermore the exhaust is not contaminated with oil as in the case of steam engines. Individual drive is preferred for mills to a combined drive for 2 - 3 mills since the formerallows variations in the speeds of each mills.

The Manufacturing Process

Juice extraction pressing

Two or three heavily grooved crusher rollers break the cane and extract a large part of the juice, or swing-hammer type shredders (1,200 RPM) shred the cane without extracting the juice. Revolving knives cutting the stalks into chips are supplementary to the crushers. (In most countries, the shredder precedes the crusher.) A combination of two, or even all three, methods may be used. The pressing process involves crushing the stalks between the heavy and grooved metal rollers to separate the fiber (*bagasse*) from the juice that contains the sugar.

As the cane is crushed, hot water (or a combination of hot water and recovered impure juice) is sprayed onto the crushed cane countercurrently as it leaves each mill for diluting. The extracted juice, called vesou, contains 95 percent or more of the sucrose present. The mass is then diffused, a process that involves finely cutting or shredding the stalks. Next, the sugar is separated from the cut stalks by dissolving it in hot water or hot juice.

Process of Extraction

Imbibition

In the milling process, the first mill extracts 50-70% of the total juice contained in the prepared cane, the remaining offering resistance to removal from fibre by simple compression in rollers. With a view to extracting the remaining juice it is imperative to resort to 'imbibition' which consists of spraying diluted juice or water on the bagasse emerging after each mill in the milling tandem. In simple imbibition water alone is applied to bagasse from every mill, but is no longer practised in the industry. The compound imbibition adopted universally involves the application of water only on the bagasse fed to last mill, the juice from this mill being sprayed on the bagasse going to the penultimate mill while juice from the penutimate mill is added at the preceeding mill. This recirculation is continued up to the second mill, the juice from which constitutes the secondary juice. This secondary juice when combined with primary juice from first mill is known as mixed juice sent to boiling house for processing. In some milling tandems with five or six mills at times imbibition water is applied at two last mills, the major portion being used at the last mill.

Principles

The main concept underlying the practice of imbibition is to dilute the juice contained in bagasse prior to its squeezing in mill rollers of the second and subsequent mills. System of imbibition for any mill must take following into consideration:

1. dry moisture free bagasse has the potential to absorb 500-1000% water, while in actual practice the ratio of water to dry bagasse is seldom higher than 250-300%.
2. the compressed bagasse as it emerges from the mill can absorb liquid quickly

before it expands and absorbs air. Thus the ideal method of imbibition would involve contact of imbibition liquid with bagasse prior to its expansion after milling i.e. at the point of emergence from discharge roll.

3. in practice the proper distribution of imbibition fluid over the bagasse layers as also thorough contact of imbibition fluid with lower and upper layers of bagasse over the entire width of the bagasse carrier is very difficult.

4. use of hot water of 70°C and above favours higher extraction though it creates difficulties in the feeding of mill compared to cold imbibition. In keeping with this modern practice is to employ up to 80-85°C hot water.

Chapter 4 Purification of Juice

Clarification and Evaporation

The juice from the mills, a dark green color, is acidic and turbid. The clarification (or defecation) process is designed to remove both soluble and insoluble impurities (such as sand, soil, and ground rock) that have not been removed by preliminary screening. The process employs lime and heat as the clarifying agents. Milk of lime (about one pound per ton of cane) neutralizes the natural acidity of the juice, forming insoluble lime salts. Heating the lime juice to boiling coagulates the albumin and some of the fats, waxes, and gums, and the precipitate formed entraps suspended solids as well as the minute particles.

The sugar beet solution, on the other hand, is purified by precipitating calcium carbonate, calcium sulfite, or both in it repeatedly. Impurities become entangled in the growing crystals of precipitate and are removed by continuous filtration.

The muds separate from the clear juice through sedimentation. The non-sugar impurities are removed by continuous filtration. The final clarified juice contains about 85 percent water and has the same composition as the raw extracted juice except for the removed impurities.

To concentrate this clarified juice, about two-thirds of the water is removed through vacuum evaporation. Generally, four vacuum-boiling cells or bodies are arranged in series so that each succeeding body has a higher vacuum (and therefore boils at a lower temperature). The vapors from one body can thus boil the juice in the next one—the steam introduced into the first cell does what is called *multiple-effect evaporation*. The vapor from the last cell goes to a condenser. The syrup leaves the last body continuously with about 65 percent solids and 35 percent water.

The sugar beet sucrose solution, at this point, is also nearly colorless, and it likewise undergoes multiple-effect vacuum evaporation. The syrup is seeded, cooled, and put in a centrifuge machine. The finished beet crystals are washed with water and dried.

Crystallization

Crystallization is the next step in the manufacture of sugar. Crystallization takes place in a single-stage vacuum pan. The syrup is evaporated until saturated with sugar. As soon as the saturation point has been exceeded, small grains of sugar are added to the pan, or “strike.” These small grains, called seed, serve as nuclei for the formation of sugar crystals. (Seed grain is formed by adding 56 ounces [1,600 grams] of white sugar into the bowl of a slurry machine and mixing with 3.3 parts of a liquid mixture: 70 percent methylated spirit and 30 percent glycerine. The machine runs at 200 RPM for 15 hours.) Additional syrup is added to the strike and evaporated so that the original crystals that were formed are allowed to grow in size.

The growth of the crystals continues until the pan is full. When sucrose concentration reaches the desired level, the dense mixture of syrup and sugar crystals, called massecuite, is discharged into large containers known as crystallizers. Crystallization continues in the crystallizers as the massecuite is slowly stirred and cooled.

Massecuite from the mixers is allowed to flow into centrifugals, where the thick syrup, or molasses, is separated from the raw sugar by centrifugal force.

Centrifugaling

The high-speed centrifugal action used to separate the massecuite into raw sugar crystals and molasses is done in revolving machines called centrifugals. A centrifugal machine has a cylindrical basket suspended on a spindle, with perforated sides lined with wire cloth, inside which are metal sheets containing 400 to 600 perforations per square inch. The basket revolves at speeds from 1,000 to 1,800 RPM. The raw sugar is retained in the centrifuge basket because the perforated lining retains the sugar crystals. The mother liquor, or molasses, passes through the lining (due to the centrifugal force exerted). The final molasses (*blackstrap molasses*) containing sucrose, reducing sugars, organic nonsugars, ash, and water, is sent to large storage tanks.

Once the sugar is centrifuged, it is “cut down” and sent to a granulator for drying. In some countries, sugarcane is processed in small factories without the use of centrifuges, and a dark-brown product (noncentrifugal sugar) is produced. Centrifugal sugar is produced in more than 60 countries while noncentrifugal sugar in about twenty countries.

Drying, Grading and Packing

The separated white sugar crystals discharged from the centrifuges still contain up to 1% moisture. This is removed by passing the sugar into a dryer, through which filtered, heated air given by radiators is passed.

The moisture level of the sugar is reduced to about 0.02%. Fluidized bed dryers are used for sugar drying. Hot air is used for drying the refined sugar in a cross current flow in fluidized bed dryers. Sugar after drying is cooled . And then is sent to Elevator and Grader.

After grading the finished refined sugar is sent to bins prior to packaging.

This sugar is then packed according to the grades i.e. R1 is known as the extra white sugar. It is packed in double polythene plastic bags. While R2 and R3 simple bags having weight of 50kg. All this process is done in Bagging House. After the packing in sugar bags, sugar is stored in Go-downs.

Quality Control

Mill sanitation is an important factor in quality control measures. Bacteriologists have shown that a small amount of sour bagasse can infect the whole stream of warm juice flowing over it. Modern mills have self-cleaning troughs with a slope designed in such a way that bagasse does not hold up but flows out with the juice stream. Strict measures are taken for insect and pest controls.

Because cane spoils relatively quickly, great steps have been taken to automate the methods of transportation and get the cane to the mills as quickly as possible. Maintaining the high quality of the end-product means storing brown and yellow refined sugars (which contain two percent to five percent moisture) in a cool and relatively moist atmosphere, so that they continue to retain their moisture and do not become hard.

Most granulated sugars comply with standards established by the National Food Processors Association and the pharmaceutical industry (U.S. Pharmacopeia, National Formulary).

Sugarcane Processing

Sugarcane processing is focussed on the production of cane sugar (sucrose) from sugarcane. Other products of the processing include bagasse, molasses, and filtercake. Bagasse, the residual woody fiber of the cane, is used for several purposes: fuel for the boilers and lime kilns, production of numerous paper and paperboard products and reconstituted panelboard, agricultural mulch, and as a raw material for production of chemicals. Bagasse and bagasse residue are primarily used as a fuel source for the boilers in the generation of process steam. Thus, bagasse is a renewable resource. Dried filtercake is used as an animal feed supplement, fertilizer, and source of sugarcane wax. Molasses is produced in two forms: inedible for humans (blackstrap) or as an edible syrup. Blackstrap molasses is used primarily as an animal feed additive but also is used to produce ethanol, compressed yeast, citric acid, and rum. Edible molasses syrups are often blends with maple syrup, invert sugars, or corn syrup.

Sugarcane is produced and harvested for two purposes: production of cane sugar and use as seed for subsequent plantings. In the United States, sugarcane is produced, harvested, and processed in four states: Florida, Louisiana, Texas, and Hawaii. Cane sugar is refined in eight states: Florida, Louisiana, Texas, Hawaii, California, New York, Maryland, and Georgia.

In the following sections, unrefined, or raw sugar is referred to as “cane sugar”. Following refining, the sugar is called “refined sugar”.

Sugarcane Production

Hand cutting is the most common harvesting method throughout the world but some locations (e. g., Florida, Louisiana and Hawaii) have used mechanical harvesters for several years. After cutting, the cane is loaded by hand, mechanical grab loaders, or continuous loaders. Cane is transported to the mills using trailers, trucks, railcars, or barges, depending upon the relative location of the cane fields and the processing plants. When the cane is cut, rapid deterioration of the cane begins. Therefore, unlike sugarbeets, sugarcane cannot be stored for later processing without excessive deterioration of the sucrose content.

A simplified process flow diagram for a typical cane sugar production plant is shown in

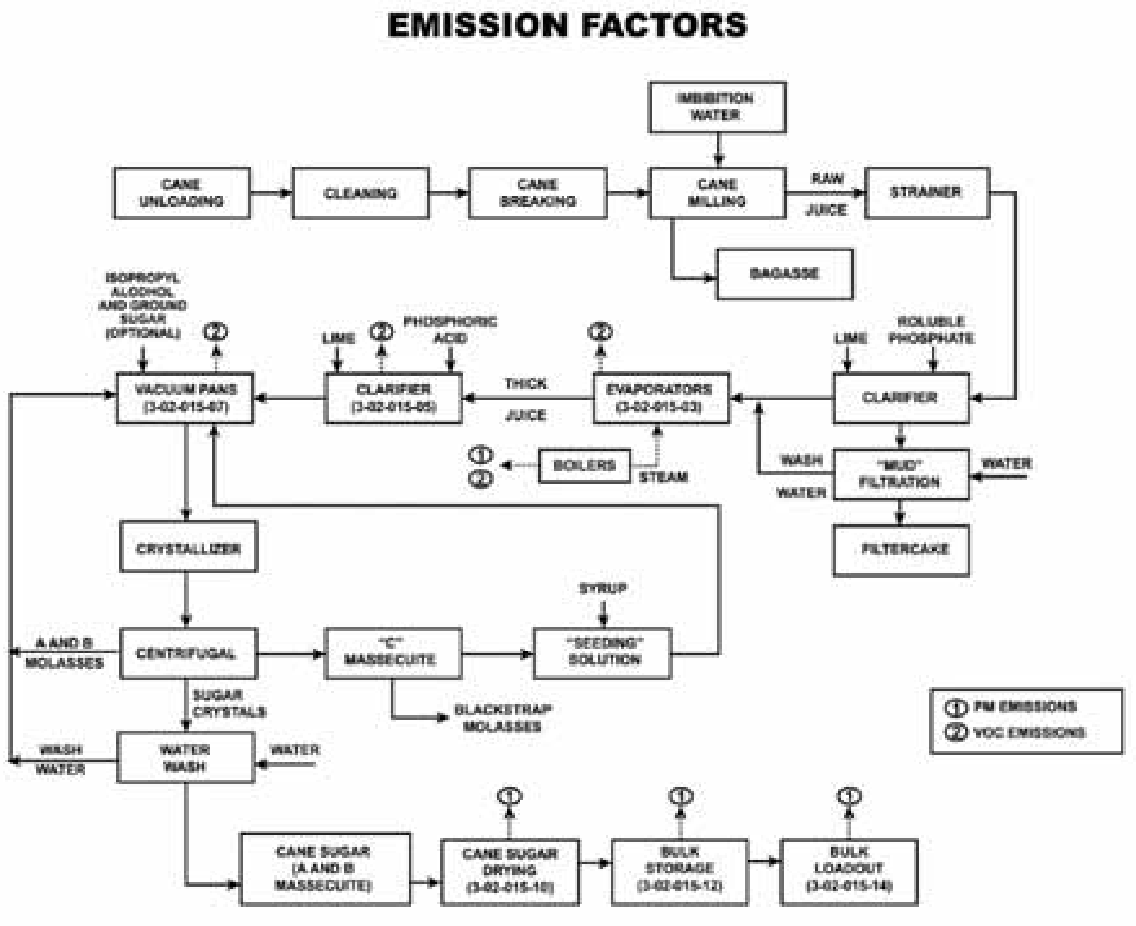


Figure 1. Simplified process flow diagram for cane sugar production. (Source Classification Codes in parentheses.)

Figure 1 & 2. The cane is received at the mill and prepared for extraction of the juice. At the mill, the cane is mechanically unloaded, placed in a large pile, and, prior to milling, the cane is cleaned. The milling process occurs in two steps: breaking the hard structure of the cane and grinding the cane. Breaking the cane uses revolving knives, shredders, crushers, or a combination of these processes. For the grinding, or milling, of the crushed cane, multiple sets of three-roller mills are most commonly used although some mills consist of four, five, or six rollers in multiple sets. Conveyors transport the crushed cane from one mill to the next.

Imbibition is the process in which water or juice is applied to the crushed cane to enhance the extraction of the juice at the next mill. In imbibition, water or juice from other processing areas is introduced into the last mill and transferred from mill to mill towards the first two mills while the crushed cane travels from the first to the last mill. The crushed cane exiting the last mill is called bagasse. The juice from the mills is strained to remove large particles and then clarified. In raw sugar production, clarification is done almost exclusively with heat and lime (as milk of lime or lime saccharate.

Small quantities of soluble phosphate also may be added. The lime is added to neutralize the organic acids, and the temperature of the juice raised to about 95EC (200EF). A heavy precipitate forms which is separated from the juice in the clarifier. The insoluble particulate mass, called “mud”, is separated from the limed juice by gravity or centrifuge. Clarified juice goes to the evaporators without additional treatment. The mud is filtered and the filtercake is washed with water.

Evaporation is performed in two stages: initially in an evaporator station to concentrate the juice and then in vacuum pans to crystallize the sugar. The clarified juice is passed through heat exchangers to preheat the juice and then to the evaporator stations. Evaporator stations consist of a series of evaporators, termed multiple-effect evaporators; typically a series of five evaporators. Steam from large boilers is used to heat the first evaporator, and the steam from the water evaporated in the first evaporator is used to heat the second evaporator. This heat transfer process continues through the five evaporators and as the temperature decreases (due to heat loss) from evaporator to evaporator, the pressure inside each evaporator also decreases which allows the juice to boil at the lower temperatures in the subsequent evaporator. Some steam is released from the first three evaporators, and this steam is used in various process heaters in the plant. The evaporator station in cane sugar manufacture typically produces a syrup with about 65 percent solids and 35 percent water. Following evaporation, the syrup is clarified by adding lime, phosphoric acid, and a polymer flocculent, aerated, and filtered in the clarifier. From the clarifier, the syrup goes to the vacuum pans for crystallization.

Crystallization of the sugar starts in the vacuum pans, whose function is to produce sugar crystals from the syrup. In the pan boiling process, the syrup is evaporated until it reaches the supersaturation stage. At this point, the crystallization process is initiated by "seeding" or "shocking" the solution. When the volume of the mixture of liquor and crystals, known as massecuite, reaches the capacity of the pan, the evaporation is allowed to proceed until the final massecuite is formed. At this point, the contents of the vacuum pans (called "strike") are discharged to the crystallizer, whose function is to maximize the sugar crystal removal from the massecuite. Some mills seed the vacuum pans with isopropyl alcohol and ground sugar (or other similar seeding agent) rather than with crystals from the process. From the crystallizer, the massecuite (A massecuite) is transferred to high-speed centrifugal machines (centrifugals), in which the mother liquor (termed "molasses") is centrifuged to the outer shell and the crystals remain in the inner centrifugal basket. The crystals are washed with water and the wash water centrifuged from the crystals.

The liquor (A molasses) from the first centrifugal is returned to a vacuum pan and reboiled

EMISSION FACTORS

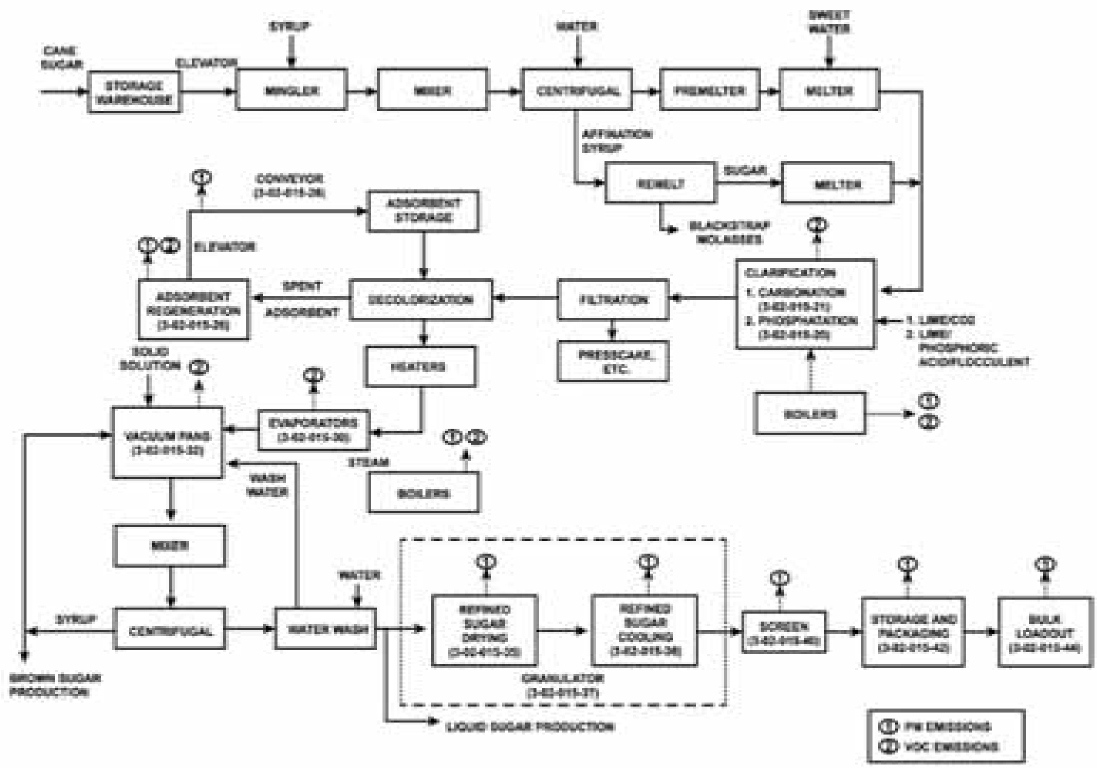


Figure 2. Simplified process flow diagram for refined sugar production.
(Source Classification Codes in parentheses.)

to yield a second massecuite (B massecuite), that in turn yields a second batch of crystals. The B massecuite is transferred to the crystallizer and then to the centrifugal, and the raw sugar is separated from the molasses. This raw sugar is combined with the first crop of crystals. The molasses from the second boiling (B molasses) is of much lower purity than the first molasses. It is reboiled to form a low grade massecuite (C massecuite), which goes to a crystallizer and then to a centrifugal. This low-grade cane sugar is mingled with syrup and is sometimes used in the vacuum pans as a “seeding” solution. The final molasses from the third stage (blackstrap molasses) is a heavy, viscous material used primarily as a supplement in cattle feed. The cane sugar from the combined A and B massecuites is dried in fluidized bed or spouted bed driers and cooled. After cooling, the cane sugar is transferred to packing bins and then sent to bulk storage. Cane sugar is then generally bulk loaded to trucks, railcars, or barges.

Refined Sugar Production

A simplified process flow diagram for refined sugar production is shown in Figure 1 & 2. Cane sugar is refined either at the same location where it was produced as part of an integrated facility or at separate raw sugar refineries. The initial step in cane sugar refining is washing the sugar, called affination, with warm, almost saturated syrup to loosen the molasses film. This is followed by separation of the crystals from the syrup in a centrifugal and washing of the separated crystals with hot water or a high purity sweetwater. If the refinery is part of the cane sugar production facility, the cane sugar may be washed more heavily in previous steps and the affination step omitted. The washed raw sugar is sent to a premelter and then to a melter, where it is mixed with high-purity sweetwaters from other refinery steps and is steam heated. The resultant syrup is passed through a screen to remove any particulate in the syrup and sent to the clarification step. The syrup from the crystal washing, called affination syrup, is transferred to a remelt processing station or reused in the raw sugar washing step. In the remelt station, the syrup volume is reduced to form the massecuite, and the sugar crystals are separated from the syrup. The separated liquor is blackstrap molasses. The sugar crystals are sent to a melter and then to the clarification step. Two clarification methods are commonly used: pressure filtration and chemical treatment; chemical clarification is the preferred method. Two chemical methods are commonly used: phosphatation and carbonation; both processes require the addition of lime. The phosphatation uses phosphoric acid, lime (as lime sucrate to increase solubility), and polyacrylamide flocculent to produce a calcium phosphate floc. Air flotation is usually used to separate the floc from the liquor and the floc skimmed from the liquor surface. Carbonation consists of adding lime to the raw melter liquid and then bubbling carbon dioxide (CO_2) through the liquor to produce a calcium carbonate precipitate. The source of CO_2 is boiler flue gas, which contains about 12 percent CO_2 by volume. The clarifier systems yield either presscakes, muds, or scums which are treated to remove entrapped sugar, and then sent to disposal.

The next step is decolorization, which removes soluble impurities by adsorption. The two most common adsorbents are granular activated carbon and bone char, manufactured from degreased cattle bones. Powdered carbon and synthetic resins are less commonly used. Bone char or activated carbon are used in either fixed or moving bed systems. Spent adsorbent is removed from the bed, regenerated, and stored for reuse.

The decolorized sugar liquor is sent to heaters (at some refineries), followed by multiple-effect evaporators, and then to the vacuum pans; this is the same sequence used in cane sugar manufacture. Basic operation of the evaporators and vacuum pans is the same as for cane sugar. The sugar liquor from the evaporators (thick juice) is transferred to the vacuum pans to further reduce the liquor volume and form the massecuite. In refined sugar production, the most common boiling system is the four-strike system. When the liquor in the pans has reached the desired level of supersaturation, the liquor is “seeded” to initiate formation of sugar crystals. At this point, the strike is discharged to a mixer and then to the centrifugal. In the centrifugal, the white sugar is retained in the inner basket and the liquor centrifuged to the outer shell. The sugar liquor is returned to a vacuum pan for further volume reduction and white or brown sugar production. The white sugar is washed one time in the centrifugal; the separated wash water, containing liquor and dissolved sugar, is returned to the vacuum pans. The moist sugar from the centrifugals contains about 1 percent water by weight.

To produce refined granulated sugar, white sugar is transported by conveyors and bucket elevators to the sugar dryers. The most common sugar dryer is the granulator, which consists of two drums in series. One drum dries the sugar and the other cools the dried sugar crystals. Dryer drums typically operate at a temperature of about 110EC (230EF). Fluidized bed dryers/coolers are used at some facilities in place of the conventional rotary drum granulators. From the granulators, the dried white sugar crystals are mechanically screened by particle size using a sloping, gyrating wire mesh screen or perforated plate. After screening, the finished, refined granulated sugar is sent to conditioning bins, and then to storage bins prior to packaging or bulk loadout. Almost all packaged sugar uses either multiwall paper containers, cardboard cartons, or polyethylene bags; bulk loadout is the loadout of the sugar to specially designed bulk hopper cars or tank trucks.

In addition to granulated sugar, other common refined sugar products include confectioners (powdered) sugar, brown sugar, liquid sugar, and edible molasses. There are about six other less common sugar products.

Emissions and Controls

Particulate matter (PM), combustion products, and volatile organic compounds (VOC) are the primary pollutants emitted from the sugarcane processing industry. Combustion products include nitrogen oxides (NOx), carbon monoxide (CO), CO2, and sulfur oxides (SOx).

Potential emission sources include the sugar granulators, sugar conveying and packaging equipment, bulk loadout operations, boilers, granular carbon and char regeneration kilns, regenerated adsorbent transport systems, lime kilns and handling equipment (at some facilities), carbonation tanks, multi-effect evaporator stations, and vacuum boiling pans. Potential emissions from lime kilns and boilers are addressed in AP-42 Section 11.15 (Lime Manufacturing) and Sections 1.1 through 1.4 and 1.8 (Combustion), respectively, and are not included in this discussion. Potential sources of PM emissions include the granular carbon and char regeneration kilns, regenerated adsorbent transporting systems, sugar granulators, granulated sugar transport systems, and sugar packaging operations. The multi-effect evaporators and vacuum boiling pans are a potential source of VOC emissions from the juice. However, only the first three of five evaporators (in a typical five-stage evaporator) release exhaust gases and the gases are used as a heat source for various process heaters before release to the atmosphere. Emissions from the carbonation tanks are primarily water vapor but may contain small quantities of VOC and may also include CO_2 and other combustion gases from the boilers.

The exhaust from granulators typically is vented to cyclones to remove large PM and is then passed through a wet cyclone system (e. g., Rotoclone) to remove smaller particles. Fabric filters are sometimes used to control PM emissions from sugar handling operations and from fluidized bed drying and cooling systems. Particulate matter emissions from boilers typically are controlled with cyclones. Wet scrubbers are sometimes used as primary or secondary control devices for boilers. Some natural gas-fired boilers are not equipped with controls. Emissions from the carbonation tanks, evaporators, and vacuum boiling typically are not controlled.

Two emission test reports were identified for sugarcane processing. Both tests were conducted at sugar refineries. The first test report documents testing of a sugar granulator that is controlled by a Rotoclone wet cyclone system. The average filterable PM emission factor for the granulator (SCC 3-02-015-37) is 0.095 lb/ton. In AP-42 Section 9.10.1.2, Sugarbeet Processing, the filterable PM emission factor for a granulator equipped with a Rotoclone control was 0.064 lb/ton. Because the granulators in cane sugar and beet sugar production are expected to be similar, it is not surprising that the two emission factors are comparable. The second test report includes measurements of filterable PM emissions at the outlet of a gravity collector that controls PM emissions from a bone char conveyor transfer point (SCC 3-02-015-26). The average emission factor for this test is 0.26 lb/ton of char transferred.

The use of emission factors based on a single test is not recommended. If necessary, the average filterable PM emission factors can be used, but would be rated E.

Chapter 5

Boiler House

Introduction

What is a Boiler?

It is a device for heating water or generating steam above atmospheric pressure. All boilers consist of a separate compartment where the fuel is burned and a compartment where water can be evaporated into steam.

Types of Boilers

Water Tube Boiler

In water tube Boiler a number of water tubes are arranged in and around the furnace. Water circulates in the tubes and outside is the fire.

This type generally gives high steam production rates, but less storage capacity. water tube boilers are also capable of high efficiencies and can generate saturated or superheated steam. The ability of water tube boilers to generate superheated steam makes these boilers particularly attractive in applications that require dry, high-pressure, high-energy steam, including steam turbine power generation.

Fire Tube Boiler

In fire Tube Boiler There is a fire in the tubes and water is present outside the tubes in the big vessel or cylindrical drum. Fire-tube boilers usually have a comparatively low rate of steam production, but high steam storage capacity.

Boiler Water Treatment

Origin of the problem

Scaling

Total hardness in the water if not properly removed will cause scale formation. A layer of scale on the metal surface of the boiler will act as an insulator and reduce the rate of heat transfer from hot zone to water. A layer of scale as thick as the surface of the boiler will reduce boiler efficiency by some 20%. Scaling results in

- More fuel will be used to maintain boiler output at acceptable level.
- Since heat transfer is retarded the metal becomes hotter to a point where it deforms and even rapture with disastrous results.

Corrosion

The most common source of corrosion in boiler systems is dissolved gas:

oxygen, carbon dioxide and ammonia. Of these, oxygen is the most aggressive. The importance of eliminating oxygen as a source of pitting and iron deposition cannot be over-emphasized. Even small concentrations of this gas can cause serious corrosion problems.

Water Treatment Plant

This is the plant where water is purified from unwanted particles which make the consumption of oil less in furnace for burning water. It consist of two sections

a. Reverse Osmosis Plant (R.O. Plant)
b. Demineralization Plant (D.M. Plant)

Water Demineralization Plant

A Demineralization Plant consists of two pressure vessels containing cation and anion exchange resins. Various types of ion exchange resins can be used for both the cation and the anion process, depending on the type of impurities in the water and what the final water is used for. Typically, the cation resin operates in the hydrogen cycle. The cat ions in the water (i.e. calcium, magnesium and sodium) pass through the cation exchange resin where they are chemically exchanged for hydrogen ions.

The water then passes through the anion exchange resin where the anions (i.e. chloride, sulphate, nitrate and bicarbonate) are chemically exchanged for hydroxide ions. The final water from this process consists essentially of hydrogen ions and hydroxide ions, which is the chemical composition of pure water.

Simple demineralisation plant consist of Composite resin vessels with charge of strong cation and anion resin; control-panel encompassing a conductivity measurement and alarms, etc; acid and caustic injection facility from bulk, semi-bulk or carboy containers. This plant also has the same purpose as R.O. Plant but its total capacity is 45 tons per hour.

There are 3 small tanks series and 3 larger tanks series through which raw water passes for treatment. Each first tank (small and large) contains Hydrochloric Acid (HCl). Each 2nd tank (small and large) contains NaOH. After that water passes through 3rd tank of each series from where it is sent out to condensate storage plant. Each 3rd tank contains both HCl and NaOH. Water treating capacity of small tank series is 15 tons per hour and that of large tank series is 30 tons per hour which makes a total of 45 tons per hour. Water from Water Treatment Plant is sent to Condensate Storage Plant.

RO Reverse Osmosis Plant

Reverse osmosis plants have at their heart a membrane that, if damaged, reduces output, increases costs and gives poor water quality. So it is important to keep it clean and operating efficiently.

Most reverse osmosis membranes are formed from hollow fiber or thin film composite sheets with the membrane allowing passage of pure water and rejecting the dissolved solids contained in the water. As water passes along the membrane surface the solids concentration increases and some sparingly soluble salts start to exceed their solubility and precipitate. When precipitated onto the membrane surface this causes fouling that may reduce output and increase product water conductivity. The worst of these solids being calcium carbonate and calcium sulphate and so the prevention of their precipitation is vital if the membrane is to function efficiently.

Raw water comes in R.O. Plant which is first treated with Caustic Soda (NaOH) and Sulphuric Acid (H2SO4) and then passed through a filter having 12 filters of 5 micron type. After that it is passed through five membrane systems (First it enters in three of them and then after that in the rest two of them), having each 6 membranes. Water is also flushed with Sodium BiSulphate during this process with a 60 % recovery of water.

Then the water is sent to condensate storage plant. The capacity of R.O. Plant is 30 tons per hour. RO Membrane Antiscalant Effective membrane Antiscalant should be:

(1) Safe to use and safe to handle (2) Good scale

Steam Generation

Properties of Steam

In sugar mills steam is used for both power generation and as source of heat in process operation. Some of the fundamental properties of steam which govern its use for generation of power and for heating as well as boiling in process are:

1. High pressure and temperatures of steam are desirable for generating power.
2. Low pressure steam is required in process operation.
3. Latent heat of steam increases as pressure is reduced.

High pressure steam from boiler is fed to prime movers for some units like mills as also to the power generating turbines and the exhaust steam from these prime movers is utilised for process operations. In modern plants this exhaust steam supplies 80-90% of the needs of boiling house. Water is transformed into vapour phase by external supply of heat from fuels and the heat supplied performs the function in three ways:

1. Gives sensible heat for raising the water temperature to boiling point.
2. Provides latent heat for formation of vapour phase for transforming water at boiling temperature into steam.
3. Super heating the steam beyond that corresponding to saturation temperature of steam.

Thus saturated steam is in complete vapour phase when it is free from water and the dryness fraction indicates the water content of the steam as for instance dryness fraction.of 0.95 indicates 5% water content of steam. The superheated steam is at a higher temperature than the saturated steam of the same pressure and is absolutely essential for turbines as it is moisture free and has higher heat content. In modern factories the common practice is to generate steam at 21 Kg/cm2 pressure with a degree of superheat of 70-80°C i.e. at a temperature of around 300°C.

Recent trends favour installation of boilers generating steam at 31 or 45 Kg/cm2 pressure and superheat of about 150°C since high pressures are conducive for higher power generation. The exhaust steam from the prime movers is of about 0.7 to 1 Kg/cm2 and is entirely used for heating and boiling in the process. Live steam is used in two ways in sugar mill:

1. for driving turbines or engines
2. directly for process at reduced pressure to make up for the shortage of exhaust and also at centrifugal station and for sulphur furnace.

The live steam directly used in process is the boiler high pressure steam passed through reducing station for reducing pressure to 5 Kg/cm2. In this way the steam generation in sugar mill serves two fold objectives of:

1. generating power for machinery operation and
2. providing heat energy for the process of sugar factory.

Ash Dust Collector Disposal System

It collects the dust and poisonous particles from the exit flu gases. The gases which are left over the complete process of steam generation are full of poisonous particles and dust as well. These gases cannot be allowed to pass in the atmosphere as such so we have to treat them for the removal of these poisonous particles of a boiler called Dust Collector.

Working of Dust Collector

The flu gases from the third pass of the boiler come into a first portion where the blades are arranged in a sequence, the gases strike these blades and at that time heavy particles settle down and the remaining gases flow to the 2nd portion which is called Cyclone.

Flu gases first strike to the circular portion of the cyclone where the blades are arranged when the flu gasses strike the blades the heavy particles settle down and the remaining gases again go upward in the pipe where a circular blade is circulating at a very high speed creating the swirling action due to which heavy particles settle down and remaining almost non dangerous gases flow to the I.D. fan which let them go outside in atmosphere.

Rotary Valve

The main part of dust collector is the rotary valve. In this valve there are many blades having no gap between the blade and body of valve. These blades rotate at a very high speed due to which vacuum is produced which is enough to capture the dust particles.

Rotary Screen

Ash from the rotary valve comes into the rotary screen which then throws the ash into ash container. It contains many blades which rotate and lead the ash to the container.
The detailed picture of Water-tube steam boiler with two drums is given below:

Smoke uptake

Following are the instruments used for smoke uptake.

1. Economizer: A heat exchanger that transfers heat from Boiler Flue Gases to Boiler Feedwater.

2. Steam outlet: Saturated steam from the Steam Drum to the Super heater.

3. Cyclone: A device inside the steam drum that is used to prevent water and solids from passing over with the steam.

4. Stay tube: For super heater

5. Stays: For super heater tubes

6. Superheated steam outlet

7. Super heater: A bank of tubes, in the exhaust gas duct after the boiler, used to heat the steam above the saturation temperature.

8. Super heater Headers: Distribution and collecting boxes for the super heater tubes.

9. Water drum

10. Burner

11. Water wall Header: Distribution box for water wall and down comers.

12. Foting

13. Water wall: Tubes welded together to form a wall.

14. Back side water wall

15. Boiler hood

16. Water wall Header: Collecting box for water wall and risers.

17. Riser: Tubes in which steam is generated due to high convection or radiant heat. The water-steam emulsion rises in these tubes toward the steam drum.

18. Down comer: A tube through which water flows downward. These tubes are normally not heated, and the boiler water goes through them to supply the generating tubes.

19. Steam drum: Separates the steam from the water.

20. Economizer Header: Distribution box for the economizer tubes.

Key factors for Boiler Efficiency Calculations

Following are the key factors to calculate efficiency of boilers:

1. Flue gas temperature (Stack temperature)
2. Fuel specification
3. Excess air
4. Ambient air temperature
5. Radiation and convection losses.
6. Flue Gas Temperature
7. This process of conduction between a solid surface and a moving liquid or gas is called convection.
8. High boiler efficiency is the result of specific design criteria, including
9. Number of boiler passes
10. Burner / boiler compatibility
11. Repeatable air/fuel control
12. Heating surface
13. Pressure vessel design
14. Boiler efficiency calculations that are accurate and representative of actual boiler fuel usage require the use of proven and verified data, including:
15. Proven stack temperature
16. Accurate fuel specification
17. Actual operating excess air levels
18. Proper ambient air temperature
19. Proper radiation & convection losses.

Injection Water Cooling

The warm water from the condensers needs to be cooled to the lowest practical temperature before being re-used. The cooling process is carried out in cooling towers or spray ponds after which the water is pumped back to the condensers. In cooling towers or spray ponds the exchange of heat between the warm water and ambient air is by:

1. Conduction between the fine droplets of water and the surrounding air
2. Evaporative cooling, which is by far the most effective factor.

The efficiency of the system is mainly dependent on the relative humidity of the air. The efficiency should be between 50% and 70%, 60% being a satisfactory average, and the efficiency can be calculated from

$$\eta = (Th - Tc) / (Th - Twb)$$

where

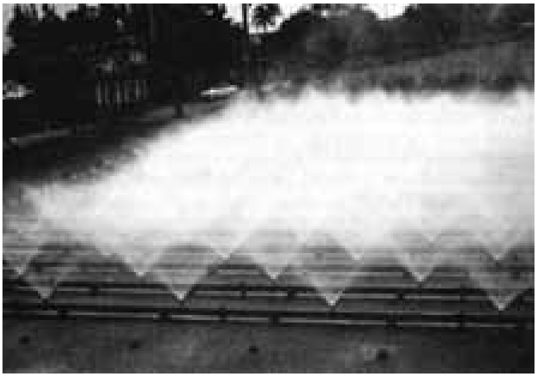
- "η" is the efficiency of the system
- "Th" is the temperature of warm water entering the system, °C
- "Tc" is the temperature of cooled water leaving the system, °C
- "Twb" is the temperature of wet bulb, °C

An approach temperature of between 8°C and 10°C is possible. Approach temperature is defined as

$$Tapp = Tc - Twb$$

Spray Ponds

Capacity



Two criteria are involved namely

- depth and
- surface area

Depth

This has virtually no influence on the cooling of the water. An average depth of 1 metre should be adequate provided there is sufficient water to fill the flumes, seal wells and flood the injection and export pump suctions at the starting up of the plant. There is no advantage in exceeding a depth of 1 metre, since the increase in the mass of water in the circuit has only a negligible influence on the cooling. Only the surface area is important.

Area of the Pond

The area of the pond is important on account of the necessity of arranging the nozzles so that the curtains of water formed by them do not overlap or interfere with each other, and so that air may circulate between the sprays. The area of the pond is deduced from the quantity of water which it can treat per hour per unit area of the pond. Tromp suggests 120 lb/ft2/h (585 kg/m2/h), Webre and Robinson 150 lb/ft2/h (732 kg/m2/h).

	Min	Max	Avg
Hawaii	145	168	156
Queensland	133	170	152

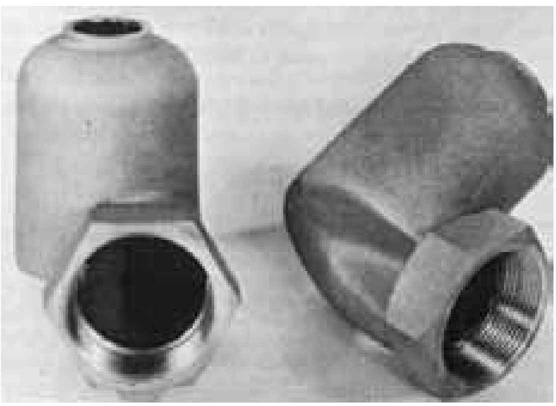
Table: Area of the Pond in lb/ft2/h

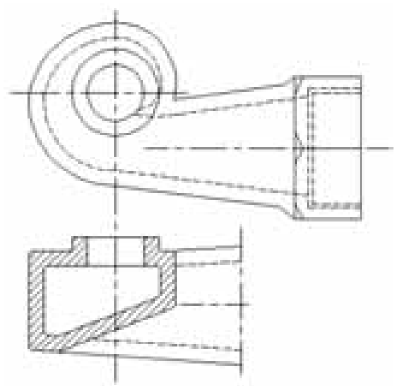
Among French manufacturing firms, Fives Lille bases its calculations on 164 lb/ft2/h (800 kg/m2/h). We consider that the best value to adopt is: 750 kg/m2/h

Spray Nozzles

The main design features are that nozzles should:

1. deliver water in a cone, and
2. be of simple design, easily dismantled with no portion of smaller cross-section than the orifice.





Quantity of water delivered
This is calculated from
q = C•S √(2gH)
where,

- "q" is the capacity of nozzle in m3/s
- "C" is the coefficient of contraction, normally 0,5
- "S" is the cross-section area of orifice, m2

- "g" is the acceleration due to gravity 9.81 m/s2
- "H" is the pressure head of water = 0.5m

Nozzles are mounted on pipes called laterals at right angles to the main pump delivery line. Laterals decrease in size towards the end.

Nozzles

These are best grouped in a star pattern with the following dimensions given as guidelines:
1. branch diameter to star = 50 mm
2. nozzle orifice diameter = 41.3 mm
3. length of branch to nozzle = 1220 mm
4. distance between cluster centres = 4 m

Spacing between pipes

Let,
1. a = spacing between laterals, m
2. b = spacing between nozzles, m

then ab = q/750, in which q = output/nozzle, in kg/h

Loss of water

1. by entrainment 3%
2. by entrainment and evaporation 5 - 6%

Practical Considerations

Following are the practical considerations:

1. A spray pond should be long and narrow to improve the efficiency at the centre, but cost might be prohibitive.
2. All laterals should be provided with quick acting flushing valves at their ends, easily accessible.
3. Pump suctions should be adequately protected from blockage by tank, bagasse and other flotsam. Easy access for cleaning screens must be provided.
4. The arrangement of nozzles may not always conform to a star pattern as cost will be an important consideration but efficiency might suffer.
5. Due to loss of water from the pond, a fresh water make up system operating on pond level is required.

Chapter 6

Laboratory Analysis

Purity

Technicians usually measure the purity (sucrose content) of sugar by polarimetry — the measurement of the rotation of plane-polarized light by a solution of sugar. In past sulphur dioxide was bubbled through the cane juice before evaporation to bleach many colour impurities in to colourless. Sugar was bleached by this process was known as "SULPHITATION".

In Pakistan the sulphitation process has blurred off completely from the old mills and the new technique of "CARBONATION" is adopted where sugar syrup is decolorized by filtration through a bed of activated carbon.

Following are the requirements established by the Pakistan Standard Quality Control Authority (PSQCA) for the production of white sugar ps 1822-2007 R. some of the specified limits i.e. ICUMSA is considered as un-necessarily higher side for domestic consumption, which is still to be considered by the sugar industry.

Anylysis for Refined Sugar and White Sugar

Sr.	Characteristics	Requirements		Remarks
		Specification Refined Sugar	Specification White Sugar	
1.	Polarization Min.	99.8°s	99.70s	ICUMSA GS2/3-I
2.	Moisture (Loss on drying 3 hours at IOS°C)	0.08	0.08	ICUMSA GS2/1/3-I5
3.	Invert Sugar, percent m/m, Max.	0.04	0.04	ICUMSA GS2-6
4.	Ash, percent m/m Max.			
	i. Sulphate Ash	0.06	0.06	ICUMSA GSI/3/4/7/8-11
	ii. Conductivity Ash	0.04	0.04	ICUMSA G S2/3-17
5.	Solution Colour ICUMSA Unit Max.	60	80	ICUMSA GS2/3-9
6.	Sulphur Dioxide Mg / kg, Max	I5.0	I5.0	ICUMSA GS2/7-33
7.	Copper mg/kg. Max.	2.0	2.0	ICUMSA GS2/3/29
8.	Arsenic mg/kg. Max.	1.0	1.0	ICUMSA G S2/3-25
9.	Lead mg/kg. Max.	1.0	1.0	ICUMSA G S2/I/3-27

(P.S. 1822-2007 R revised version still to be published by PSQCA)

Chapter 7

By Products

Bagasse

Bagasse is the fibrous matter that remains after sugarcane or sorghum stalks are crushed to extract their juice. It is currently used as a biofuel and in the manufacture of pulp and paper products and building materials.

Agave bagasse is a similar material that consists of the tissue of the blue agave after extraction of the sap.

Storage and composition

For each 10 tonnes of sugarcane crushed, a sugar factory produces nearly 3 tonnes of wet bagasse. Since bagasse is a by-product of the cane sugar industry, the quantity of production in each country is in line with the quantity of sugarcane produced.

The high moisture content of bagasse, typically 40 to 50%, is detrimental to its use as a fuel. In general, bagasse is stored prior to further processing. For electricity production, it is stored under moist conditions, and the mild exothermic reaction that results from the degradation of residual sugars dries the bagasse pile slightly. For paper and pulp production, it is normally stored wet in order to assist in removal of the short pith fibres, which impede the papermaking process, as well as to remove any remaining sugar.

A typical chemical analysis of bagasse might be (on a washed and dried basis):

Cellulose	45–55%
Hemicellulose	20–25%
Lignin	18–24%
Ash	1–4%
Waxes	<1%

Bagasse is an extremely inhomogeneous material comprising around 30-40% of “pith” fibre, which is derived from the core of the plant and is mainly parenchyma material, and “bast”, “rind”, or “stem” fibre, which comprises the balance and is largely derived from sclerenchyma material. These properties make bagasse particularly problematic for paper manufacture and have been the subject of a large body of literature.

Heaps of bagasse, covered with blue plastic, outside of a sugar mill Research efforts have explored using bagasse as a renewable power generation source and for the production of bio-based materials.

Fuel

Bagasse is often used as a primary fuel source for sugar mills; when burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare. To this end, a secondary use for this waste product is in cogeneration, the use of a fuel source to provide both heat energy, used in the mill, and electricity, which is typically sold on to the consumer electricity grid.

The resulting CO_2 emissions are equal to the amount of CO_2 that the sugarcane plant absorbed from the atmosphere during its growing phase, which makes the process of cogeneration greenhouse gas-neutra. In many countries (such as Australia), sugar factories significantly contribute 'green' power to the electricity supply. For example, Florida Crystals Corporation, one of America's largest sugar companies, owns and operates the largest biomass power plant in North America. The 140 MW facility uses bagasse and urban wood waste as fuel to generate enough energy to power its large milling and refining operations as well as supply enough renewable electricity for nearly 60,000 homes.

Ethanol produced from the sugar in sugarcane is a popular fuel in Brazil. The cellulose-rich bagasse is being widely investigated for its potential for producing commercial quantities of cellulosic ethanol. For example, Verenium Corporation is building a cellulosic ethanol plant based on cellulosic by-products like bagasse in Jennings, Louisiana.Bagasse is often used as a primary fuel source for sugar mills; when burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare.

Paper

Main article: Soda pulping

Around 5–10% of paper production worldwide is produced from agricultural crops, valuing agricultural paper production at between $5 and 10 billion. One of the most notable of these is bagasse. Paper production is the second-largest revenue stream from bagasse; the largest is electricity cogeneration. Using the by-products of agricultural crops for paper production, rather than wood, does offset commercial forestry practices. This is believed beneficial because the conversion of the rainforest to commercial tree stock and common forestry practices destroys a majority of the indigenous rainforest life forms.

For example, the most common commercial tree stock for short fiber pulp for paper is eucalyptus, which is considered an invasive species due to compounds in the leaves that can be toxic in large quantities (i.e. on a tree farm), and because it is considered a fire hazard. A secondary benefit of substituting agricultural by-products for commercial forestry practices is the reduction of the number of farmers following logging roads into the rainforest for the purpose of burning pristine rainforests to convert to farming. It is thought that bagasse has the added advantage over other forms of papermaking feedstock in that it requires fewer greenhouse gases to collect, compared to harvesting of wood chips, as the fibre has already been transported to the factory for extracting the sugar. However, a full lifecycle analysis should be performed before using this claim commercially. Due to the ease with which bagasse can be chemically pulped, bagasse requires less bleaching chemicals than wood pulp to achieve a bright, white sheet of paper. The fibers vary in length depending on the country and cane variety but are typically about 1.3 to 1.7 mm long. Bagasse fibers are well suited for tissue, corrugating medium, newsprint, and writing paper.

Bagasse pulp and paper mills tend to be smaller than wood-based mills, although many world-scale factories exist. TNPL is the Largest bagasse-based Paper Mill in the world, consuming about one million tones of bagasse every year. Most chemical bagasse pulp mills concentrate the spent reaction chemicals and combust them to power the paper mills and to recover the reaction chemicals.

Boards

It can also be used for making boards resembling Plywood or Particle board. It has wide usage for making partitions, furniture etc. It is an eco-friendly method as it does not involve any harm to the world's timber resources, un-like plywood. It is known as Bagasse Board and is considered a good substitute for plywood.

Other uses

Bagasse's uses are wide and varied due to its widespread availability and low cost.

Fermented Fiber Feed

K-Much Industry has patented a method of converting bagasse into cattle feed by mixing it with molasses and enzymes (such as bromelain) and fermenting it. It is marketed in Thailand, Japan, Malaysia, Korea, Taiwan and Middle East and Australia as "fiber rich".

Bagasse is the primary ingredient in WikiCells, an edible food packaging concept that originated at David Edwards' La Laboratoire in Paris.

Health impact

Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis, more specifically referred to as bagassosis.

Molasses

Molasses is a viscous by-product of the beating of sugarcane, grapes or sugar beets into sugar. The word *molasses* comes from the Portuguese word *melaço*, which ultimately comes from *mel*, the Latin word for "honey". The quality of molasses depends on the maturity of the sugarcane or sugar beet, the amount of sugar extracted, and the method of extraction. Sweet sorghum is known in some parts of the United States as molasses, though it is not considered true molasses. In Nepal it is called chaku (Nepal Bhasa) and is used in the preparation of various Newari condiments like the yomari. It is also a popular ingredient in 'ghya-chaku'.

A bottle of molasses

Sulfured molasses is made from young sugarcane. Sulfur dioxide, which acts as a preservative, is added during the sugar extraction process. Unsulphured molasses is made from mature sugarcane, which does not require such treatment. The three grades of molasses are: mild or barbados, also known as first molasses; dark, or second molasses; and blackstrap. These grades may be sulphured or unsulphured.

To make molasses, the cane of a sugar plant is harvested and stripped of its leaves. Its juice is extracted usually by crushing or mashing, but also by cutting. The juice is boiled to concentrate it, which promotes the crystallisation of the sugar. The result of this first boiling and of the sugar crystals is first molasses, which has the highest sugar content because comparatively little sugar has been extracted from the source. Second molasses is created from a second boiling and sugar extraction, and has a slight bitter tinge to its taste.

The third boiling of the sugar syrup yields blackstrap molasses, known for its robust flavour. The term is an Americanism dating from around 1920. The majority of sucrose from the original juice has been crystallised and removed. The food energy content of blackstrap molasses is still mostly from the small remaining sugar content. However, unlike refined sugars, it contains trace amounts of vitamins and significant amounts of several minerals. Blackstrap molasses is a source of calcium, magnesium, potassium, and iron; one tablespoon provides up to 20% of the daily value of each of those nutrients. Blackstrap has long been sold as a health supplement. It is also used in the manufacture of ethyl alcohol for industry and as an ingredient in cattle feed.

Molasses made from sugar beet is different from sugarcane molasses. Only the syrup left from the final crystallization stage is called molasses; intermediate syrups are referred to as high green and low green, and these are recycled within the crystallisation plant to maximise extraction. Beet molasses is about 50% sugar by dry weight, predominantly sucrose, but also contains significant amounts of glucose and fructose. Beet molasses is limited in biotin (vitamin H or B_7) for cell growth; hence, it may need to be supplemented with a biotin source. The nonsugar content includes many salts, such as calcium, potassium, oxalate, and chloride. It also contains the compounds betaine and the trisaccharide raffinose.

These are either as a result of concentration from the original plant material or as a result of chemicals used in the processing, and made it unpalatable to humans. Hence it is mainly used as an additive to animal feed (called "molassed sugar beet feed") or as a fermentation feedstock.

It is possible to extract additional sugar from beet molasses through a process known as molasses desugarisation. This technique exploits industrial-scale chromatography to separate sucrose from nonsugar components. The technique is economically viable in trade-protected areas, where the price of sugar is supported above the world market price. As such, it is practiced in the U.S. and parts of Europe. Molasses is also used for yeast production.

Cane molasses is a common ingredient in baking, often used in baked goods such as gingerbread cookies. A number of substitutions can be made for molasses. For a given volume of molasses, one of the following may be used (with varying degrees of success):

- black treacle (which is very similar to molasses)
- honey
- sweet sorghum syrup
- barley malt syrup
- maple syrup
- ¾ of the volume of firmly packed brown sugar, especially soft dark brown sugar
- dark corn syrup
- kecap manis, a sweet, syrupy soy sauce from Indonesia (which is also salted, unlike a sweetener)

Other forms

In Middle Eastern cuisine, molasses is produced from several other materials such as carob, grapes, dates, pomegranates, and mulberries. Because of its unusual properties, molasses has several uses beyond that of a straightforward food additive.

Other food and consumption derivatives

1. Molasses can be used as the base material for fermentation into rum.
2. Molasses may be used in some dark brewed beverages such as some stouts or very heavy dark ales (however barley malt syrup is also a thick, dark syrup, and barley is a common grain for beer making).
3. Molasses is added to some brands of tobacco used for smoking through a Middle Eastern water pipe (e.g., *hookah, shisha, narghile*, etc.). It is mixed into the tobacco with glycerine and flavorings; sometimes it is used with honey and other syrups or fully substituted by them. Brands that use molasses include Mazaya, Al-Fakher, Nakhla, Tangiers and Salloum.

4. Blackstrap molasses may be used as an iron supplement for those who cannot tolerate the constipation associated with other iron supplementation.
5. Molasses is used as an additive in livestock feeds.
6. Molasses is used in fishing groundbait.
7. Molasses is also used in yeast production.

Chemical

1. Molasses can be used as the carbon source for in *situ* remediation of chlorinated hydrocarbons.
2. Molasses is blended with magnesium chloride and used for de-icing.
3. In Australia, molasses is fermented to produce ethanol for use as an alternative fuel in motor vehicles.

Industrial

1. Molasses can be used as a chelating agent to remove rust where a rusted part stays a few weeks in a mixture of 1 part molasses and 10 parts water.
2. Molasses can be used as a minor component of mortar for brickwork.
3. Ink rollers on printing presses were originally cast using a mixture of molasses and glue.

Horticultural

Soil

Molasses can be added to the soil of almost any plant to promote microbial activity.

Hydroponic

Molasses contains the disaccharide sucrose. This sugar does not substitute as a flowering enhancer in hydroponic gardening. Other substitute “sugar boosters” for hydroponics contain deoxyribose, lyxose, ribose, xylulose, and xylose. These simple and complex carbohydrates are the main components of cellular reproduction, and deliver an immediately usable form of energy to the plant, which would normally rely on a soil-type organic medium for beneficial microbial activity.

Each tablespoon of molasses (20 g) contains 58 kcal (240 kJ), 14.95 g of carbohydrates, and 11.1 g of sugar divided amongst:

1. Sucrose: 5.88 g
2. Glucose: 2.38 g
3. Fructose: 2.56 g

Molasses contains no protein or dietary fiber and close to no fat.

Tailor-made solutions

The range of GEA PHE Systems products for the sugar industry includes:

1. Plate heat exchangers:

    - Varitherm and NT Series for syrup, molasses, concentrated juice, filtered thin juice, extraction water
    - Free Flow for raw juice and limed juice as well as for unfiltered juices

2. Plate evaporators:

    - Concitherm as booster for Robert evaporator or complete stage
    - EVAPplus as retrofit solution or complete stage

3. Direct contact condensers:

    - VAPORplus as retrofit solution or complete unit

4. Engineering – consulting:

    - Heat balance of evaporation stations
    - Consulting for all evaporator types
    - Design of condensers
    - Design of condensate cigars

Mud

Sugarcane press mud is the residue of the filtration of sugarcane juice. The clarification process separates the juice into a clear juice that rises to the top and goes to manufacture, and a mud that collects at the bottom. The mud is then filtered to separate the suspended matter, which includes insoluble salts and fine bagasse. There are 3 types of filters: the press filters (used in carbonatation factories), mechanical filters and rotary vacuum filters. The yield of filter cake is variable, from 1 to 7 kg (wet basis) / 100 kg of cane). With a (conservative) yield of 2 % and a total production of 1700 million t (in 2009, from, the world output of fresh filter press mud can be estimated to be about 30 million t.

This industrial waste is mostly used as soil conditioner, soil fertilizer and for wax production. Other industrial applications are reported (cement and paint manufacturing, foaming agent, composting aid for bagasse etc.) and it has been used as human food in poor families). In animal production, it has been used as feed ingredient, notably in ruminants, for its sugar and mineral content, and as a compacting agent for ensiling.

Distribution

Sugarcane press mud is produced in sugarcane mills and its distribution is that of cane sugar production, with Brazil, India and China representing 75 % of the world production.

Processes

Ideally, soil particles should be removed from the mixed juice before clarification. In order to avoid deterioration by fungi and bacteria, the press mud should be dried or fed immediately. Drying can be achieved with a drum drier to bring down moisture to about 15 % and pelletization can reduce it to 10 % for storage.

Environmental impact

Large amounts of press mud are released by the sugarcane industry and the disposal of this by-product is a major issue. In many cases press mud is burnt in brick kilns resulting in the loss and wastage of millions of tonnes of nutrients through burning, which ultimately degrades the environment. One common utilization is to use it as a fertilizer, in unprocessed or processed form. Processes used to improve its fertilizing value include composting, treatment with microorganisms and mixing with distillery effluent.

Potential constraints

No particular problems have been reported on using sugarcane press mud in animal feeding. However, the experience on feeding it to livestock is scarce and caution is therefore required, considering that it is a mineral-rich filtration residue that could contain undesirable substances. For instance, certain samples were found to contain relatively high amounts of copper (from 500 to 5700 mg/kg in which could be problematic for sheep.

Nutritional attributes

Filter cake has a highly variable composition due to the different technologies involved. The nature of precipitation or flocculation aids, temperature and the fineness of the filtration process are all factors that influence its composition. The product may be fresh (60-80 % water) or dried. Protein content and sugars are both in the 5-15 % DM range. It can also contain important amounts of fibre (probably due to the 15-30 % of fine bagasse). Ash content is comprised between 9 and 20 %, but some press cakes may contain up 60 % mineral matter, a large part of it being silicium. Calcium content is comprised between 1 and 9 %. The content of protein, sugar and fibre makes filter press mud a potential feed ingredient, but actual feed trials are scarce.

In India, a filter press cake containing more than 30 % Ca (which is a highly unusual value) was proposed as a potential Ca source for livestock.

Tables of chemical composition and nutritional value

- Sugarcane filter-press mud
- Sugarcane rotary-filter mud

Ruminants

Filter press mud as a feed

In Cuba, dried filter press mud has been used as a filler in ruminant maintenance diets at a level of 10-30%, along with poultry manure, final molasses, ground cane, urea and minerals. For this purpose the filter mud is sun-dried or dried using heat from chimney escape gases at the sugar factory. Dairy cows were fed up to 15 % (diet DM) filter press mud (containing 13 % crude fibre, 8.8 % crude protein and 31.7 % ash) replacing forage, with positive effects on dairy performance (milk yield, fat content, non-fat solids), daily live weight gain, DM intake and ME intake.

Filter press mud as a ensiling agent

In Cuba, filter press mud has been used as a compacting and wetting agent in surface silos where 60 % of cane by-products is ensiled together with 38 % of filter mud and 2 % urea. Since the cane by-products contains 60-70 % DM, the filter mud with 30 % DM and granular consistency contributes the needed moisture and texture to ensure optimum silage.

Poultry

With an MEn value of 8.85 MJ/kg DM, sugarcan press mud was considered to be a potential low-energy feed ingredient in poultry diets in Sri Lanka. In the Philippines, dried filter press mud (6.6 % crude protein) was fed at 10 % in poultry rations.

Fish

Press mud has a chemical composition similar to that of cattle dung, which is very common fish pond fertilizer in India. When fertilizing ponds of common carps (*Cyprinus carpio*), 10 t/ha of press mud was found to be optimal for fish growth and survival. A significant effect of press mud on carcass protein was observed. Organoleptic quality of both raw flesh and cooked meat of carp was not affected by the addition of press mud.

In China, a carp and dace feed ingredient has been produced from fodder yeast grown on a substrate of hydrolysed bagacillo (waste from paper manufacture from sugarcane bagasse) and filter press mud (replacing up to 2/3 of wheat bran). This ingredient could replace up to 60 % of the control feed and increased growth performances.

Feed categories

- Other plant by-products
- Sugar processing by-products
- Plant products and by-products

Citation

Biomass Waste

- The manufacture of sugar generates large quantities of biomass waste such as rice husk, bamboo dust, bagasse, coconut coir, jute and sticks. This waste is ideal for use as fuel to generate power.
- Press mud, which is discarded as a solid waste from sugar mills and used as a manure or as a landfill, is found to be a useful substrate for biogas production.
- Two types of solid wastes are produced during the manufacture of sugar. Bagasse is produced in the mill house in a quantity of about 30% of the crushed cane. The bagasse contains 50% moisture. Press mud or filter cake is produced in vacuum filters and press filters. The mud is produced in a range of 3-8 % of the crushed cane, depending on the nature of sugar manufacturing process.
- Sugar cane straw wastes can be recycled as active additions once calcined in the temperature range of 800 or 1000 C.
- Chromatographic methods are also used in sugar production processes (e.g.: green syrup and molasses) to reduce the nonsugars and to increase the quantity of crystallisable sugar. The waste water from sugar treatment plants is normally subjected to extended aeration in ponds and is ultimately made to undergo intensive biological oxidation.
- As the world's largest sugar producer, Brazil has the potential to be a market for bagasse-based power generation worth $24B, yet less than 10% of this opportunity is currently being fulfilled.
- Sugar cane now provides 13 per cent of Brazil's energy, replacing fossil fuels with ethanol for transport and bagasse (waste pulp) for heat and power. It supplies: 180,000 barrels a day of ethanol, 400 per cent of all the gasoline used in the country.
- A large increase in the sugar production of the West Indies carries with it the important problem of the efficient disposal of the byproducts of the sugar factory. 'These are filter-press mud, bagasse (the fibre of the cane) and molasses.

Technology

- Promotion of biomass energy
- Co-Generation Opportunities Utilizing Sugar Industry Wastewater Through the Use of Biological Treatment Systems
- Waste to Energy Technologies
- Treatment Systems for Sugar Industry

Recovery Process

- Recovery of Lactic Acid from American Crystal Sugar Company Wastewater
- Pakistan's Sugar Industry
- Sugar Industry
- Characterisation of sugar cane straw waste as pozzolanic material for construction
- Sugarcane Water Treatment
- Sugar Waste Treatment
- Waste Heat Sources in Sugar Factory and Their Utilization for Cooling Condenser Water

Patent

- Processes for immobilizing waste using bagasse
- Process for the preparation of refined hard sugarcane wax having improved qualities from press mud
- Process for the Purification of Waste Waters

Uses of Sugar Waste

- Biomass Power Generation: Sugar Cane Bagasse and Trash
- Repowering / Optimizing the Use of Biomass Waste in Sugar Industries in Indonesia
- New South Wales Sugar Industry Renewable Electricity Generation
- Sugar waste used for food packaging
- Sugar cane waste could hold the answers to Central America's energy problems

Market

- The Opportunity for the Use of Sugar Cane Bagasse to Generate Electricity in Latin America and the Developing World
- Sugar solution
- Recent Trends in the Sugar Industry of the British West Indies
- Wastewater treatment market in India

Chapter 8

Electricity

Introduction

In modern plant of cane sugar manufacture most of the units like pumps, centrifugal machines, crystallisers, etc. and cane preparatory devices as also the boiler fans are electrically driven and therefore electric power generation has to be centralised. Usually except the mills, boiler feed pumps and in some factories shredders or fibrizers, electric motors are installed to provide drive for running different units. In a central powerhouse, electric power is generated by installing one or more turbine driven generators and from the main switch board power is distributed to different units in the factory by laying cables. In sugar factories three phase alternating current is produced. Back pressure turbine receiving live steam at 21 Kg/cm2 or 31 Kg/cm2 discharges exhaust steam at 0.8 to 1 K Kg/cm2 which is used in the process operation and converts nearly10% of the heat energy of steam into electric energy. The turbine installed is designed to suit the steam pressure and temperature conditions of the boiler. The turbine is coupled to an alternator through closed reduction gear. The alternator develops 3 phase alternating current of 50 cycles/Sec. and 400-440 volts. In U.S. A. the standard frequency is 60 cycles whereas in India, Europe and some other parts of the world 50 cycles/sec. is standard frequency. The alternator speed has to be submultiple of 3000 for this frequency. The installed electric power in modern cane sugar plants, with mills driven by turbines is usually 24 KW/tch though efficiently run plants operating at 115-120% total capacity consume 80% of the installed power.

Surplus power generation—For producing surplus electricity as a by product of cane sugar manufacture installing high pressure boilers becomes a necessity and in Hawaii raising boiler steam pressure to 31-85 Kg/cm2 together with modifications in the system design of the power and steam cycle have enabled factories to release surplus power to the tune of 2 to 4 megawatts of electricity for irrigation and other purposes. For a factory with a crushing rate of 2500 t. per day by installing high pressure boilers of 31 Kg/cm2 or so it is possible to generate 2 M.W. or more power for sale to state grid or other industrial units. For new sugar projects to be set up it is possible to plan for surplus power production by installation of high pressure boilers, turbo alternators to suit the conditions of boiler steam and steam turbines for mill drive operating at high steam pressure. The boilers should operate at 41 Kg/cm2 and 400°CFor existing plants installation of high pressure boiler together with extraction/ condensing turbine in which the function of back pressure and condensing are combined should be suitable and the surplus heat in the steam after meeting process demand, is converted into electrical energy. The total system design has to be carefully worked out and it is desirable to have two or three turboalternators so that in the event of shut down of any unit in the entire steam power generation system, the factory operation may not suffer.

Whether for producing additional power or energy or for any other industrial purposes the full potential of bagasse is to be exploited and therefore it is essential to save maximum amount of bagasse for which following major steps are considered important.

1. Steam pressure and temperature have to be higher 31-51 Kg/cm2
2. and 400°C respectively. The boiler design must be suitable for highly efficient operation and should incorporate heat recovery systems like air heater and economiser.
3. Bagasse moisture should be brought down if possible by installing dryer. At the mills bagasse moisture should be reduced to 45-47% and it should be sent out to form a heap in the open space from which by means of carrier it is conveyed to boiler. This will help further reduce the moisture by 1% or so and ensure regulated supply of fuel to boiler.
4. Boiler feed water must be at 95°C and conform to the standards required for high pressure boilers.
5. Recovery of heat from blow down of boilers and conservation as well as maximum use of hot condensates are essential.
6. Steam consumption in process has to be controlled so that the factory can manage within 50% or if possible with 45-50% steam consumption.
7. Process operation has to be geared to maximum energy conservation.

Instrumentation

In any process industry, instrumentation and automation play an important role for its techno-economical growth. There is a fast growing need of instrumentation in sugar industry in the light of overall automation which will help in increasing the efficiency of the process and save energy. During 1970's the level of instrumentation in sugar industry was very poor and minimal. The implemented instrumentation systems were either pneumatic or electrical. Most of these were in non-working conditions. Hence, the purpose of their implementation could not be availed for correct process operations.

The main reasons for the non-working conditions of instruments were:

1. Low level instrumentation
2. Frequent failures due to hostile environmental conditions
3. Poor maintenance
4. Lack of Instrumentation Engineers/ Technicians.

In order to meet the main objective of the instrumentation department i.e. to improve the efficiency of the sugar plants through effective instrumentation measurement & control systems, the objectives of the instrumentation department are further detailed as under:

1. Collecting the information of existing instrumentation systems in the sugar factories.
2. Preparing the specific action plan for the phase wise implementation of the

instrumentation systems.

3. Collecting the information regarding the advanced instrumentation systems at National and International level.
4. Implementation of the proper process instrumentation and control systems in new/ expansion/ modernization sugar plant.
5. Interaction with the instrument manufacturers, educational institutes and eminent personalities in the instrumentation field to strengthen the extension services as well as academic input.
6. Attending the various seminars/ workshops / symposiums/ exhibitions dedicated to instrumentation measurement and control to understand the latest trends in the instrumentation engineering.
7. Render the instrumentation maintenance services to the various sections/ departments of the Institute to minimize the discontinuities in the research work.
8. Development of the instrumentation laboratory in line with the advancement in instrumentation engineering.
9. Evaluation and improvement in the performance of the trained staff by establishing good rapport during the factory visits for resulting healthy growth of instrumentation & automation.
10. Co-ordination with the registrar regarding the academic input.
11. Upgradations of practicals and corresponding manuals, booklets for theory and practicals related with the teaching & training programmes.

Chapter 9

Sugar Trade

A Source of Forex Earnings

Sugar Trade A Source of Forex Earnings

FISCAL YEAR	IMPORTS		EXPORTS		BALANCE OF TRADE		
	Tons	Value ”000”Rs	Tons	Value ”000”Rs	Tons	Value ”000”Rs	
1993-94	47669	444105	121565	1204964	73896	760859	Favourable
1994-95	5188	68761	315886	3770558	310698	3701797	Favourable
1995-96	3214	50239	29134	350066	25920	299827	Favourable
1996-97	681083	9861825	-	-	681083	9861825	Adverse
1997-98	110990	1685859	210632	2897750	99642	1211891	Favourable
1998-99	10097	152591	906602	11549170	896505	11396579	Favourable
1999-00	66,627	771,280			66,627	771,280	Adverse
2000-01	930,142	22,749,588			930,142	22,749,588	Adverse
2001-02	851	1,479,498			851	1,479,498	Adverse
2002-03	8,315	152,746	45,669	627,949	37,354	475,203	Favourable
2003-04	11,398	188,509	116,175	1,589,210	104,777	1,400,701	Favourable
2004-05	266,707	5,288,976	54,771	1,028,710	211,936	4,260,266	Adverse
2005-06	1,527,322	45,160,571	61,047	1,590,555	1,466,275	43,570,016	Adverse
2006-07	586,543	15,721,704	12	330	586,531	15,721,374	Adverse
2007-08	36,692	912,073	260,840	5,738,856	224,148	4,826,783	Favourable
2008-09	125,743	4,505,407	23,980	639,677	101,763	3,865,730	Adverse
2009-10	370,000	14,811,000			370,000	14,811,000	Adverse
2010-11	1,031,919	58,669,007			1,031,919	58,669,007	Adverse
2011-12	17,221	1,166,825	48,672	2,575,403	31,451	1,408,578	Favourable
2012-13	7,308	500,644	1,064,215	51,692,066	1,056,907	51,191,422	Favourable
Sub-Total	858241	12263380	1583819	19772508	725578	7509128	Favourable
Arrived by 15/11/2000	720000						
In transit	80000						
Brown Sugar	100000			Nil		(13509000)	Adverse
Total L/Cs opened	900000						
Grand Total		25772380		19772508		(5999872)	Adverse

Table : Balance of Sugar Trade – Imports VS Exports

Table shows that net amount of foreign exchange amounting to Rs. 7.509 billion saved as a result of total exports of Rs.19.772 billion during the last six years from 1994 to 1999 has been eaten away by the import of 900,000 tons during the current year 1999-2000 estimated to cost Rs.13.509 billion to the government exchequer. In other words this huge amount of Rs. 13.509 billion nullified the foreign exchange' savings as a result of surplus production of wheat for the import of sugar. Pakistan's agrarian economy thus faced negative compulsions.

Contribution in Government Revenue

Sugar industry's average annual contribution to the Government exchequer in respect of Federal Excise duty of Rs. 5,430 million represents 11.2% of the total average of Federal Excise duty collection for the last 9-years.

The estimated sugar production for the current season facing a series of crisis is worked out to 2.128 million tons, which may contribute GST between Rs. 4.468 billion to Rs. 4.915 billion. Hence the government revenue from sugar industry will decline by 18% for the year 2000-2001.

Fiscal Year July - June	Revenue from Sugar industry Rs. Million	Federal Excise Duty Collection Rs. Million	Sugar Industry Contribution %
1991-92	4,540	30,334	15.0
1992-93	5,100	35,169	14.5
1993-94	5,445	34,591	15.8
1994-95	5,552	43,691	12.7
1995-96	5,831	51,104	11.4
1996-97	5,000	55,297	9.0
1997-98 (Est)	4,920	62,011	7.9
1998-99 (Est)	7,415	60,904	12.2
1999-00 (Est)	5,071	63,000	8.0
Total	48,874	436,029	
Average P.A.	**5,430**	**48,448**	**11.2%**

Table : Source, Economic Survey 1999-2000

Sugar Industry Contribution in Large Scale Manufacturing and Gross Domestic Product

Sugar industry share during the last five years from 1996 to 2000 was Rs.249,629 million in large scale manufacturing of Rs. 1,394,461 million, which in term of average percentage is 18%. Pakistan's total GDP at market prices for these five years was Rs.13,364,078 million, out of which sugar industry's average contribution was 1.9%.

These indicators clearly show the incredible performance of sugar industrial sector performance in national economy.

Employment Opportunities

Sugar industry is one of those industries of Pakistan which accommodates not only direct labour but also indirect labour as well. More than 1,000 workers are employed during the crushing season in 8 hour shift round the clock for 100-120 days depending on the availability of sugarcane. In addition, hundreds of indirect opportunities are also created during the campaign in the shape of daily wage workers, transportation contracts, contractors for lifting of bagasse and molasses etc.

Investment Contribution

As has been previously mentioned elsewhere in the study, in addition to the huge initial investment for setting up the mill, regular investments are required to keep the mill in most efficient and modern condition ready to give the best in the shortest possible time. Besides producing the sugar, the mill has to avail the advantage of utilizing its bye products in most efficient manner. This requires investment on regular basis to take advantage of modern day research.

Industry Regulators

Sugar industry is one of the few industries which is regulated by number of regulatory bodies. These are enumerated as follows:

1. Securities & Exchange Commission of Pakistan
2. Competition Commission of Pakistan
3. Federal Board of Revenue
4. Ministry of Industries/Commerce
5. Employees Oldage Benefit Institution
6. Pakistan Standards & Quality Control Authority
7. Relevant Stock Exchange where company is listed
8. Sugar Advisory Board
9. Provincial Cane Commissioner
10. Provincial Labour Department
11. Provincial Revenue Department
12. District Market Committee

Laws applicable to the Industry

1. The Companies Ordinance 1984
2. The Income Tax Odinance 2001
3. Federal Excise and Sales Tax Act
4. Sugar Factories Control Act
5. Agriculture Produce and Marketing Act
6. EOBI Act
7. Factories Act
8. Workmen Compensation Act
9. Standing Orders Ordinance
10. Workers Welfare Fund Ordinance
11. Workers Profit Participation Act

Chapter 10
Analysis of Sugar Industry

Strengths

1. Employment Opportunities (Direct and Indirect employment to hundreds of families during crushing season and off season)
2. Increased Domestic Investment in plant and machinery and infrastructure.
3. Research and Development in finding new sugarcane varieties as well as optimizing plant efficiency.
4. Social contribution to the nearby areas in the shape of education, medical facilities and assistance to growers in the shape of loans and other facilities.
5. Image building of the area in the shape of rural development
6. Contribution to the national exchequer in the shape of taxes and duties to federal and provincial governments.
7. Strong financial backing of sponsors
8. Generation of foreign exchange from exports of surplus output

Weaknesses

1. Diversion of agricultural land
2. Huge water requirements for sugarcane fields
3. Exposure to cyclical trends of weather
4. Limited time available for factory operations and longer duration of off season
5. Dependence on growers for supply of sugarcane
6. Dependence on transporters for carrying sugarcane from field to factory
7. Crop diseases and attack of pests/insects
8. Exposure of agriculture land to water logging and salinity

Opportunities

1. Increase in area under cultivation and reduction in barren area
2. Utilisation of bye products in other industries
3. Rural Development and utilization of human resources within their own area
4. Development of research institutes to promote variety development thereby providing opportunities to local people for advanced studies in their area.
5. Overcoming power outages by cogeneration.
6. Exports of locally made sugar machinery to other countries of the world.
7. Absorption of local youth in fruitful activities.

Risk / Challenges associated with Sugar Industry

Each business has its peculiar risks and challenges. Accordingly, we have tried to highlight risks and challenges which particularly affect the sugar business.

1. Sugar Price Fluctuation: Sugar prices like most commodities primarily depend on supply and demand. International prices also play an important role in determining local prices. In addition, the cost of production especially cane price affects sugar prices as well. It has been noted that international and domestic sugar prices have continued to remain extremely volatile which doesn't allow one to forecast future revenue streams. While sugar production is a seasonal operation for approximately 100 - 125 days, sales continue throughout the year, thus holding inventory is a risk, especially in a high interest rate environment.

2. Plant Efficiency During The Season: Proper maintenance during the off-season enables the plant to run smoothly during the season. Since the season is for a limited duration, a major breakdown could affect financial results for the entire year.

3. Cyclical Nature Of Sugarcane Crop: Change in the size of the sugarcane crop can have an effect on the financial results of a company. Sugarcane crop sizes vary depending on the weather, water availability and pricing of competitive crops. Sugarcane disease can have a detrimental effect on both farmer and factory yields.

4. Correlation Between Cane And Sugar Prices: Cane prices have a minimum support price and are determined through a free market mechanism. Whereas sugar prices, though supposedly free market, are met with resistance when prices co-relate with cane prices. Thus government intervention cab be a benefit and yet a challenge for the industry.

5. Molasses Price Fluctuation: Price primarily depends on supply and demand. Bulk of Molasses is now bought by ethanol distilleries as export of molasses is no more a feasible option in view of duty structure. Prices remain volatile and have swung by as much as 100 percent in some financial years. Since molasses revenue is an important determinant of our cash flow, this fluctuation does not allow us to forecast our revenue stream.

6. Fluctuating Interest Rates: In order to curb inflation, State Bank of Pakistan regularly intervenes and revises interest rates which affect the cost of doing business. A sudden surge in borrowing rates could adversely impact the Company's financials.

7. Law And Order: Sugar mills are typically located in rural areas which are more susceptible to Law and Order situation. The movement of our cane team as well as farming team in specific areas can also be difficult and restricted.

8. Inflation: Inflation affects the business due to unprecedented cost increase. It also reduces the consumer buying power. Pakistan has been going through near double digit inflation since the last 5 years.

9. Foreign Exchange Risk: Devaluation of local currency increases cost of imports thereby increasing our processing cost as well as the cost of capital expenditure.

10. Cane Crop Vs Crushing Capacities: In the last two decades the industry has consistently increased its sugarcane crushing capacities without objectively ensuring an increase in the size of crop. A major challenge going ahead is to ensure increased sugarcane cultivation to match crushing capacity. However we feel that there is still an unabated bandwagon of capacities without similar growth or a long term plan for increasing the cane crop.

11. Sugarcane Varieties: With the passage of time, the sucrose recovery from traditional varieties is reducing. The need of the time is to bring new varieties with high sucrose recovery to mitigate the reduction and improve our overall sugar production. Therefore, research and development need to be given preferred attention for continuous improvement. This will give long term sustainability to the industry. Currently many varieties are being sown without any formal attestation from recognized research institutes which is a risk.

12. Regulatory Environment: Changes in taxation regime (Sales Tax/Excise duty) and Provincial levies (Road Cess/Market Committee fee) also affect the sentiments of sugar market and cause abrupt change in supply demand cycle. Similarly control on foreign sugar trade also deprives the country availing timely opportunities for exports in case of surplus production and imports during shortage. The procurement or sales policy of the TCP which is now a major player in the sugar market can be a challenge.

Chapter 11

Costing

Manufacturing Cost

Direct Material	
Cost of Sugar Cane Consumed	40,100
Road Cess on Sugar Cane	61
Cost of Raw Sugar	0
Market Committee fee	97
	40,258
Direct Labour	
Salaries, Wages & Other Benefits	1,496
	1,496
Factory Overheads	
Stores, Spares, Packing material and Lubricants	1,794
Repairs & Maintenance	630
Fuel, Electricity and Water Charges	193
Vehicle running & maintenance	90
Insurance	91
Depreciation	1,141
Other Overheads	244
	4,184
Current Manufacturing Cost	**45,938**
Sugar in Process Opening	51
Sugar in Process Closing	(40)
	11
Cost of goods manufactured	**45,949**
(Per tonne of Sugar)	

Project Cost (8000 tcd. of sugar manufacturing plant)

Particulars	**Amount (PKR)**	
Land (leasehold)	125,000,000	Atleast 125 acres of land will be required
Plant & Machinery (Sugar)	1,200,000,000	
Plant & Machinery (Dist)	1,500,000,000	
Building-Factory	250,000,000	
Building-Others	200,000,000	Offices and residences for workers, officers and executives
Vehicles	50,000,000	
Farming	50,000,000	In order to ensure production of quality seed for cultivation
Office Equipment	25,000,000	computers and other means of communication
Unforeseen and contingencies	50,000,000	
Total Capital Cost	**3,450,000,000**	
Working Capital	250,000,000	Fixed cost for atleast one year during construction period
Total Cost	**3,700,000,000**	
MEANS OF FINANCING		
Sponsors Equity	1,480,000,000	
Bank Loans	2,220,000,000	
	3,700,000,000	

Chapter 12

Key Performance Indicators

MEHRAN SUGAR MILLS LIMITED

Key Indicators

Production Data

PARTICULARS	Sep 30, 2012	Sep 30, 2011	+ / (-)	%
Duration of season - Days	108	104	4	3.85
Cane crushed - M. tons	915,666.04	722,120.40	193,545.64	26.80
- Maunds	22,891,651	18,053,010	4,838,641	26.80
Average daily crushing - M. tons	8,478	6,943	1,535	22.11
Plant Capacity (TCD)	10,000	10,000	-	-
Capacity Utilization - %	85%	69%	15%	22.11
Sugar production - M. tons (from cane)	103,580	74,201	29,379	39.59
Sugar-in-process - M. tons	47	67	(20)	(30.05)
Molasses production	37,158	36,563	594	1.63
Average recovery of sugar	11.31%	10.28%	1.03%	10.02
Average recovery of molasses	4.22%	4.92%	-0.70%	(14.17)
Average price of cane per 40 Kgs.	187	165	22	13.41

COST OF SUGAR PRODUCED PER M.TON

PARTICULARS	Sep 30, 2012	Sep 30, 2011	+ / (-)	%
Sugarcane (Notified Rate)	38,013	37,468	545	1.45
Quality premium	2,884	1,922	962	50.05
Subsidy/Premium	33	244	(211)	(86.47)
Transport Subsidy	329	323	6	2.00
Subtotal (paid to growers)	**41,259**	**39,957**	**1,302**	**3.26**

Sugacane handling	13	16	(3)	(18.94)
Other cane related exp (Sector, Lab contract etc)	39	127	(88)	(69.39)
Road cess	55	61	(6)	(9.16)
Market Committee fee	88	97	(9)	(9.16)
Total Cane & related expenses	**41,455**	**40,258**	**1,197**	**2.97**
Salary, wages & other benefits	1,339	1,496	(157)	(10.50)
Stores,spares,packing material,repair maint, fuel and power	2,328	2,618	(290)	(11.08)
Vehicle maint., insurance & other overheads	356	425	(68)	(16.11)
Depreciation	946	1,141	(196)	(17.14)
Total Conversion Cost	**4,969**	**5,680**	**(711)**	**(12.52)**
Manufacturing cost	**46,424**	**45,939**	**485**	1.06
Sugar-in-process	8	11	(3)	(23.85)
Cost of sugar manufactured	**46,432**	**45,950**	**483**	**1.05**
Cost of opening stock	45,810	57,757	(11,947)	(20.69)
Average manufacturing cost of sugar sold	**46,301**	**49,886**	**(3,586)**	**(7.19)**
Administrative expenses	1,174	1,352	(177)	(13.11)
Distribution cost	834	365	469	128.45
Financial expenses	1,659	1,540	119	7.74
Operating expenses / (income)	(1,185)	(660)	(525)	79.60
Other Cost per ton of sugar sold	**2,482**	**2,596**	**(115)**	**(4.41)**
Total Cost of sugar sold	**48,782**	**52,483**	**(3,700)**	**(7.05)**

SALES - M. TONS (LIFTED)

PARTICULARS	Sep 30, 2012	Sep 30, 2011	+ / (-)	%
Sugar-Current stocks (Local)	45,950	36,861	9,089	24.66
Sugar-Current stocks (Export)	37,848	9,700	28,148	290.19
Sugar-Current stocks (TCP)	4,920	3,795	1,125	29.64
Sugar-Brown	16.46	8.81	8	86.83
Sugar-White Refined (Packed)	**63.71**	**-**	**64**	**100.00**
Sugar-Current year stocks	88,799	50,365	38,434	76.31
Sugar-last year stocks (Local)	15,835	25,188	(9,353)	(37.13)
Sugar-Last year stocks (Export)	250	-	250	100.00
Sugar-Last year stocks (TCP)	7,760	-	7,760	100.00
Sugar-last year stocks	**23,845**	**25,188**	**(1,343)**	**(5.33)**
Total - Sugar sold	**112,644**	**75,553**	**37,091**	**49.09**
Molasses	37,158	36,563	594	1.63
Bagasse	8,576	7,701	875	11.37

AVERAGE SELLING PRICE Rs. / M. TON (NET OF TAXES)

PARTICULARS	Sep 30, 2012	Sep 30, 2011	+ / (-)	%
Sugar-Current stocks (Local)	48,562	46,723	1,839	3.94
Sugar-Current stocks (Export)	47,985	53,250	(5,264)	(9.89)
Sugar-Current stocks (TCP)	52,800	46,250	6,550	14.16
Sugar-Brown	116,094	114,979	1,116	0.97
Sugar-White Refined (Packed)	54,429	-	54,429	100.00
Sugar-Current year stocks	**48,568**	**47,572**	**996**	**2.09**
Sugar-last year stocks (Local)	46,764	57,410	(10,646)	(18.54)

Sugar-Last year stocks (Export)	52,259	-	52,259	100.00
Sugar-Last year stocks (TCP)	47,763	-	47,763	100.00
Sugar-last year stocks	**47,147**	**57,410**	**(10,263)**	**(17.88)**
Overall - Sugar	**48,267**	**51,095**	**(2,828)**	**(5.53)**
Molasses	9,319	7,641	1,678	21.96
Bagasse	1,659	1,215	444	36.53

CLOSING STOCKS - M. TONS

PARTICULARS	Sep 30, 2012	Sep 30, 2011	+ / (-)	%
Sugar - Current Stock - still unsold	8,581	5,637	2,944	52.22
Sugar - Last Year Stock - Sold but unlifted	-	-	-	-
Sugar - Current Stock - sold but unlifted	**6,201**	**18,208**	**(12,007)**	**(65.95)**
Total - Closing Stock	14,781	23,845	(9,064)	(38.01)

TURNOVER - Rs.

Sugar - Refined - (Local)	3,602,365,586	3,343,833,407	258,532,179	7.73
Sugar - Refined - (Export)	1,829,209,183	516,520,354	1,312,688,829	254.14
Brown Sugar	1,910,334	1,012,677	897,657	88.64
P. Fine Sugar	3,467,815	-	3,467,815	100.00
Molasses	346,289,785	279,385,495	66,904,290	23.95
Bagasse	14,226,855	9,357,000	4,869,855	52.05
Overall	**5,797,469,558**	**4,150,108,933**	**1,647,360,625**	**39.69**

RATIOS	%	%		
Gross profit	10.04%	9.11%	0.93%	10.18

Operating profit	8.44%	7.19%	1.25%	17.42
Profit before tax	7.43%	8.52%	-1.09%	(12.75)
Profit after tax	6.86%	6.57%	0.29%	4.40
Current Ratio (Current assets / current liabilities)	1.19 : 1	0.92 : 1		
Quick Ratio	0.56 : 1	0.61 : 1		
Debt Equity Ratio (Debt / shareholder's equity)	25 : 75	24 : 76		

Chapter 13

Cost Audit

Introduction

Under clauses (a) and (b) of sub-rule (1) of Rule 4 of the Companies (Audit of Cost Accounts) Rules 1998 every company shall, in addition to the records and statements specified in the order of the Securities and Exchange Commission of Pakistan, issued under clause (e) of sub-section (1) of Section 230 of the Companies Ordinance 1984, prepare:

(a) a statement of productions capacity of the plant, in terms of machine hours and production units, the actual utilisation of the capacity and the reasons of difference between the two; and

(b) a stock-in-trade of the company as at the end of financial year in terms of quantity and cost thereof, distinguishing between:

   I. stock of raw material and components;
   II. stock of work-in-process;
   III. stock of finished goods; and
   IV. other stocks.

Under sub-rule 2 of Rule 4 of the Cost Audit Rules, (2) the statements specified in clauses (a) and (b) of subrule (1) shall be signed by the chief executive and chief accountant of the company. Both the statements specified in clauses (a) and (b) shall be submitted along with the Cost Auditor’s report. As explained in para (1) of Appendix III of the Rules: 1. Capacity: (a) Licensed, installed and utilised capacities of the factory or factories for the product under reference. (b) If the company is engaged in other activities besides the manufacture of the product under reference, give a brief note on the nature of such other activities.

Production: After checking the stock-in-process at the end of the financial year with the production records and after adjusting the opening stock-in-process or last year’s closing stock-in-process, production in quantities of each type of product under reference should be worked out, as required in para 3(a) of Appendix III (sub-rule (3) of Rule 4) of the Companies (Audit of Cost Accounts) Rules 1998.

The percentage of production of the product under reference should be seen in relation to the installed capacity. If there is any shortfall in production as compared to the installed capacity, brief comments as to the reasons for the shortfall, shall be offered in the cost auditor’s report. While laying down particulars to be included in cost auditor’s report to the Directors of the Company, para 3(c) of Appendix III to the Companies (Audit of Cost Accounts), Rules 1998, further provides that if there is any addition to the production capacity during the year under review or in the immediately preceding two years, this may also be mentioned.

Cost Accounting System and Reconciliation

Determining Unit Cost

Cost Accounting systems differ from industry to industry. The system under which the data may be processed manually or on a computer would also differ to some extent from company to company, according to the interpretation of the management and cost control requirements of the management of the company. Basically different cost accounting systems are followed for job processing, batch processing and continuous processing industries. Job costing is generally adopted where specific jobs have to be individually costed and completed, like aircraft manufacturing. Batches are processed in industries like pharmaceutical. Textile and cement are examples of continuous process industries.

Both in batch costing and continuous process industries, cost per unit in the batch or in the production process run is determined by averaging the total cost of the batch or the production process run over the units produced.

Cost Control

Cost accounting is needed both for ascertaining cost of a product or operation, as well as for exercising cost control.

However, there should be some benchmark or yardstick against which actual cost can be measured. Such a yardstick may be estimated cost, standard cost, budget cost or activity based cost. Cost auditors are familiar with all such cost measurement and cost control techniques. Standard costing and activity based costing are complete systems. Under the standard costing, standard costs are used instead of actual costs and then variances are analysed and adjusted. Under activity-based costing, costs are ascertained on the basis of activities, which are cost drivers.

Financial accounting has been a mandatory requirement ever since corporate laws were framed to regulate corporate business. Cost accounting records, in earlier times and in some cases even now, are maintained in an informal manner in memorandum form, which in small industries meet the basic managerial control requirements. Even when cost data is compiled in memorandum form for providing managerial control information, the cost data isreconciled with financial accounting data. Financial accounting data being subject to mandatory audit, is usually considered more reliable and comprehensive. Units of such industry as are covered by the cost accounting record order/rules, have to maintain proper and adequate cost accounting records, in order to provide cost accounting information in the prescribed schedules and annexures.

The cost auditor has to judge and give his opinion on whether or not the cost accounting records maintained are adequate for the cost accounting of important elements of cost, specifically mentioned and explained in the cost accounting record order/rules.

Cost Accounting System

Under para 2 of Appendix III to the Companies (Audit of Cost Accounting) Rules 1998, the cost auditor has to offer brief comments on the cost accounting system and its adequacy or otherwise to determine correctly the cost of the product under reference. It is always appropriate to give a brief description of the cost accounting system being followed by the unit under audit, before offering any comments on it. The cost auditor, in his comments, should highlight changes, which may have been made in the cost accounting system, since last year.

Adequacy of Cost Accounting System

Although the rules refer only to the adequacy of the cost accounting system in arriving at the cost of production, it is necessary to examine the adequacy of the system from the angle of arriving at the marketing costs as well. This is necessary in view of the provisions that are generally included in the cost accounting record orders that (1) the cost accounting shall be kept in such a way as to make it possible to calculate from the particulars entered therein, the cost of production and cost of sales of each of the products under reference, during the financial year.

The term cost of production must be taken to include cost of processing activities. For example, when cost accounting record rules are issued to cover an industry like Textile, the textile processing company which processes textile produced by another manufacturer, will also be covered by those record rules. Similarly, some cement manufacturing units may buy Clinker produced by a different cement plant. Both making clinker as well as processing clinker to produce cement are covered by the cost accounting record rules, applicable to the cement industry. In such cases, all processing companies have to get their cost accounts audited by Cost Auditors for the processes involved.

Requirement of Cost Accounting Record Rules

It is advisable for the cost auditor to keep the requirements of Schedule 1 of the relevant cost accounting record rules in his files and review the existing cost accounting system being followed by the unit under audit, in the light of that analysis. Important elements of cost, like raw materials, labour, employee related cost, power, fuel, stores and spares, repairs and maintenance, other overheads and depreciation, which are generally specifically mentioned and explained in the cost accounting record order/rules and for which adequate cost accounting records have to be maintained.

Sugar Industry (Cost Accounting Records) Order, 2001

Short title, application and commencement

1. This order may be called the Sugar Industry (Cost Accounting Records) Order, 2001.
2. This Order shall apply to every company engaged in production of sugar in any form except liquid sugar.
3. It shall come into force at once.

Maintenance of Records

1. Every company to which this order applies shall, in respect of each financial year commencing on or after the commencement of this order, keep cost accounting records, containing, inter-alia, the particulars specified in Schedules I, II and III to this Order.
2. The cost accounting records referred to sub-para (1) shall be kept in such a way as to make it possible to calculate from the particulars entered therein, the cost of production and cost of sales of white sugar separately, during a financial year.
3. Where a company is manufacturing any other product in addition to sugar, the particulars relating to the utilization of materials, labour and other items of cost in so far as they are applicable to such other product, shall not be included in the cost of sugar.
4. It shall be the duty of every person referred to in sub-section (7) of Section 230 of the Companies Ordinance, 1984 (XLVII of 1984), to comply with the provisions of sub-paragraphs (1) to (3), in the same manner as they are liable to maintain books of financial accounts required under Section 230 of the said Ordinance.

Penalty

If a Company contravenes the provisions of this order, such company and every officer thereof referred to in sub-paragraph (4) of paragraph 2, shall be punishable under sub-section (7) of section 230 of the Companies Ordinance, 1984 (XLVII of 1984).

SCHEDULE I

Materials

Direct Materials

1. Adequate records shall be maintained showing separately the quantity and cost of sugar-cane procured at the factory gate or other collection centers. Where sugar-cane is grown in farms owned or taken on lease by a company, detailed records shall be maintained in a suitable proforma so as to enable computation of the cost of such sugar-cane. The rate fixed by the Government from year to year adopted for pricing the sugar cane supplied by the sugar cane grower (growers) to the sugar mill shall be indicated in the cost records.

2. Where beet is used as raw material for the production of sugar, separate records shall be maintained on the lines similar to sugar-cane.

3. A separate proforma shall be maintained to record sugar-cane and beet procurement expenses along with other related expenses. These expenses shall be separately determined.

4. All issues of materials shall be reconciled with figures shown in Annexures to

Schedule III to this Order, or in any other form as near thereto as possible. Any losses or surpluses arising as a result of physical verification of inventories and adjustments thereof shall be clearly indicated in the cost records.

5. Record of purchase and supply through indent by suppliers shall be maintained showing the rates at which the various quantities of material are to be acquired. The records shall indicate principal features of each indent particularly conditions relating to quantity, quality, price, period of delivery and discounts.

6. If the quantity and value of material consumed in a company are determined on any basis other than actuals for example at standards, the method adopted shall be mentioned in cost records and followed consistently. The overall reconciliation of such quantities and values of material with the actuals shall be made at the end of the financial year explaining the reasons for variances. The treatment of such variances in determining the cost of items referred to in para 2 shall be indicated in the cost records.

7. The records shall be maintained in such detail as may enable the company to readily provide data required in the various Annexures to Schedule III, to this Order in a verifiable state.

Process Material

Adequate records shall be maintained to show the receipts, issues and balances, both in quantities and costs of each item of the process material such as lime, sulphur, super phosphate, caustic soda, filter cloth and other chemicals. The cost shall include all direct charges up to works, wherever specifically incurred. The issues of material shall properly be identified with the departments or cost centers.

Consumable Stores, Small Tools, Machinery Spares etc.

1. Adequate records shall be maintained to show the receipts, issues and balances, both in quantities and cost of each item of consumable stores, small tools and machinery spares. The costs shown shall include the direct charges up to works, wherever specifically incurred.

2. In case of small tools, the costs of which are insignificant, the company may maintain such records for the main groups of such items.

3. The cost of issues of consumable stores, small tools and machinery spares, shall be charged to the relevant heads of accounts such as repairs to plant and machinery, or repairs to building. Material consumed on capital works such as addition to buildings, plant and machinery and other assets shall be shown under the relevant capital heads.

4. Wastages, spoilages, rejections or losses etc.:
   Adequate records shall be maintained showing the quantity and cost of wastages,

spoilages, rejections and losses of sugar-cane and other raw material, process material, consumable stores, small tools and machinery spares, whether in transit, storage, or for any other reasons. The method followed for adjusting the above losses as well as the income derived from the disposal of scrap, if any, in determining the cost of the product shall be disclosed in such details as may enable the company to arrive at the net cost of white sugar produced.

Excise Duty and Sales Tax

Adequate record of excise duty and sales tax paid and the rebate claimed or earned in case of allowance for excess production or export of sugar shall be maintained along with the record of white sugar manufactured. Calculation for rebate shall be worked out through formula prescribed by the Government. The working of the adjustment or claim, if any, shall also be shown.

Salaries and Wages

1. Adequate record shall be maintained to show the attendance of workers employed by the company whether on regular, seasonal, temporary, or on contract basis, as the case may be. Proper record shall also be maintained in respect of payment made for overtime work and production incentives whether in the shape of production bonus or incentives based on output given to the workers. Payment of any retirement benefits including pension, provident fund, gratuity , old age benefits, contribution and any welfare expenses shall also be included in the labour or factory overhead cost of beneficiary cost center/ department. This will be done in a manner that labour cost is available for each cost center or department and for each product whether by-product or main product so that different Annexures of Schedule III to this order, are filled properly and easily.

2. Fair and reasonable allocation shall be made for wages paid to such direct labour as has been utilized in more than one department, between the various departments or cost centers and the basis of such allocation shall be consistently followed. Idle time or lay-off payments shall be recorded separately indicating the reasons and the method of treatment in the calculation of the cost of the items referred to in Para 2. Any wages paid for additions to plant and machinery or other capitalised assets, shall be capitalized and excluded from the cost statements of white sugar produced.

3. Benefits paid to the employees other than covered in clause (a) above shall be worked out separately and shown in the cost statement department wise.

Service / Departments

Adequate records shall be maintained to indicate the expenses incurred for each services department or cost center.

In the case of multi-product companies, these expenses shall be apportioned to other service and production departments on an equitable basis. Where these service departments serve products other than white bagged sugar, suitable basis shall be worked out so that the share apportioned to white bagged sugar is worked out and applied consistently.

Utilities

1. Steam: Adequate records showing the quantity and cost of steam raised and consumed shall be maintained in such detail as may enable the company to fill up the necessary particulars in Annexure 7 to schedule II to this Order. The cost of steam consumed by the sugar mill and other units of the company shall be calculated on a reasonable basis and applied consistently. The cost of steam should be allocated to electric power house, white bagged sugar and other users including staff colony and office building etc. Basis adopted for valuation of steam at different pressures shall also be indicated in the records.

2. Electric Power: Adequate record of cost of electric power generated by the company and purchased shall be kept in such details as may enable the company to furnish the necessary cost data as in Annexure 8 to Schedule III to this Order. The records shall be so maintained as to enable assessment of consumption of power by different departments or production units or cost centers. Allocation of cost of electric power shall be on the basis of actual consumption, if separate meters are installed; or on the basis of technical estimates in the absence of separate meters. In the case of fixed charges or fuel adjustment surcharge claimed by the utility company, irrespective of the actual power consumed and if the amount payable as per actual consumptions fall below the contractual minimum, the difference between the contractual minimum and the actual amount shall be treated as fixed or period cost and transferred to other factory expenses statement [Annexure 9 of Schedule III]. Cost of power consumed in and chargeable to non-production departments, if significant, shall be shown separately. Record shall also be kept for any electric power sold to out-side agencies.

Note: In case of self-generation quantity and reasons for under utilization shall be specified and the relevant cost shall be treated as fixed or period cost.

Repairs and Maintenance

Adequate records showing the expenditure incurred on workshop facilities for repairs and maintenance of buildings, civil works, offices and plant and machinery in different departments and cost centers shall be maintained on regular basis. Details of costs incurred and the basis of allocation of repairs and maintenance expenditure to different departments or production units shall be indicated. Cost of work of capital nature, heavy repairs, and overhaul cost, benefit of which is likely to be spread over a period longer than the financial year, shall be shown separately. If a separate maintenance team is working for a particular department, the salaries, wages, cost of consumables, spares and tools shall be charged as direct expense of that department.

If the maintenance services are utilized for other products, the portion utilized for them shall be segregated and charged thereto.

Depreciation

1. Adequate records shall be maintained showing values and other particulars

of fixed assets in respect of which depreciation is to be provided. The records shall, inter alia, indicate the cost of each item of asset, the date of its acquisition, accumulated depreciation, the rate of depreciation and the depreciation charged, for the relevant period.

2. Basis on which depreciation is calculated and allocated to the various departments and products shall be clearly indicated in the records. Cost Audit Hand Book 98.
3. Amount of depreciation chargeable to different departments, production units or cost centers, for the financial year shall be in accordance with the provisions of clause (F) of Part II of the Fourth Schedule to the Companies Ordinance, 1984, and shall relate to the plant and machinery and other fixed assets utilized in such departments or units or cost centers. The method once adopted shall be applied consistently.

Insurance

1. The record shall be maintained showing the insurance premia paid for the various risks covered on the assets and other interests of the company.
2. Method of allocating insurance cost to the various departments shall be indicated in the cost records and followed consistently.

Other Overheads

Adequate records showing the amounts comprising the manufacturing overhead expenses other than those already mentioned and details of apportionment thereof to the various departments or processes shall be maintained.

If products other than white bagged sugar are also being produced in the factory, adequate basis should be developed to apportion the overhead cost equitably.

By-Products

Detailed records shall be maintained for each item of by-product showing the production, disposal and balance both in quantity and value. The basis adopted for valuation of the by-products shall be equitable and consistent. Records indicating the actual sales realisation of by-products shall also be maintained.

White Sugar Transferred for Self Use

Adequate records shall be maintained showing the quantity and cost of white sugar transferred to other units of the company for self consumption. The rate at which such transfers are affected shall be disclosed in the cost records.

Work-In-Process and Finished Goods Stock

The method of valuation of work-in-process and finished goods stock shall be indicated in the cost records so as to reveal the cost elements that have been taken into account in such computation. The cost element shall be related to the items referred to in the relevant Annexures to Schedule III to this Order. The costing method adopted shall be consistently followed. Treatment of differences, if any, on physical verification of stocks with book balances, shall also be indicated in the cost records.

Adjustment of Cost Variance

Where the company maintains cost records on any basis other than actuals, such as standard costing, the records shall indicate the procedures followed by the company in working out the actual cost of the product under such systems. The method followed for adjusting the cost variances in determining the actual cost of the product shall be indicated clearly in the cost records. The reasons for the variances shall be indicated in detail in the cost records.

Inter-Company Transactions

In respect of supplies made or services rendered by the company to its holding company or a subsidiary of a company in the same group or company in which a director of the company is also a director in such companies and vice versa, records shall be maintained showing contracts entered into, agreements or understandings reached, in respect of:- Cost Audit Hand Book 1999.

1. Purchase and sale of raw materials and process material;
2. Utilisation of plant facilities;
3. Supply of utilities; and
4. Administrative, technical, managerial and other consultancy services.

These records shall indicate the basis followed to arrive at the rates charged between them so as to enable determination of the reasonableness of the rate charged or paid for such services.

Reconciliation of Cost and Financial Accounts

1. If integrated accounts are not maintained, the cost records shall be periodically reconciled with the financial accounts to ensure accuracy. Variations, if any, shall be clearly indicated and explained.
2. The reconciliation shall be done in such a manner that the profitability of each product produced and sold is correctly judged and reconciled with the overall profits of the company from all of its activities.
3. Adequate cost records shall be maintained in a manner so that the cost statements may be properly compiled.

Statistical Records

1. Data such as the duration of crushing period, the quantity of each grade of white sugar produced, mill stoppages during the season indicating the reasons, quantity of by-products obtained, percentage of sugar balance, bagasse, press-mud, molasses and sugars shall be kept in detail.
2. The data maintained in the cost records shall be reconciled with the periodical returns submitted by the company to excise and other authorities.
3. Companies may develop an appropriate standard for use as a basis to evaluate performance properly.

SCHEDULE II

A. COMPANY INFORMATION

1. Name of the Company
2. Date of Incorporation
3. Location of Registered Office
4. Location of Factory/Factories
5. Products other than sugar being manufactured
6. Installed Cane Crushing Capacity in tonnes

B. PRODUCTION DATA

S. No. (1)	Particulars (2)	Current Year (3)	Previous Year (4)
1 (a)	**CANE CRUSHED** Date of started Date of Finished Duration of run days Total number of hours in duration Total number of hours of actual crushing Total numbers of hour lost Total cane milled (tonnes) Converted maunds Total mixed juice obtained (tonnes)		
(b)	**GUR MELTED**		
2	**JUICE & ADDED WATER** Average mixed juice % cane Average added water % cane		
3	**SUGAR MADE** Total sugar bagged of all grade (100 kg)(50 kg) Sugar bagged (tonnes) Sugar in process (tonnes)		
4	**MOLASSES EXTRACTED** Total molasses sent out (tonnes) Molasses in process (tonnes)		
5	**RECOVERY (PERCENT)** Laboratory test percentage recovery of sugarcane Average recovery of marketable white sugar % cane Average production of final molasses % cane		
6	**BY- PRODUCTS** Bagasses % cane (calculated) (tonnes) V.F. Cake % cane (tonnes)		
7	**CLARIFICATION PROCESS** Specify the process used by the mill		

SCHEDULE III

Annexure 1

STATEMENT SHOWING COST OF PRODUCTION & SALE OF WHITE BAGGED SUGAR FOR THE YEAR ENDED ____________________

Quantitative Data & Bagged Sugar

Opening Stock (M.Ton)
Production (M.Ton)
Closing Stock (M.Ton)
Sales (M.Ton)

S.No.	Particulars	Current Year		Previous Year	
		Amount Rs.	Cost per Ton of Sugar	Amount Rs.	Cost per Ton of Sugar
(1)	(2)	(3)	(4)	(5)	(6)
1.	Raw Materials				
	a) Sugar Cane (Annex 3)				
	b) Beet (Annex 4)				
	c) Gur				
	d) Raw Sugar				
	e) Process Material (Annex 5)				
2.	Salaries/Wages and benefits (Annex 6)				
3.	Consumable Stores				
4.	Repairs and maintenance				
5.	Utilities				
	Steam (Annex 7)				
6.	Electric Power (Annex 8)				
7.	Water & Gas				
8.	Insurance				
9.	Depreciation				
10.	Other Factory Overheads (Annex 9)				
11.	Total Cost				
12.	ADD : Opening Stock of W.I.P.				
13.	LESS : Closing Stock of W.I.P.				
14.	Total Cost of goodsManufacturing				
15.	Less: Realisable value of By-Products				
	Molasses				
	Bagasse				
	Others				
16.	Net Cost of goods Manufacturing:				
17.	Add: Packing Material & Handling				
18.	Net Cost of Bagged Sugar				
19.	Add: Excise Duty / sales tax				
20.	Total Cost of Bagged Sugar:				
21.	Add: Opening Stock of Sugar				
22.	Less: Closing Stock of Sugar				
23.	Cost of Sales				
24.	Administrative Expenses (Annex 10)				
25.	Selling & Distrib. Expenses (Annex 11)				
26.	Financial Expenses				
	Other Charges				
	Total Cost to Make and Sell				

Annexure 2

STATEMENT SHOWING COST OF SUGARCANE PRODUCED FOR THE YEAR ENDED ____________________________

S.No. (1)	Particulars (2)	Current Year		Previous Year	
		Quantity Rs. (3)	Amount Rs. (4)	Quantity Rs. (5)	Amount Rs. (6)
1.	**Seeds and Other inputs**				
	Seed				
	Fertilizers, herbicides etc.				
	Insecticides				
	Abiana/Water Charges				
	Total Cost of Inputs				
2.	**Labour Cost**				
	Land preparation				
	Plantation				
	Maintenance of cane crop/ratoons				
	Operation of Tractors				
	Harvesting				
	Total Labour Cost				
3.	**Other Cost**				
	Fuel for Tractors operation				
	Maintenance and over haul of Tractors				
	Insurance				
	Interest expenses				
	Depreciation of equipments				
	Rent of agriculture equipments (if any)				
	Total Other Costs				
	Total Cost of own production (1+2+3)				
	Sales value at controlled price				
	Profit/Loss on own production				

Notes: 1. This Annexure will be prepared by those enterprises which cultivate sugarcane on their own farms.
2. Similar Annexure will be prepared by those enterprises which cultivate beet on their own farms.

Annexure 3

STATEMENT SHOWING COST OF SUGARCANE CRUSHED FOR THE YEAR ENDED ____________________________

S.No. (1)	Particulars (2)	Current Year			Previous Year		
		Quantity M. Ton (3)	Rate Rs./ M. Ton (4)	Amount Rs. (5)	Quantity M. Ton (6)	Rate Rs./ M. Ton (7)	Amount Rs. (8)
1.	Total sugarcane purchased at Government fixed rate						
	Sugarcane produced from own farm (Annex 2)						
	Less: Loss in transit						
	Sugarcane received at factory gate						
2.	Commission						
3.	Quality premium						
4.	Loading/unloading charges						
5.	Cane development expenses:						
	a) Salaries and Wages of Supply and Development Staff						
	b) Sugarcane Development Research						
	c) Supply staff and transportation expenses						
	d) Other expenditure						
6.	Taxes and Levies:						
	a) Cane cess/ purchase tax						
	b) Market committee fee						
	c) Road cess						
	d) Octroi						
	e) Other levies						
7.	Transportation Charges						
	a) Delivery expenses						
	b) Transport subsidy						
	c) Others						
8.	Other Expenditures at Cane Collection Centers						
	a) Salaries and Wages						
	b) Stores						
	c) Repairs and Maintenance						
	d) Others						
	Total cost of “SUGARCANE” Transferred to production processes (Annex 1)						

Notes:
1. Cane supplied from own farm shall be charged at controlled rate & the profit/loss on farm shall be taken to profit &loss account directly.
2. All expenses relating to own farm shall be excluded from this Annexure.
3. Where beet is used in addition to sugarcane, separate Annexure shall be maintained on similar lines for beet also.

Annexure 4

STATEMENT SHOWING COST OF BEET CONSUMED FOR THE YEAR ENDED ____________________

S.No. (1)	Particulars (2)	Current Year			Previous Year		
		Quantity M. Ton (3)	Rate Rs./ M. Ton (4)	Amount Rs. (5)	Quantity M. Ton (6)	Rate Rs./ M. Ton (7)	Amount Rs. (8)
1.	Total beet purchased at Government fixed rate						
	Less: Loss in transit						
	Beet received at factory gate						
2.	Commission paid						
3.	Loading unloading						
4.	Beet development expenses:						
	a) Salaries and Wages of Supply and Development Staff						
	b) Sugar Development Research						
	c) Supply staff and transportation expenses						
	d) Other expenditure						
5.	Taxes and Levies (if any)						
	a) Purchase tax						
	b) Market committee fee						
	c) Road cess						
	d) Octroi						
	e) Other levies						
6.	Transportation Charges						
	a) Delivery expenses/ travelling from purchases centre to mill gate						
	b) Transport subsidy						
	c) Others						
7.	Other Expenditures at Beet Collection Centers						
	a) Salaries and Wages						
	b) Stores						
	c) Repairs and Maintenance						
	d) Others						
	Total cost of "BEET" Transferred to production processes (Annex 1)						

Notes: 1. Beet supplied from own farm shall be charged at controlled rate & the profit/loss on farm shall be taken to profit & loss account directly.
2. All expenses relating to own farm shall be excluded from this Annexure.
3. Where sugarcane is used in addition to beet, separate Annexures shall be maintained on similar lines for sugarcane also.

Annexure 5

STATEMENT SHOWING COST OF PROCESS MATERIAL CONSUMED FOR THE YEAR ENDED ______________________________

S.No.	Particulars	Current Season		Previous Season	
		Amount Rs.	Cost per Ton of Sugar	Amount Rs.	Cost per Ton of Sugar
(1)	(2)	(3)	(4)	(5)	(6)
	Total Sugar Produced (M-Tons)				
1.	Unslaked Lime				
2.	Phosphoric Acid				
3.	Filter Acid				
4.	Sulphur				
5.	Caustic Soda				
6.	Soda Ash				
7.	Tri sodium Phosphate				
8.	Bleaching Powder				
9.	Anti Foam				
10.	Formaline				
11.	Laboratory Chemicals				
12.	Filter Cloth				
13.	Sewing Thread				
14.	Cleaning Brushes				
15.	Lubricant and Grease				
16.	Other (Specify)				
	Total				
	Less allocated to				
	(a) Electricity generation				
	(b) Steam Generation				
	(c) Raw Material				
	(d) Admin Expenses				
	(e) Selling and Distribution Expenditure				
	(f) Any Other Specify				
	Balance transferred to production process Annexure 1.				

Annexure 6

STATEMENT SHOWING COST OF SALARIES, WAGES AND BENEFITS FOR THE YEAR ENDED ___________________________

S.No.	Particulars	Current Year		Previous Year	
		Amount Rs.	Cost per Tonne of Sugar	Amount Rs.	Cost per Tonne of Sugar
(1)	(2)	(3)	(4)	(5)	(6)
	Total Sugar Produced (M-Tons)				
	Cost				
1.	**Salaries/Wages:**				
(i)	Officers and Permanent Staff				
(ii)	Seasonal Staff				
(iii)	Daily rated and Contract Labour				
(iv)	Bonuses				
2.	**Benefits:**				
(i)	Medical Expenses				
(ii)	Canteen Expenses				
(iii)	Welfare, Recreation				
(iv)	Transport and Travelling				
(v)	Education Cess/Expenses				
(vi)	Group Insurance/Workmen				
(vii)	Comp. Insurance				
	Prov. Fund (Employer’s Contribution)				
(viii)	Gratuity/Pension				
(ix)	Other Benefits (if any)				
(x)	Total				
	Less allocated to-				
	(a) Electricity Generation				
	(b) Steam Generation				
	(c) Raw Material				
	(d) Admin Expenses				
	(e) Selling & Distribution Expenses				
	(f) Any Other Specify				
	Balance transferred to production process (Annexure)				

Annexure 7

STATEMENT SHOWING COST OF STEAM/GENERATED CONSUMED FOR THE YEAR ENDED ______________________

S.No. (1)	Particulars (2)	Unit (3)	Current Year (4)	Previous Year (5)	Variance (6)
	Types of steam boilers used				
1.	No. of days worked				
2.	Installed Capacity (steam in tonnes)				
3.	Utilised capacity (steam in tonnes)				
4.	Production:				
	a) High pressure steam				
	b) Medium pressure steam				
	c) Low pressure steam				
	d) Less: transit losses				
	e) Total				
5.	Percentage of capacity utilization (3/2 * 100)				

S.No. (1)	Particulars (2)	Current Year			Previous Year		
		Quantity (3)	Rate Per Unit Rs. (4)	Amount Rs. (5)	Quantity (6)	Rate Per Unit Rs. (7)	Amount Rs. (8)
1.	Water						
2.	Fuels:						
	a) Bagasse						
	(i) Own						
	(ii) Purchased						
	b) Pith						
	c) Coal purchased						
	d) Furnace Oil						
	e) Fire Wood						
	f) Gas						
	g) *Other fuels, if any (to be specified)*						
3.	Quantity of waste heat from the plant, if any						
4.	Consumable stores						
5.	Direct salaries, Wages and benefits						
6.	Repairs and Maintenance						
7.	Other direct expenses (e.g. Boiler inspection fee etc.)						
8.	Insurance						
9.	Depreciation						
	Total Cost of Steam Raised						
10.	Less : Outside sale						
	Total Cost of Steam for Self Consumption						
	Add: Cost of steam purchased						
11.	Total Cost of Steam Consumed						
12.	**ALLOCATION**						
	Total of item 12 allocated to						
	i) White bagged sugar						
	ii) Electric power house						
	iii) Others:						
	a) Staff colony						
	b) Office building etc.						
	Total						

Notes: 1. The rate at which waste heat is evaluated vide item 3 of this annex should be indicated giving details of cost centre from which transferred.
2. Basis adopted for valuation of steam at different pressures be also indicated in the records.
3. Realisation, if any, by sale of steam to outside parties and waste products such as boiler ash shall be shown separately against item 10.
4. Where meters are not installed, consumption of steam shall be assessed on a reasonable basis and applied consistently.

Annexure 8

STATEMENT OF COST OF ELECTRIC POWER PURCHASED / GENERATED & CONSUMED FOR THE YEAR ENDED ____________________________

	Current Year	Previous Year	Variance
1. Installed Capacity (KWH)			
2. No. of units generated (KWH)			
3. No. of units purchased (KWH)			
4. Total (2+3)			
5. Consumption in Power House including other losses			
6. Net units consumed (4-5)			
7. Percentage of Consumption and losses to total units Available =5/4* 100			
8. Percentage of power generated to installed capacity 2/1 * 100			

S.No. (1)	Particulars (2)	Current Year			Previous Year		
		Quantity M. Ton (3)	Rate Rs./ M. Ton (4)	Amount Rs. (5)	Quantity M. Ton (6)	Rate Rs./ M. Ton (7)	Amount Rs. (8)
1.	Steam (Annex 7)						
2.	Consumable Stores						
3.	Salaries and Wages						
4.	Other direct expenses						
5.	Repairs and maintenance						
6.	Duty on electricity						
7.	Depreciation						
	Total						
8.	Less: a) Credit for exhaust steam used in process etc.						
	b) Other credits, if any						
9.	Cost of power generated						
10.	Less: Cost of power sold						
11.	Add: Cost of power Purchased						
12.	Total net cost of power consumed						
13.	Cost per unit average						
	ALLOCATIONS						
	Total at item 12 allocated to:						
	i) White bagged sugar						
	ii) Self consumption						
	iii) Others:						
	a) Staff colony						
	b) Office building						
	c) Other (specify)						
	Total						

Notes:
1. Credit for the cost of exhaust steam supplied to the sugar factory and for other units shall be determined on a reasonable basis and shown against item 8(a).
2. Realisation, if any, by sale of steam to outside parties, etc. shall be shown separately against item 8(b).
3. Cost per unit shall be worked out with reference to the net units of power available for use after deducting consumption in the power house and other losses.

Annexure 9

STATEMENT SHOWING OTHER FACTORY OVERHEADS FOR THE YEAR ENDED ________________________

S.No.	Description	Amount in Rupees			
		Current Year		Previous Year	
		Amount Rs.	Cost per Ton of Sugar	Amount Rs.	Cost per Ton of Sugar
	Total Sugar Produced (M-Tons)				
	Cost				
1.	Rent, Rate and Taxes				
2.	Printing & Stationery				
3.	Postage & Telegram				
4.	Telephone Fax & Telex				
5.	Travelling & Conveyance				
6.	Subscriptions, Books & Periodicals				
7.	Entertainment				
8.	Vehicle Running Expenses				
9.	Security				
10.	Fire Fighting				
11.	Other Expenses				
12.	Total				
	Allocated to				
	i)White bagged sugar				
	ii) Electric Power House				
	iii)Steam Generation				
	iv) Others:				
	a) Staff colony				
	b)Office building etc				
	Total as per item 12 above				

Note: 1. Bases of allocation should be disclosed.
2. Expenses are illustrative only. Companies should provide in detail all items of general overheads.

Annexure 10

STATEMENT SHOWING ADMINISTRATIVE EXPENSES FOR THE YEAR ENDED ____________________

S.No.	Particulars	Current Year		Previous Year	
		Amount Rs.	Cost per Ton of Sugar	Amount Rs.	Cost per Ton of Sugar
1.	Total Sugar Sold (M-Tons)				
2.	Cost				
-	Salaries, Wages & Benefits (Annex 6)				
-	Rent, Rate and Taxes				
-	Insurance				
-	Water, Gas & Electricity				
-	Printing & Stationery				
-	Postage & Telegram				
-	Telephone Fax & Telex				
-	Repair & Maintenance				
-	Travelling & Conveyance				
-	Subscriptions, Books & Periodicals				
-	Entertainment				
-	Advertising				
-	Legal & Professional Exp				
-	Auditors remuneration				
-	Vehicle Running Expenses				
-	Charity & Donation				
-	Others				
	Total				

Annexure 11

STATEMENT SHOWING SELLING EXPENSES DURING THE YEAR ENDED ____________

S.No.	Particulars	Current Year		Previous Year	
		Amount Rs.	Cost per Ton of Sugar	Amount Rs.	Cost per Ton of Sugar
1.	Total Sugar Sold (M-Tons)				
2.	Cost				
–	Salaries, Wages & Benefits (Annex 6)				
–	Travelling & Conveyance				
–	Commission				
–	Freight Outwards				
–	Stacking/Restacking				
–	Loading/Unloading				
–	Export Expenses				
–	Vehicle Running Expenses				
–	Advertising for Sales Promotion				
–	Other Expenses				
	Total				

Chapter 14

Integrated Computerized Accounting System of Sugar Industry in Pakistan


CANE ACCOUNTING
2012-2013

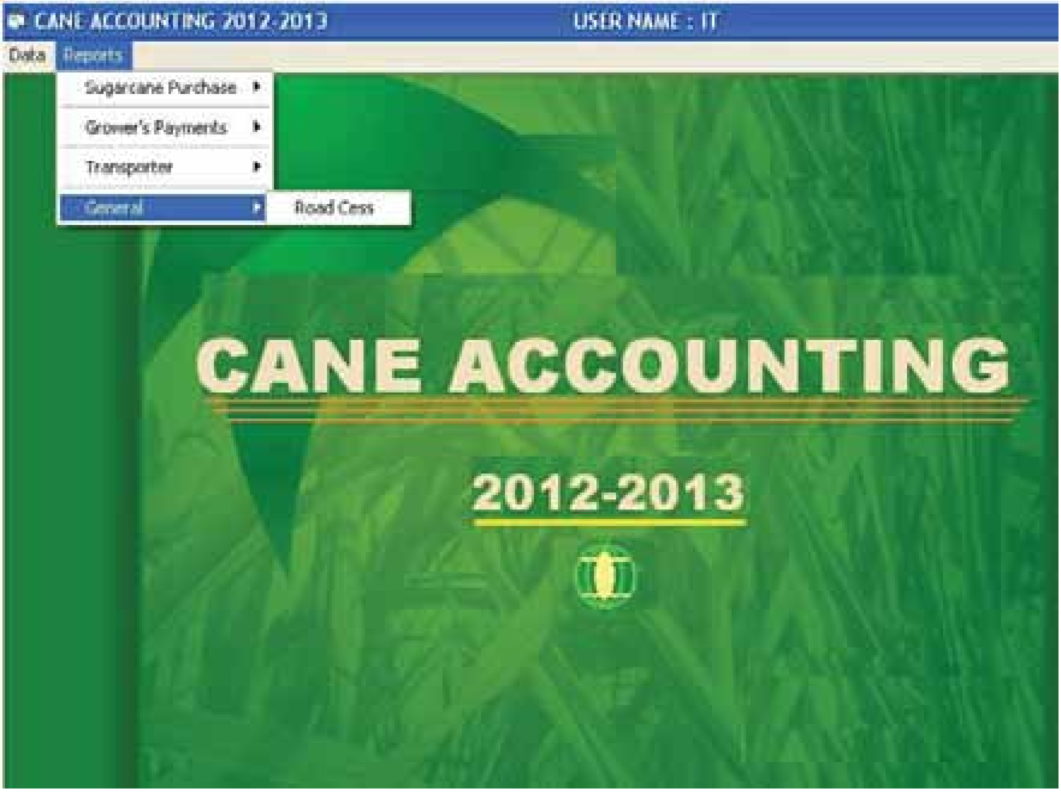

CANE ACCOUNTING 2012-2013
USER NAME : IT
Data
Reports
Growers
Transporter
Add/Edit Grower Code
Enter Grower Loans
Loan Recoveries
Payment Process
Bill Paid Entry
Post In GL
CANE ACCOUNTING
2012-2013


CANE ACCOUNTING 2012-2013
USER NAME : IT
Data
Reports
Sugarcane Purchase
Grower's Payments
Transporter
General
TPT Subsidy Rates
Daily Check List
Sugarcane Purchase - Date Wise
Sugarcane Purchase Summary - Date Wise
Sugarcane Purchase - IC No. Wise
Sugarcane Purchase Summary - IC No. Wise
Sugarcane Purchase - Grower Wise
Sugarcane Purchase Summary- Grower Wise
Supply Summary- Grower Wise
Sugarcane Receipt Inquiry - IC No. Wise
Sugarcane Receipt Inquiry - Grower Wise
Sugarcane Purchase - Sector / Media Wise
Sugarcane Purchase - Shift / Media Wise
Sugarcane Supply (Group Wise)


CANE ACCOUNTING 2012-2013
USER NAME : IT
Data
Reports
Growers
Transporter
Transporter's Record
Transporter Vehicles
Transporter Loan
Transporter Payment Process
CANE ACCOUNTING
2012-2013

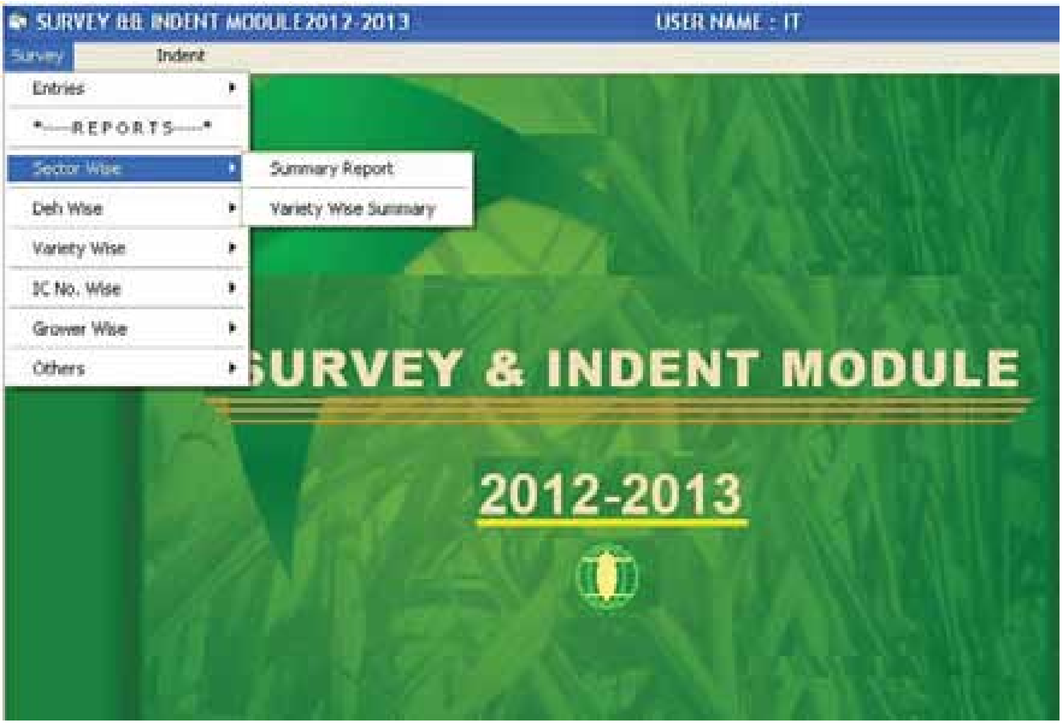

CANE ACCOUNTING 2012-2013
USER NAME : IT
Data
Reports
Sugarcane Purchase
Grower's Payments
Transporter
General
Grower's Bills
Payment Summary
Payment List Sector / Grower Wise
Mark-up Check List
Bank Advice
Bills Summary - Bank Wise
Print Paid Bills
Payment of S/C throgh Banks - Period Wise
Bills Paid Report - Grower Wise
Print Unpaid Bills
Print Unpaid Bills - Period Wise
Loan Sanctioned Check List
Print Loan Ledger
Loan Ledger Summary
Grower's Ledger Card
Outstanding Loan
Print Advance List
Grower's Loan & Advance
Print Cane Payment J.V


CANE ACCOUNTING 2012-2013
USER NAME : IT
Data
Reports
Sugarcane Purchase
Grower's Payments
Transporter
General
Print TPT Charges
TPT Other Loans
Print TPT Charges - Vehicle Wise
Print TPT Charges - Contractor Wise
Print Transporter Transaction Report
Print Transporter Bills
Print Transporter Bills (Summary)
Transporter Bills Summary (Vehicle Wise)
Bank Advice
Transporter Ledger
2012-2013


CANE ACCOUNTING 2012-2013
USER NAME : IT
Data
Reports
Sugarcane Purchase
Grower's Payments
Transporter
General
Road Cess
CANE ACCOUNTING
2012-2013


SURVEY && INDENT MODULE 2012-2013
USER NAME : IT
Survey
Indent
SURVEY & INDENT MODULE
2012-2013


SURVEY && INDENT MODULE2012-2013
USER NAME : IT
Survey
Indent
Entries
Enter Survey
----R E P O R T S----
Sector Wise
Deh Wise
Variety Wise
IC No. Wise
Grower Wise
Others
SURVEY & INDENT MODULE
2012-2013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Indent
Entries
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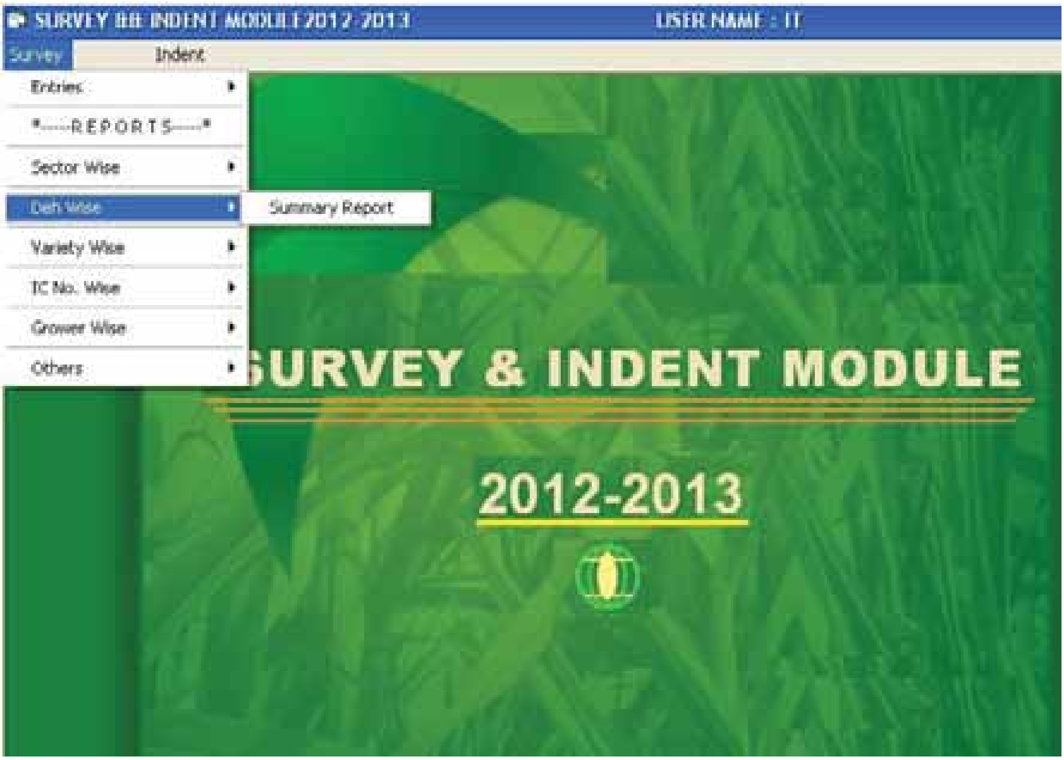
Sector Wise
Summary Report
Variety Wise Summary
Deh Wise
Variety Wise
IC No. Wise
Grower Wise
Others
SURVEY & INDENT MODULE
2012-2013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Indent
Entries
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Sector Wise
Deh Wise
Summary Report
Variety Wise
IC No. Wise
Grower Wise
Others
SURVEY & INDENT MODULE
2012-2013


SURVEY && INDENT MODULE 2012-2013
USER NAME : IT
Survey
Indent
Entries
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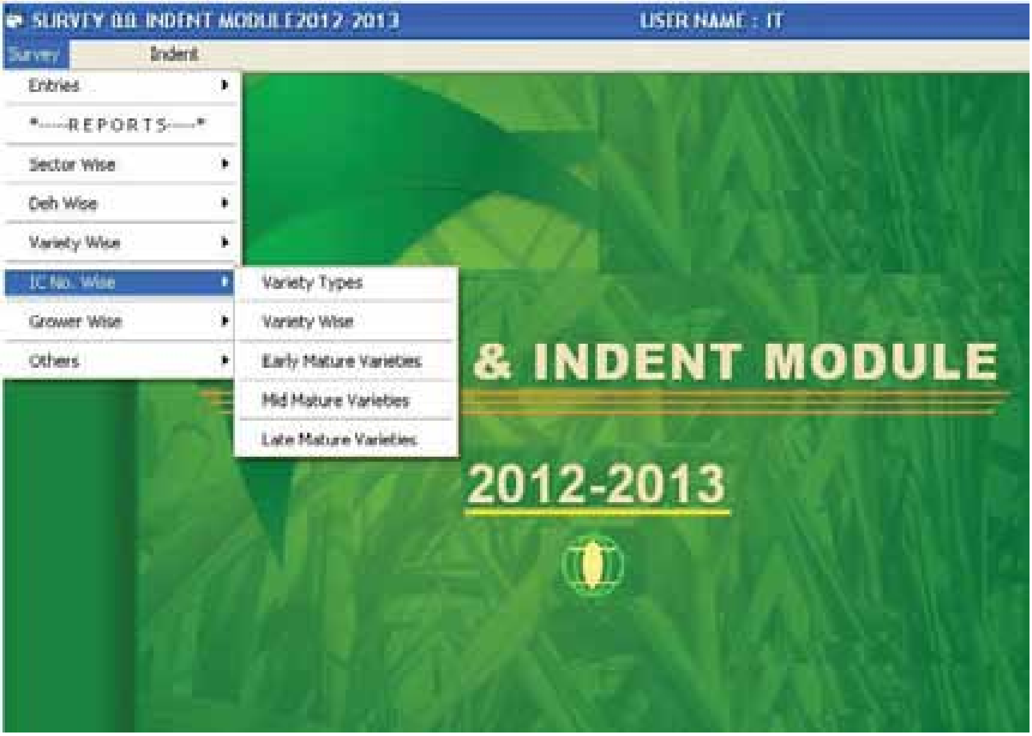
Sector Wise
Deh Wise
Variety Wise
Summary Report
IC No. Wise
Grower Wise
Others
SURVEY & INDENT MODULE
2012-2013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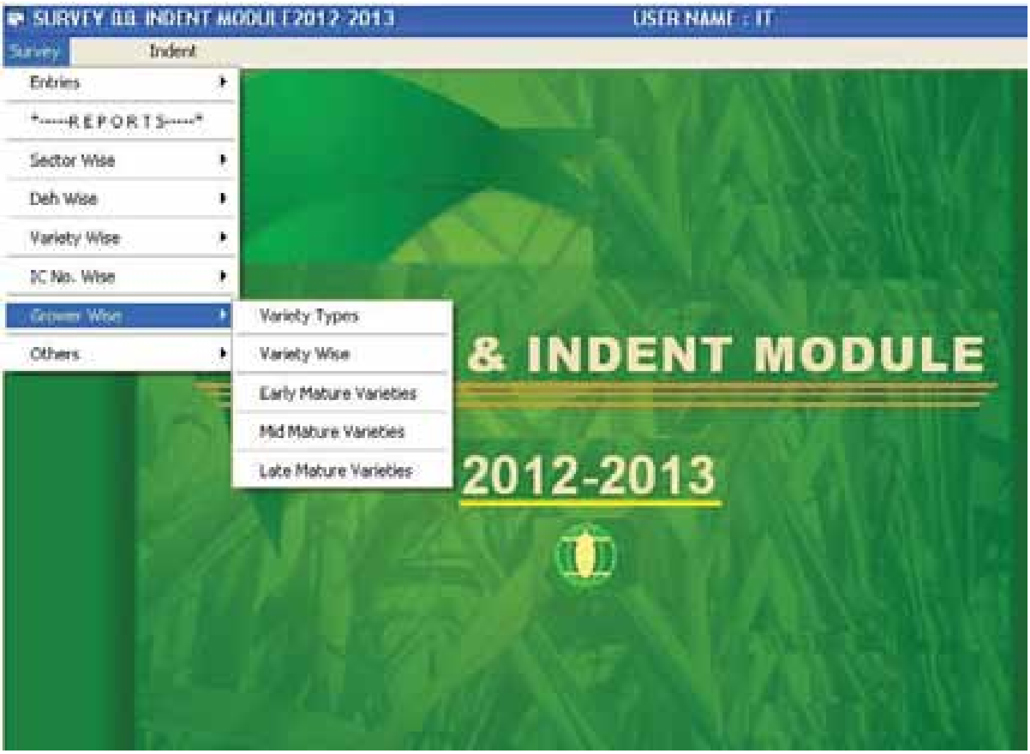
USER NAME : IT
Survey
Indent
Entries
-----R E P O R T S-----
Sector Wise
Deh Wise
Variety Wise
IC No. Wise
Grower Wise
Others
Variety Types
Variety Wise
Early Mature Varieties
Mid Mature Varieties
Late Mature Varieties
& INDENT MODULE
2012-2013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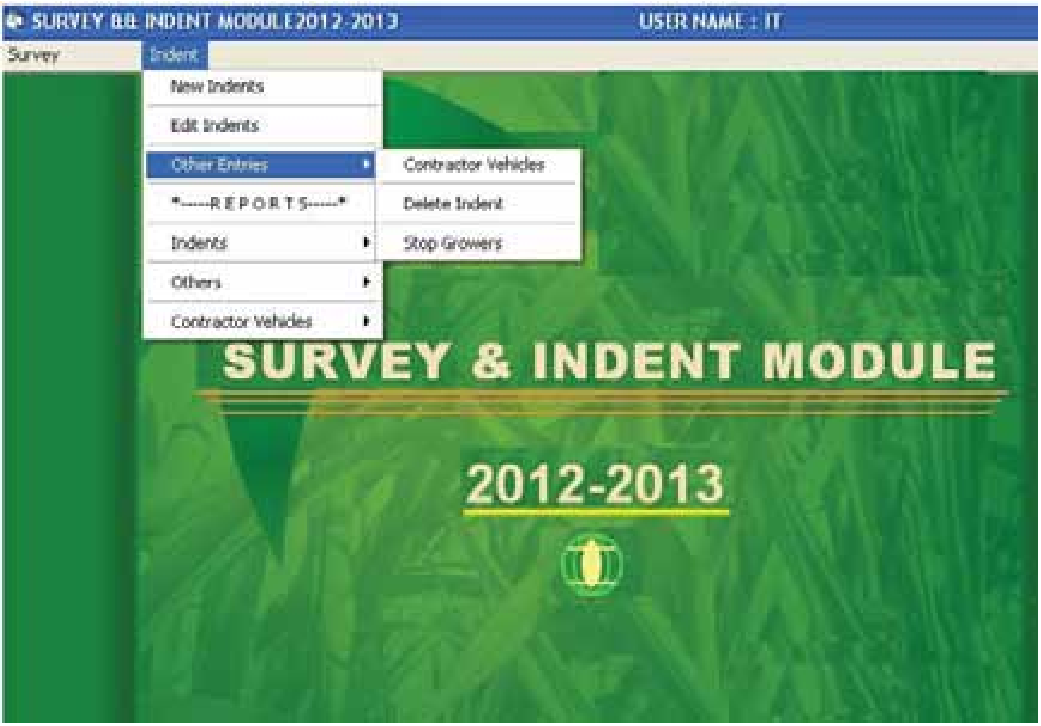
Indent
Entries
-----R E P O R T S-----
Sector Wise
Deh Wise
Variety Wise
IC No. Wise
Grower Wise
Others
Variety Types
Variety Wise
Early Mature Varieties
Mid Mature Varieties
Late Mature Varieties
& INDENT MODULE
2012-2013


SURVEY && INDENT MODULE2012-2013
USER NAME : IT
Survey
Indent
Entries
-----R E P O R T S-----
Sector Wise
Deh Wise
Variety Wise
IC No. Wise
Grower Wise
Others
Distance Wise Report
Acrage Wise Report
& INDENT MODULE
2012-2013

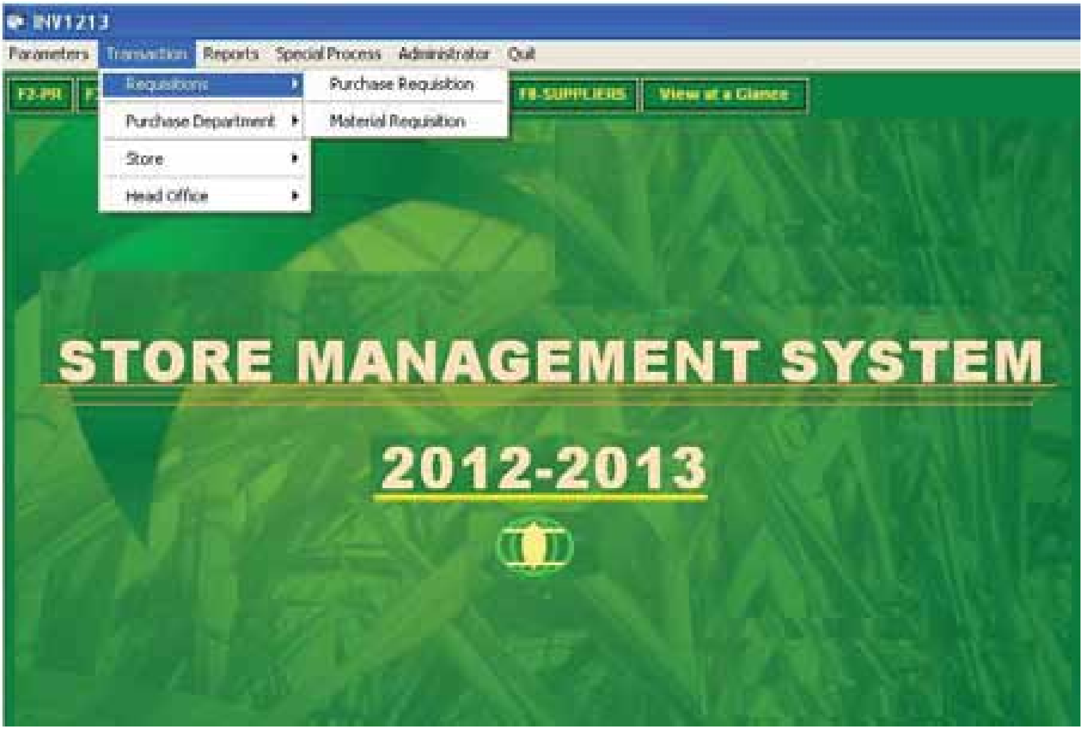

SURVEY && INDENT MODULE2012-2013
USER NAME : IT
Survey
Indent
New Indents
Edit Indents
Other Entries
-----R E P O R T S-----
Indents
Others
Contractor Vehicles
Contractor Vehicles
Delete Indent
Stop Growers
SURVEY & INDENT MODULE
2012-2013


SURVEY && INDENT MODULE 2012-2013
USER NAME : IT
Survey
Indent
New Indents
Edit Indents
Other Entries
-----R E P O R T S-----
Indents
Others
Contractor Vehicles
Indent
Indents (Sector Wise)
Indent Challan (Sector Wise)
Indent Register
Daily Dak Dispatch
Indent Issuance and Utilization Report (Sector & Vehicle Wise)
Grower Wise Indent Register
2012-2013


SURVEY && INDENT MODULE 2012-2013
USER NAME : IT
Survey
Indent
New Indents
Edit Indents
Other Entries
-----R E P O R T S-----
Indents
Others
Contractor Vehicles
Vehicles Attendant Report
SURVEY & INDENT MODULE
2012-2013


INV1213
Parameters Transaction Reports Special Process Administrator Quit
F2-PR F3-PO F4-Receiving F5-MR F6-ISSUE F7-ITEMS F8-SUPPLIERS View at a Glance
STORE MANAGEMENT SYSTEM
2012-2013


INV1213
Parameters Transaction Reports Special Process Administrator Quit
Item Head Codes
Item Sub Codes
Item Detail Codes
Units
Currencies
Opening Balance
Suppliers
Locations
Contractors
F5-MR F6-ISSUE F7-ITEMS F8-SUPPLIERS View at a Glance
STORE MANAGEMENT SYSTEM
2012-2013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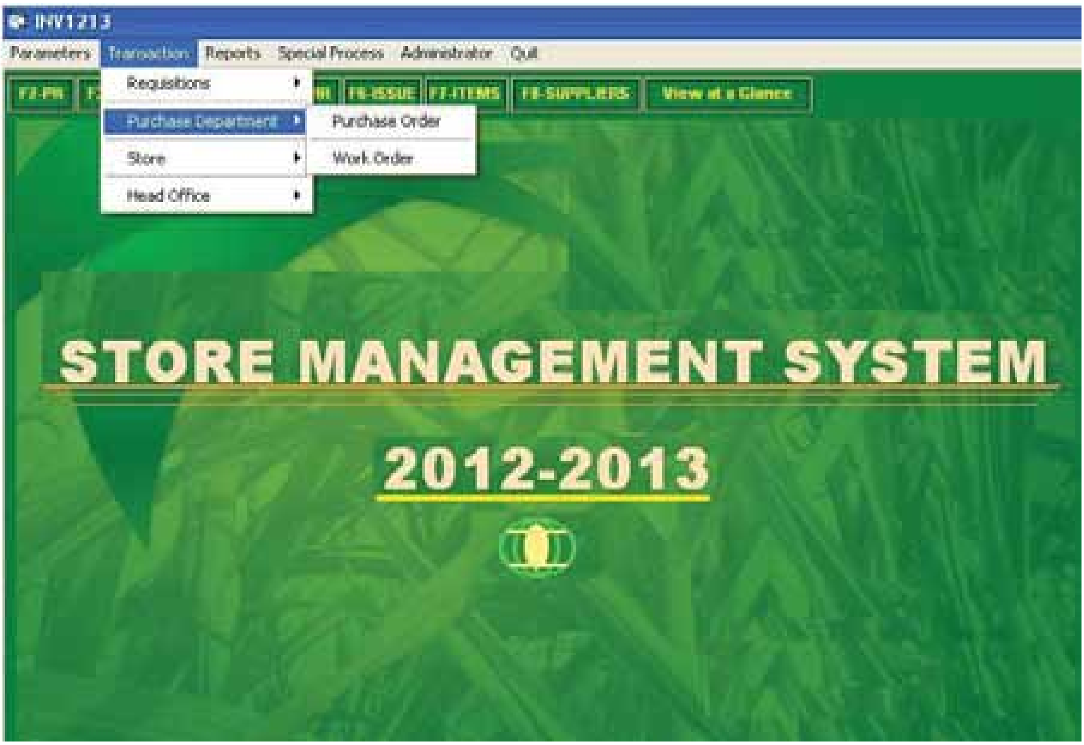
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
Requisitions
Purchase Requisition
Purchase Department
Material Requisition
Store
Head Office
F8-SUPPLIERS
View at a Glance
STORE MANAGEMENT SYSTEM
2012-2013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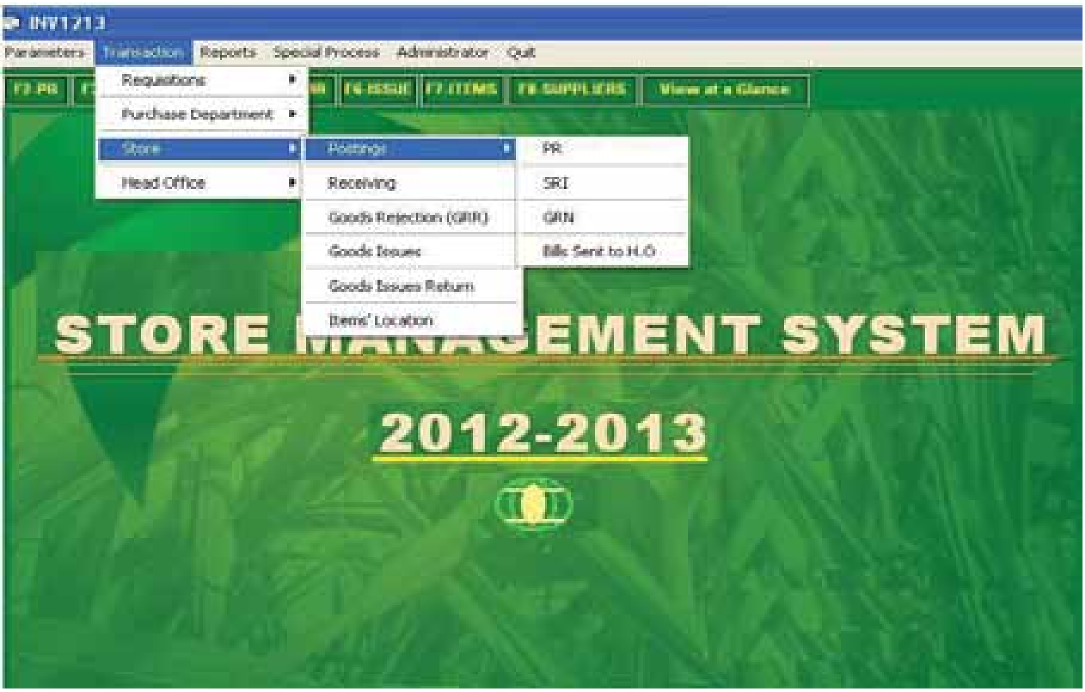
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
Requisitions
F6-ISSUE
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Department
Purchase Order
Store
Work Order
Head Office
STORE MANAGEMENT SYSTEM
2012-2013


INV1213
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F6-ISSUE
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Requisitions
Purchase Department
Store
Head Office
PO Posting
Currency Converter for PO
Dispatch Control Program
GRN Received
Transporters
Inquiry Form
STORE
SYSTEM
2012-2013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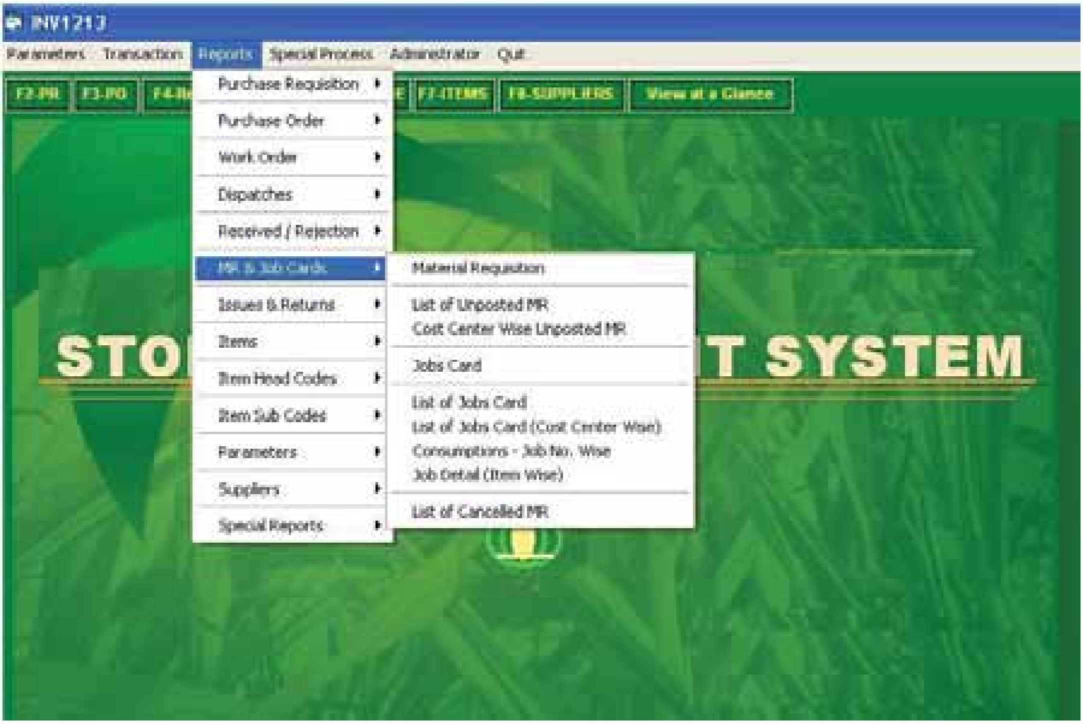
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F6-ISSUE
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Requisitions
Purchase Department
Store
Head Office
Postings
Receiving
Goods Rejection (GRR)
Goods Issues
Goods Issues Return
Items' Location
PR
SRI
GRN
Bills Sent to H.O
STORE
SYSTEM
2012-2013


INV1213
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
PR
Posting of PR
Verification List
PR List (New Format)
Item Wise PR Status
PR Status (Cost Center Wise)
PR Status
Outstanding PR's
Outstanding PR's (Cost Center Wise)
NAGEMENT SYSTEM
2012-2013


INV1213
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Purchase Order
List Of Purchase Orders
Purchase Orders Summary
Purchase Orders Summary New
Supplier Wise Purchase Orders
Supplier Wise PO Summary
Item Wise Purchase Orders
Outstanding PO
Outstanding PO (Summary)
Outstanding PO (Item Wise)
PO Activity
PO Verification List
NT SYSTEM


INV1213
Parameters Transaction Reports Special Process Administrator Quit
F2-PR F3-PO
F7-ITEMS F8-SUPPLIERS View at a Glance
Purchase Requisition
Purchase Order
Work Order
Inquiry From Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
NAGEMENT SYSTEM
2012-2013


INV1213
Parameters Transaction Reports Special Process Administrator Quit
F2-PR F3-PO
F7-ITEMS F8-SUPPLIERS View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Store Receipt Intimation (SRI)
Goods Received Note (GRN)
Bills Printing
Daily Receipts & Consumptions Report
Goods Received List
Approved GRN List (Net Quantity basis)
GRR List
Received But Not Issued
T SYSTEM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Transaction
Reports
Special Process
Administrator
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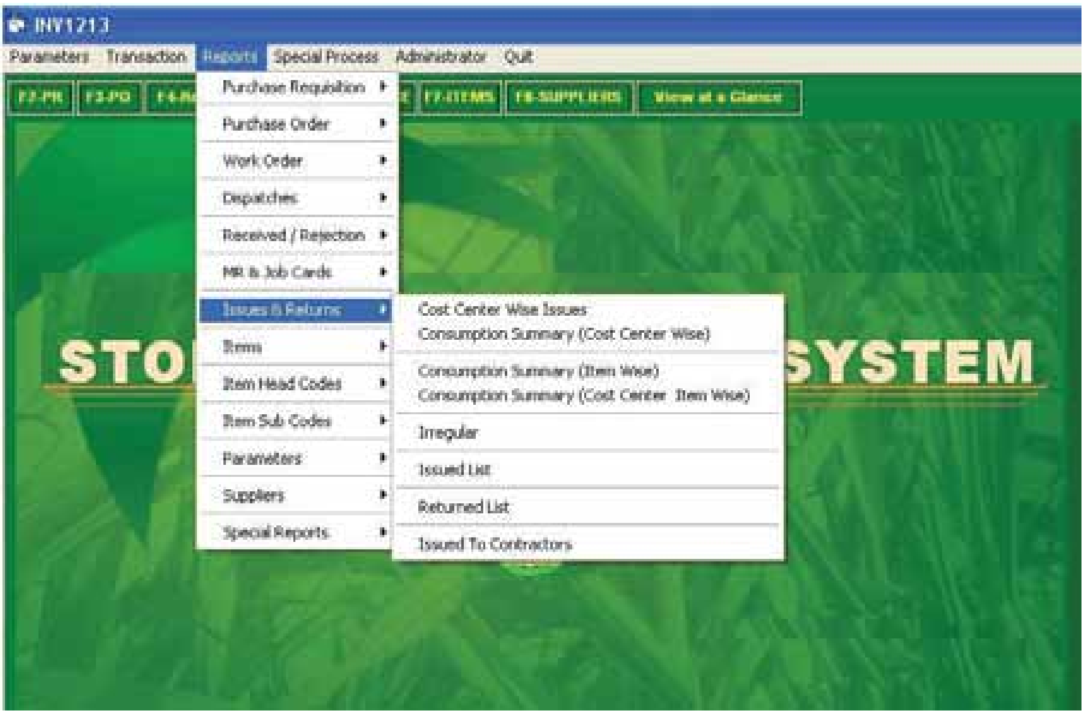
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Material Requisition
List of Unposted MR
Cost Center Wise Unposted MR
Jobs Card
List of Jobs Card
List of Jobs Card (Cost Center Wise)
Consumptions - Job No. Wise
Job Detail (Item Wise)
List of Cancelled MR
T SYSTEM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Reports
Special Process
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Quit
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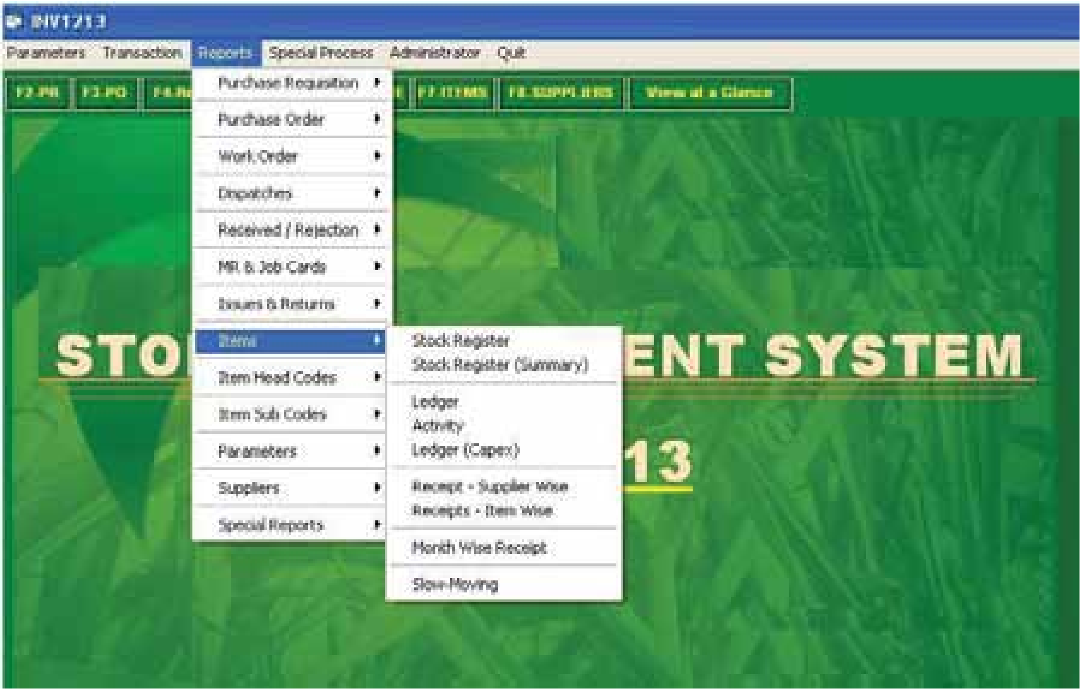
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Cost Center Wise Issues
Consumption Summary (Cost Center Wise)
Consumption Summary (Item Wise)
Consumption Summary (Cost Center Item Wise)
Irregular
Issued List
Returned List
Issued To Contractors
SYSTEM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Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Stock Register
Stock Register (Summary)
Ledger
Activity
Ledger (Capex)
Receipt - Supplier Wise
Receipts - Item Wise
Month Wise Receipt
Slow-Moving
STO
ENT SYSTEM
13


INV1213
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Stock Register
Stock Register (Summary)
Supplier Wise Receipt
Month Wise Receipt
Cost Center Wise Consumption
Month Wise Consumption
STO
NAGEMENT SYSTEM
3


INV1213
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
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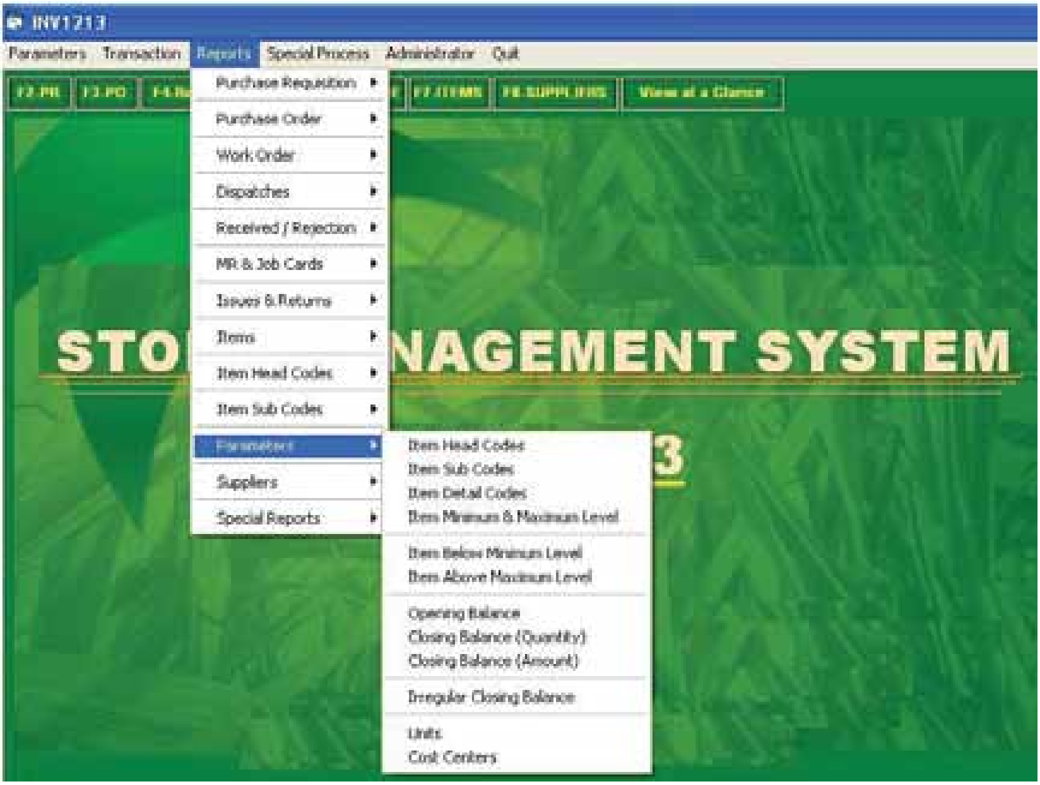
Special Reports
Stock Register
Stock Register (Summary)
Supplier Wise Receipt
Month Wise Receipt
Cost Center Wise Consumption
Month Wise Consumption
NAGEMENT SYSTEM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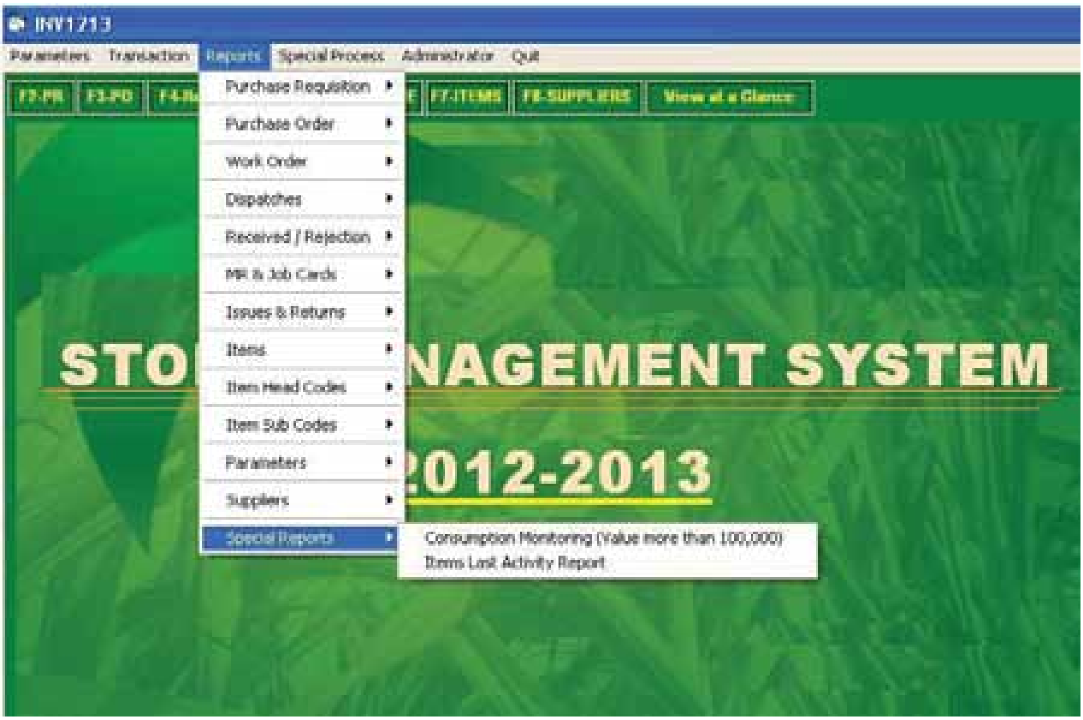
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Item Head Codes
Item Sub Codes
Item Detail Codes
Item Minimum & Maximum Level
Item Below Minimum Level
Item Above Maximum Level
Opening Balance
Closing Balance (Quantity)
Closing Balance (Amount)
Irregular Closing Balance
Units
Cost Centers
NAGEMENT SYSTEM


INV1213
Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
List of suppliers
Supplier quality performance
Supplier Re-valuation Record
NAGEMENT SYSTEM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Parameters
Transaction
Reports
Special Process
Administrator
Quit
F2-PR
F3-PO
F7-ITEMS
F8-SUPPLIERS
View at a Glance
Purchase Requisition
Purchase Order
Work Order
Dispatches
Received / Rejection
MR & Job Cards
Issues & Returns
Items
Item Head Codes
Item Sub Codes
Parameters
Suppliers
Special Reports
Consumption Monitoring (Value more than 100,000)
Items Last Activity Report
NAGEMENT SYSTEM
2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
Reports
D.Wages
PAYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
Reports
D.Wages
Monthly Entries
Loan Installments & Relief Fund
Stop Pay
Loan Sanction
Create/Edit Employee Information
Deduction - Bonus (Workers)
Deduction - Bonus (Officers)
Staff Provident Fund
Balance From Previous Year
Enter PF Loan Balance
PF Withdrawals
PF Income Process
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
Reports
D.Wages
Payroll Process
Undo Payroll Process
Update Loan
Bonus
End of Season
Production Bonus
Update Process
Statutory (10-C) Bonus
Stop Bonus
Update Bonus
Officers Bonus
Stop Bonus
Update Bonus
PAYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
Reports
D.Wages
Payroll
Summary Reports
Loan
P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
General Reports
IT Department
Salary Check List
Department Wise Payroll (Detail)
Department Wise Payroll (Summary)
Pay Slip (Bank)
Pay Slip (Cash)
Bank Advice
Cash Advice
Deductions
Month Wise Earnings
Leave Encashment
Payroll (WPPF)
MENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME : IT
Entries
Process
Reports
D.Wages
Payroll
Summary Reports
Loan
P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
General Reports
IT Department
Salary
Salary Reconciliation
Deductions
Department Wise (Single Month)
AYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
Reports
D.Wages
Payroll
Summary Reports
Loan
P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
General Reports
IT Department
Ledger
Summary
AYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
Reports
D.Wages
Payroll
Summary Reports
Loan
P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
General Reports
IT Department
P.F Contribution
PF Check List
P.F Statement
AYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
Process
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Summary Reports
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P.F
EOBI
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Officer's Bonus
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EOBI (Other Staff)
Annual Statement of EOBI
AYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
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Officer's Bonus
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Monthly Income Tax (e-Filing)
Annual Income Tax
Annual Salary Income Tax Certificate
Annual Statement of Income Tax
Annual Income Tax Calculation Statement
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PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
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P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
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Overtime - Summary
Monthly Overtime - Detail
Monthly Overtime - Summary
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PAYROLL MANAGEMENT SYSTEM
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P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
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Cash Advice
Bonus Slip (Bank)
Bonus Slip (Cash)
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PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
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P.F
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10-C Bonus
Officer's Bonus
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Cash Advice
Bonus Slip (Bank)
Bonus Slip (Cash)
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PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
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EOBI
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Officer's Bonus
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Cash Advice
Bonus Slip (Bank)
Bonus Slip (Cash)
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PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
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Payroll
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EOBI
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Officer's Bonus
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Employee List
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PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
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P.F
EOBI
Income Tax
Overtime
Bonus
10-C Bonus
Officer's Bonus
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Workers to Officers
AYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
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D.Wages
Entries
Process
Reports
Wages
Deductions
PAYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
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Reports
D.Wages
Entries
Process
Reports
Payment
Update
PAYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


PAYROLL MANAGEMENT SYSTEM
USER NAME: IT
Entries
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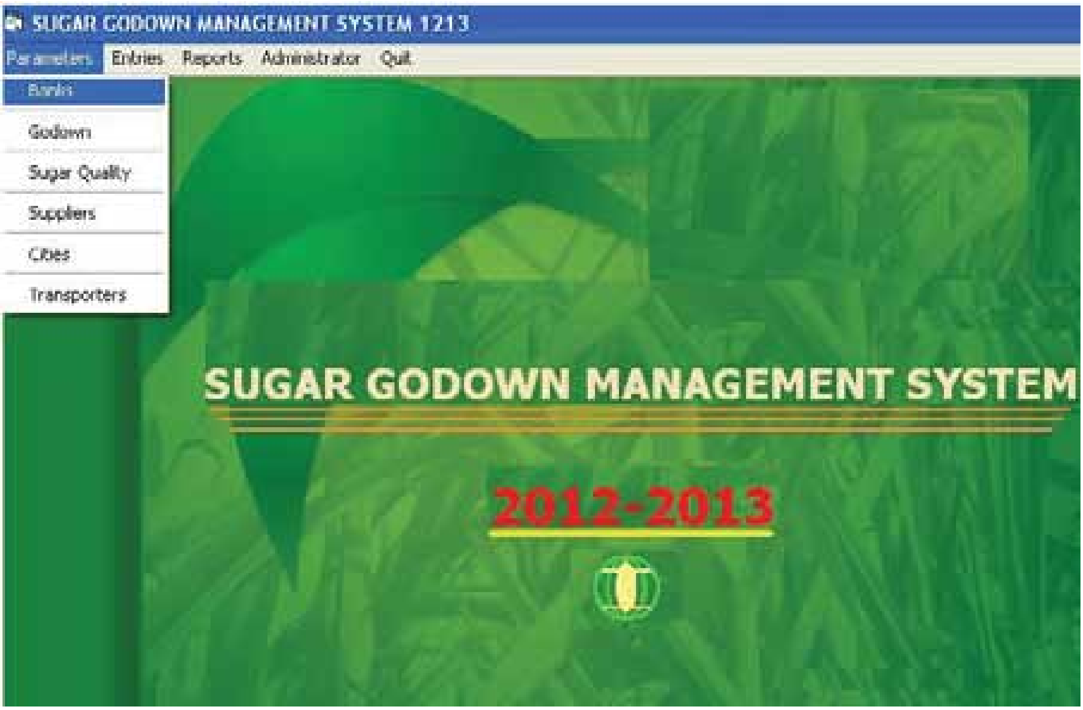
Reports
D.Wages
Entries
Process
Reports
Payment Sheet - Detail
Payment Sheet - Summary
Cash Advice
Deductions
Deductions Summary
PAYROLL MANAGEMENT SYSTEM
YEAR 2012-2013


SUGAR GODOWN MANAGEMENT SYSTEM 1213
SUGAR GODOWN MANAGEMENT SYSTEM
2012-2013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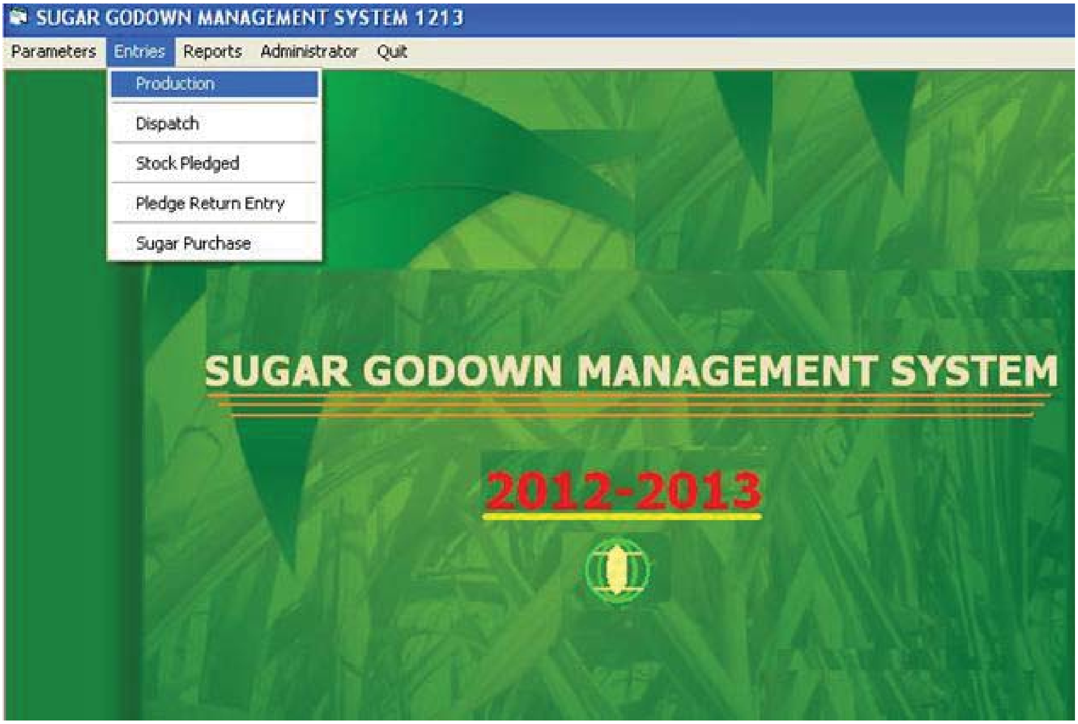
Godown
Sugar Quality
Suppliers
Cibes
Transporters
SUGAR GODOWN MANAGEMENT SYSTEM
2012-2013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Administrator
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Production
Dispatch
Stock Pledged
Pledge Return Entry
Sugar Purchase
SUGAR GODOWN MANAGEMENT SYSTEM
2012-2013


SUGAR GODOWN MANAGEMENT SYSTEM 1213
Parameters
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Administrator
Quit
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Gate Pass
Sales Tax Invoice
Abstract Report
Production Reports
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Dispatches Reports
Pledge Reports
DO Reports
Sugar Lifting & Godown Progress Report
Lifting Report
Godown Progress Report
ODOWN MANAGEMENT SYSTEM
2012-2013


SUGAR GODOWN MANAGEMENT SYSTEM 1213
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Abstract Report
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Date Wise
Date Wise (TCP Invoices)
Invoice No. Wise
Monthly Sales Tax Summary
ODOWN MANAGEMENT SYSTEM
2012-2013


SUGAR GODOWN MANAGEMENT SYSTEM 1213
Parameters
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Forms
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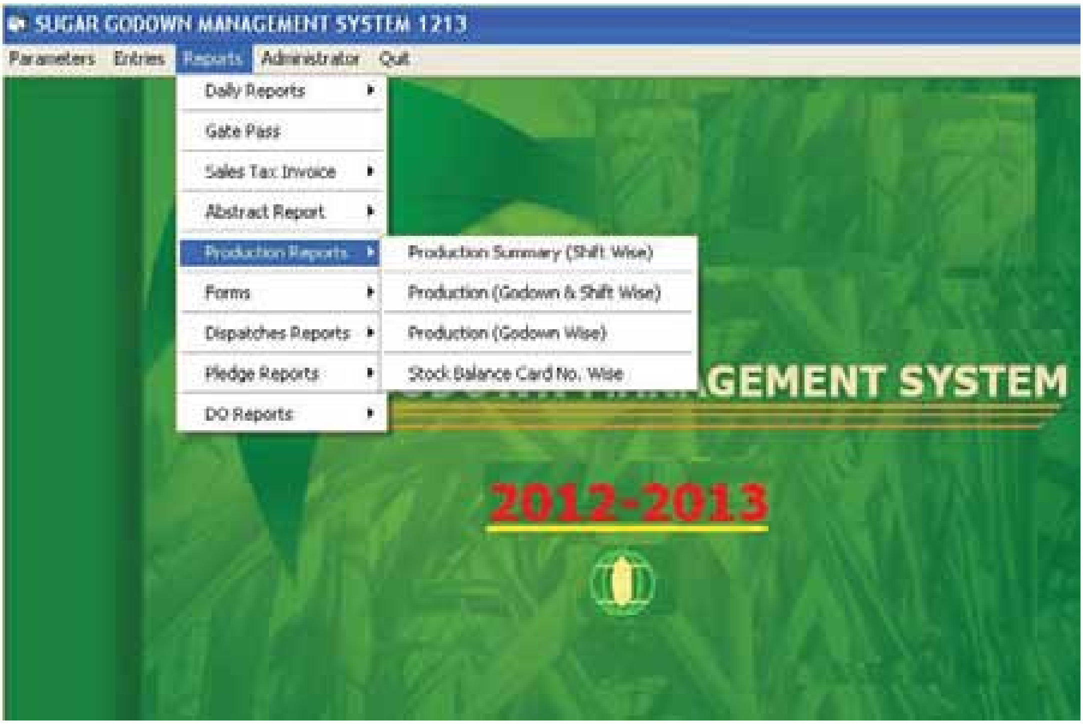
Pledge Reports
DO Reports
Abstract Report (Un-Posted)
Abstract Report (Posted)
ODOWN MANAGEMENT SYSTEM
2012-2013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Administrator
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Daily Reports
Gate Pass
Sales Tax Invoice
Abstract Report
Production Reports
Forms
Dispatches Reports
Pledge Reports
DO Reports
Production Summary (Shift Wise)
Production (Godown & Shift Wise)
Production (Godown Wise)
Stock Balance Card No. Wise
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SUGAR GODOWN MANAGEMENT SYSTEM 1213
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Sales Tax Invoice
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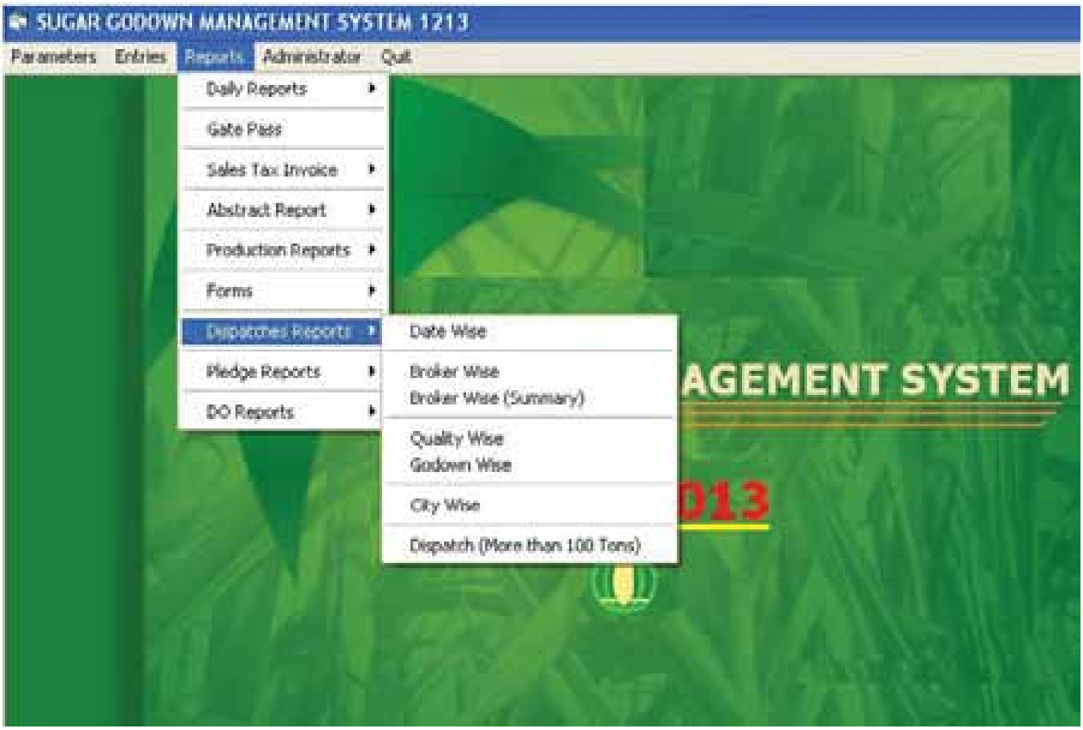
Production Reports
Forms
Dispatches Reports
Pledge Reports
DO Reports
Form R.G. 1
Form R.G. 6
2012-2013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Administrator
Quit
Daily Reports
Gate Pass
Sales Tax Invoice
Abstract Report
Production Reports
Forms
Dispatches Reports
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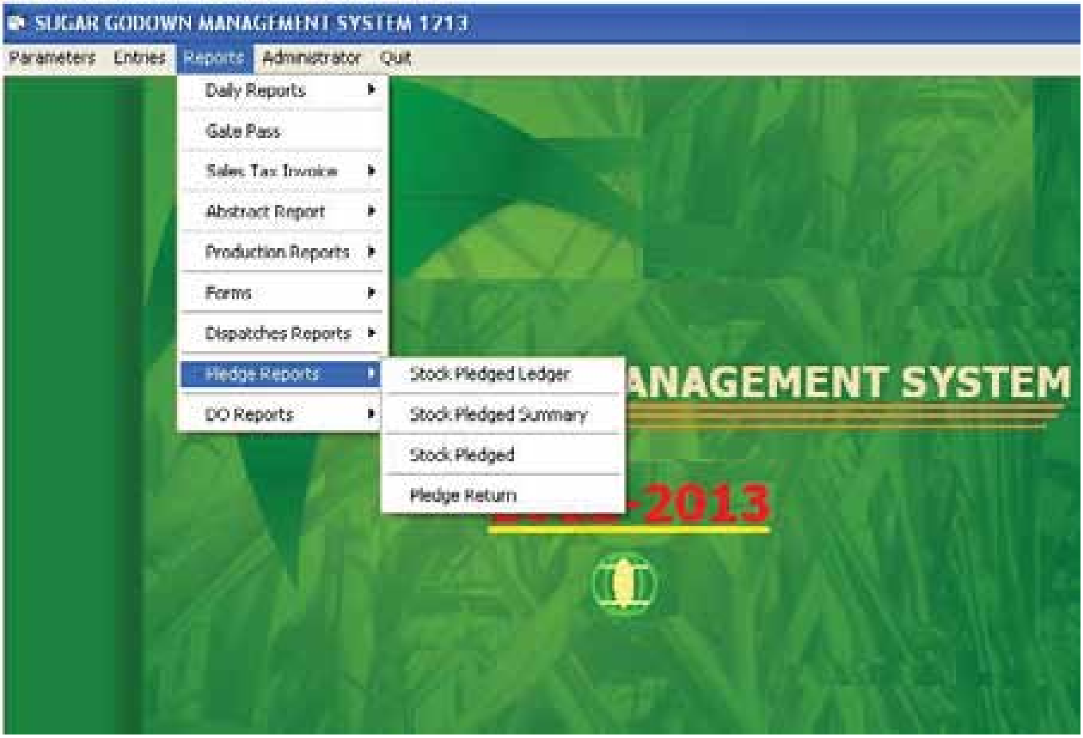
DO Reports
Date Wise
Broker Wise
Broker Wise (Summary)
Quality Wise
Godown Wise
City Wise
Dispatch (More than 100 Tons)
AGEMENT SYSTEM
013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Reports
Administrator
Quit
Daily Reports
Gate Pass
Sales Tax Invoice
Abstract Report
Production Reports
Forms
Dispatches Reports
Pledge Reports
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Stock Pledged Ledger
Stock Pledged Summary
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Pledge Return
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-2013


SUGAR GODOWN MANAGEMENT SYSTEM 1213
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DO Reports
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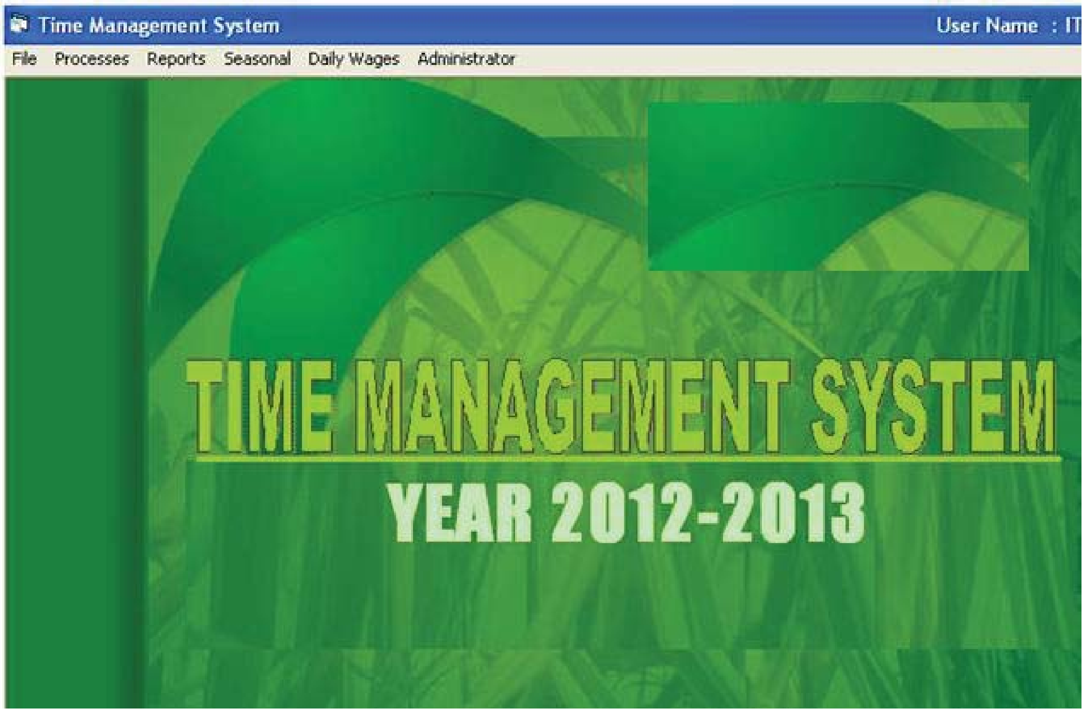
Outstanding DO
Outstanding DO (Summary)
Irregular D/O Report
Sauda Slip Activity
ODOWN MANAGEMENT SYSTEM
2013


Time Management System
User Name : IT
File Processes Reports Seasonal Daily Wages Administrator
TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
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Processes
Reports
Seasonal
Daily Wages
Administrator
Attendance
Leaves
Over Time Menu
Gatepass Menu
Shift Schedules
PMC
Employees
CPL & Gazzated Entitled & Sactioned
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Time Out F3
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Outdoor Attendance
Attendance (Date Wise)
TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
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Shift Schedules
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Sunday Leaves
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Time Management System
User Name : IT
File
Processes
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Time Management System
User Name : IT
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Shift Schedules
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CPL & Gazzated Entitled & Sactioned
Time Out
Time In
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Time Management System
User Name : IT
File
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Stop Attendance
TIME MANAGEMENT SYSTEM
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Time Management System
User Name : IT
File
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Month End Process (Final)
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Bonus Process (Workers)
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Time Management System
User Name : IT
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Absent Report
Absent + Leaves Report
Leaves - Check List
Leaves Report
Late Arrival Report
Time Out (Missing)
Early Departure
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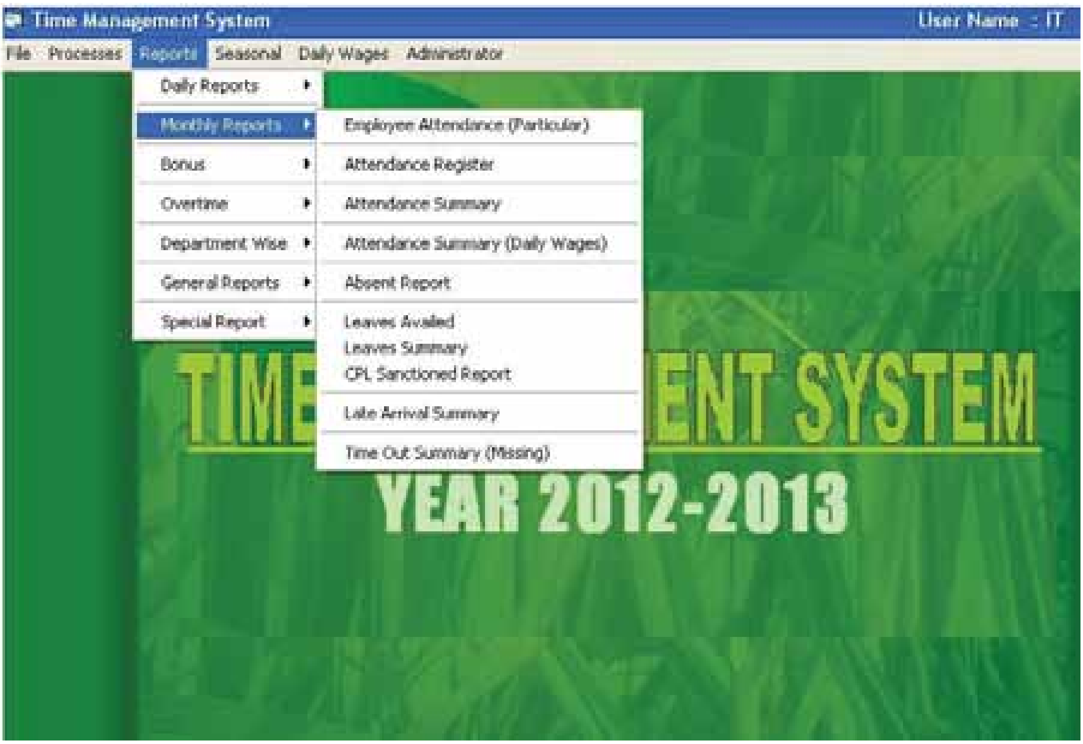
Gatepass Report Summary
YEAR 2012-2013


Time Management System
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Reports
Seasonal
Daily Wages
Administrator
Daily Reports
Monthly Reports
Bonus
Overtime
Department Wise
General Reports
Special Report
Employee Attendance (Particular)
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Attendance Summary (Daily Wages)
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Leaves Summary
CPL Sanctioned Report
Late Arrival Summary
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Time Management System
User Name : IT
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Department Wise
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Special Report
Bonus
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Time Management System
User Name : IT
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Monthly Reports
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Time Management System
User Name : IT
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Time Management System
User Name : IT
File
Processes
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Daily Wages
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Daily Reports
Monthly Reports
Bonus
Overtime
Department Wise
General Reports
Special Report
Leaves Ledger
Shift Wise
TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
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Processes
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Monthly Reports
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Department Wise
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PMC
Long Absent
TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
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Administrator
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Terminations
Calling Letter
Appointment Letter
Allowances - Seasonal Staff
TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
File
Processes
Reports
Seasonal
Daily Wages
Administrator
Appointment
Terminations
Termination
Termination Letter
Clearnace Certificate of Outgoing
TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
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Processes
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Add/Edit D/Wages
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YEAR 2012-2013


Time Management System
User Name : IT
File
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TIME MANAGEMENT SYSTEM
YEAR 2012-2013


Time Management System
User Name : IT
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Daily Wages
Administrator
Employees
Process
Reports
Attendance Summary
Appointment Date Wise
TIME MANAGEMENT SYSTEM
YEAR 2012-2013

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1. The Research Study material was primarily extracted from;

2. Annual Reports of Pakistan Sugar Mills Association (Centre)

3. Annual Reports of Pakistan Sugar Mills Association-Sindh Zone)

4. Information on manufacturing process, related matters and international statistics was obtained from various internet sites.

5. SECP Cost Accounting Records Order (2001)

6. Practical experience of **Mr. Muhammad Arif Nara, FCMA** for more than 2 decades in Sugar Industries and **Muhammad Hanif Aziz, FCMA** is presently CFO of a Sugar Mill for about a decade. Both have contributed in developing research book on Sugar Industry.

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