CHAPTER X

IMPLEMENTATION OF SYSTEM APPLICATION PRODUCT (SAP)

MATERIALS MANAGEMENT (MM-MODULE) FOR STORING AND STOCK POSITION OF GODOWN IN SUGAR INDUSTRY
10. INTRODUCTION:

10.1. SUGAR STORAGE & PACKING

Commercial white sugar is packed in 100 Kg. bags of hessian in the Indian industry but in other countries paper bags or 50 Kg. jute hessian bags are also used. In region with humid climatic conditions polythene lined hessian bags are preferred for better preservation of sugar from ingress of moisture. It is essential to get rid of iron specks from sugar before packing by attaching a magnet at the chute from which sugar flows into packing bags. The bags after filling are weighed accurately and sent to warehouse after closing the open end. The practice of hand sewing the top seams of bags with hemp twine is slowly being replaced by mechanical stitching. Stitching is preceded by accurate weighing on a platform type weighing scale in Indian industry. Since transport to warehouse for storage is carried out only in day time, the sugar packing house must be designed to accommodate the filled bags of sugar produced in the remaining 14-16 hours of the day.

10.2. In the sugar house where sugar bags are filled and weighed, the equipment usually installed is as under:

(i) Sugar grader with screens of different openings which receives sugar from the hopper through an elevator provided with 3 or 4 chutes from which bags are filled.

(ii) Magma mixer with suitable magma pump, for reprocessing of fine sugar or unwanted sugar, fine sugar magma being sent as seed to pan floor seed crystalliser while the unmarketable sugar is melted in the melter located behind centrifugals.

(iii) Sugar dust collector is connected to the top of grader for recovering dust which is collected in bags and melted. Sugar dust collector serves threefold purpose
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(a) it prevents loss of sugar, though small in proportion to total production,

(b) sugar dust is explosive and poses danger as it spreads all around

(c) it pollutes the atmosphere in sugar house where number of workers are carrying out different functions, connected with packing of marketable sugar.

(iv) Weighing scales and bag stitching machine if the stitching is not manually carried out by workers.

(v) Small belt conveyors or portable trolleys for conveying bags from grader to weighing scale.

In plants not producing more than two grades of sugar it is possible to store the overnight production in steel silos which are emptied during day time when packing and weighing operations are conducted.

10.3. WAREHOUSING

In regions where the crushing campaign is restricted to 4-7 months in a year as in the case of Indian Sugar Factories, the sugar mills have to make provision for storage of nearly half the year's production in well constructed godowns. The weighed and stitched sugar bags are conveyed to the godowns on a belt conveyor from the sugar house and arranged in stacks of nearly 7-8 m height. The stacks are separated on the basis of grades as also quality and at the time of sale the bags are removed from stacks, care being taken in handling bags to avoid physical damage. In respect of warehousing following points need special attention of the factories.

10.3.1 The godowns have to be located near the sugar packing house but away from the place where the filter cake is discharged from clarification house, as also at a safe distance from molasses storage in view of the fact that filter cake dumps or molasses tank surroundings serve
as breeding places of all sorts of microorganisms. Similarly in relation to spray pond the location
should be such as to prevent moisture laden air from entering the godown.

10.3.2. The warehouses are constructed on raised ground with proper arrangement for drains,
away from factory water channels.

10.3.3. The roof of warehouse is constructed of corrugated sheets with proper slope to allow
easy drainage of rain water, care being taken to arrange longitudinal overlapping of the same and
to prevent ingress of water under any circumstances.

10.3.4. Flooring of godown has to be of sturdy construction to withstand the weight of large
stacks of sugar bags and must be constructed in such way as to prevent seepage of water. The
side walls should be coated with water proofing compound up to a height of about 1 to 1.5
meters from the ground floor.

10.3.5. The openings of the godowns should be as few as possible and windows are undesirable.
The main openings are fitted with rolling shutters.

10.3.6. It is desirable to prevent ingress of water whether through the bottom of the floor or sides
and the floor can be covered with synthetic plastic sheet over which the sugar bags are placed.
Similarly the top of each sugar stack is covered by water proof plastic sheet. Formerly wooden
planks duly supported on beams used to be laid on the floor for supporting the bags but now a
days it is common to find synthetic waterproof sheets being used to cover the floor.
10.3.7. Lanes of 0.5-0.7 m width are provided near the warehouse walls inside the godown and the bags should accordingly be stored somewhat at a distance from the side walls to protect the same from variations in temperature of the walls. The bags are stacked in accordance with grades up to a height of 7-8 m leaving open space of about 2.5 - 3 m below the roof. To avoid damage to the bags of lowermost layers it is advisable not to exceed this height of stack.

10.3.8. Regarding providing ventilation for the warehouse there are two aspects which need careful examination. In case of white sugar, prolonged exposure to atmosphere with relative humidity of > 75—85 will result in damage to sugar. In case there are some areas in the godown where the air is not displaced local pockets of high humidity regions could be formed which would spoil the sugar bags, kept in such pockets. In factories located in high rainfall regions this problem assumes serious proportion. In low rainfall areas with comparatively smaller number of wet days it may be possible to prevent contact of sugar bags with humid atmosphere by providing no ventilators but only observation windows besides the usual doors. Under such conditions during dry weather free air should be allowed through doors and other openings while on rainy days the warehouse should be opened only when necessary. However, taking both these aspects into account as also the experience at several places it is advisable to provide sufficient ventilators which are to be operated for displacing the air inside the warehouse and preventing local pockets of humid air. For this, the ventilators have to be fitted such that no leaks of air occur when they are closed and these are easily operated. In this connection, the design of godown ventilators suggested by Phansalkar et al, which is of double panel type with both panels fitting tightly on leak proof rubber gasket can be adopted. Such panels should be fitted with
necessary levers for operating them mechanically. One of the methods adopted or suggested for maintaining low humidity in sugar godown is to keep quick lime spread at few places, which will need replacement frequently as lime absorbs moisture. The stacks of sugar bags can also be protected to some extent from humid atmosphere by covering them with sheets of synthetic waterproof material. It is desirable to maintain a record of temperatures and humidity in the warehouses in order to understand the fluctuations in weather conditions.

10.4. FACTORS AFFECTING KEEPING QUALITY

Moisture in sugar: Moisture content of sugar crystals plays vital role in determining its preservation without deterioration. The moisture or water associated with sugar is of two type (i) free or unbound water (ri) bound water. The white sugar leaving the centrifugals, contains around 0.2 to 1% moisture which is brought down to 0.03-0.04% i.e. the acceptable level on the long grass hoppers or in dryers. The water associated with sugar crystals and removed due to this drying is the free water while bound water is the residual water which is determined by elaborate procedure of drying sugar.2 Each sugar crystal is surrounded by a thin film of syrup which is in a highly supersaturated state, in which crystallisation can continue to take place for a long time. When sugar is exposed to atmosphere moisture migration can take place either way i.e. either from air to sugar or from sugar to atmosphere depending upon the relative humidity of the air surrounding the sugar and soon an equilibrium is established between water vapour in surrounding air and the moisture of sugar. In this state of equilibrium no exchange of water from either sugar to air or air to sugar can take place as the vapour pressure of air and that of the thin syrup film surrounding the crystal are the same.
10.5. CANE SUGAR MANUFACTURE IN INDIA

The vapour pressure of pure water increases with temperature and vapour pressure of aqueous solutions is always lower than that of pure water at the same temperature the difference increasing as concentration in solution rises. When weather is extremely humid with atmospheric relative humidity of 100% or thereabout the stored sugar will absorb moisture but when the humidity drops considerably i.e. during dry weather period the moisture in sugar will evaporate. In any case this transmigration of water resulting from hygroscopic nature of sugar continues until equilibrium is attained between the vapour pressures of surrounding air and sugar. Powers introduced the concept of equilibrium relative humidity (E.R.H.) which signifies the state of equilibrium between the atmospheric relative humidity and the sugar. The E.R.H. for raw sugar or white sugar which would keep well without undergoing deterioration depends on the amount of impurity in the sugar crystals. For pure crystal sucrose E.R.H. has been stated to be around 83% impurities depending on the temperature while the corresponding value for refined sugar is lower than that for pure sucrose. In the case of plantation white sugar very little work in finding out the E.R.H. under different conditions of manufacture is reported but it is expected to lie somewhat below the ERH value of refined sugar.

10.6. The nature of crystals and composition of white sugar exert profound influence on the keeping quality and moisture absorption or moisture release. Formation of conglomerates or twin crystals which are essentially small joined crystals, or crystal inclusions produced on account of lack of control over crystal development in pan boiling, result in more impurities being associated with sucrose crystals. Moreover the composition of medium of crystal growth which is composed of syrup. A light molasses and melt with respect to impurities, will always be
decisive in the absorption and desorption of moisture from the atmosphere. The ERH value of pure sucrose has been found to be.

85.5 at 20°C
84.0 at 30°C
83.0 at 40°C

This value will be lowered with increase in impurity content of crystals and thus will decrease from pure sucrose to refined sugar, and mill white sugar and finally raw sugar in that order. With lower ERH resulting from higher amount of impurity content, the sugar will absorb moisture at lower relative humidity of surrounding atmosphere. Out of the non sucrose impurities influencing the hygroscopic nature of sucrose crystals are reducing substances and some inorganic salts notably the MgCl₂, CaC₂, KCl and MgSO₄.

10.7. According to Cheng and Cheng hygroscopicity of sugar increases with increase in moisture as also reducing substances and decrease in the pH value of sugar. Similarly sugar of small crystal size absorbs more moisture than that containing bigger size crystals mainly because the former offers greater surface area for moisture absorption. This is in conformity with the common experience that small grain sugar is prone to moisture absorption and caking due to variation in atmospheric humidity. Surface active substances also contribute to hygroscopicity of sugar. Presence of comparatively large amount of reducing substances and low pH value are considered responsible for higher hygroscopicity of cane sugar as compared to white sugar from beet, though both may be of very high polarisation.
10.8. CAKING OF SUGAR

10.8.1. Caking of sugar in bags is a phenomenon associated with external factors like weather conditions as also the nature of sugar crystals. If sugar, due to its hygroscopic character is exposed to atmospheric conditions of high relative humidity it will absorb moisture. Similarly the sugar crystals part with the moisture whenever they come in contact with atmosphere of low relative humidity. In consonance with this, whenever packed sugar which contains originally high moisture or has absorbed moisture after packing is exposed to atmosphere of low relative humidity the syrup film surrounding the sugar crystals parts with some of its moisture and reaches zone of high super saturation. The sugar crystals being closely packed, crystallisation in the film results in joining of sugar crystals eventually leading to cake formation. The blocks of sugar cakes are difficult to dislodge from the packing bags and present problems in marketing.

The factors favouring the cake formation of sugar crystals are—

(a) Small grain size

(b) Higher impurities in sugar crystals like reducing sugars which contribute to the hygroscopic character of sugar

(c) Higher initial moisture of sugar at the time of packing than specified (> 0.04%)

(d) Higher relative humidity of atmosphere followed by dry weather conditions of low R.H. In the absence of any remedial measures in the case of caking of sugar following preventive measures are essential.

(i) Sugar should be dried well which means efficient removal of unbound moisture.

(ii) Prior to packing, sugar must be cooled to 38°-40°C. Since hot sugar bagging leads to cake formation.
(iii) In view of the role of impurities like reducing sugars in increasing hygroscopicity of white sugar, in the process every effort is essential to minimise the impurities in sugar crystals.

(iv) Small grain size favours moisture absorption and in case the grain size is to be maintained small to suit market needs, special attention needs to be paid to—

(a) Minimum impurity levels

(b) Avoiding conglomerate or twin crystal formation

(c) Efficient drying and cooling

(d) Avoiding exposure of sugar bags to large variations in atmospheric humidity.

(v) Irrespective of the size of sugar grain, the proper grading of sugar has to be taken care of to avoid mixing of different size grains.

10.9. SUGAR LOSS DURING STORAGE

Under Indian conditions the sugar losses experienced by the factories during storage of sugar in godowns can be attributed to—

(a) Sugar loss during prolonged storage arising out of quality deterioration even though the external condition of packing is satisfactory.

(b) Damage to sugar bags in the warehouse during storage for over 6-8 months or so which can be as high as 0.2 to 2% of the total production.

The first one i.e. pol loss or colour development is essentially connected with process operating conditions which have been discussed elsewhere. In brief it may be stated that in process control, the factor of preservation of sugar during storage also must receive sufficient attention.

As regards losses occasioned by inadequate storage precautions or unsatisfactory warehouse conditions the usual experience of the factory technologists in India is that most of the sugar loss during warehousing takes place on account of -
(a) Physical damage to bags during handling

(b) Height of stack exceeding safe limits

(c) Lack of precautions for preventing ingress of water on wet days from outside.

All the damaged sugar is collected and put back in process by one or a combination of 2-3 methods like—

(a) Melting,

(b) Adding to 'A' messecuite crystallisers or

(c) if it is in dry and good condition by mixing with freshly produced white sugar on the grass hoppers.

Handling damaged sugar and reprocessing it involves sugar loss which can be substantial. Moreover additional expenditure has to be incurred on labour, steam etc. and the eventual monetary loss is quite high and hence needs to be avoided by preventive measures.

10.10. Implementation of SAP in Sugar Warehouse

Computer support for the organization and management of warehouses has become imperative for timely, effective processing of logistic requirements within a company. The SAP Warehouse Management (WM) application provides flexible, automated support to assist in processing all goods movements and in maintaining current stock inventories in warehousing complex. WM supports warehousing processes by making it possible for Define and manage complex warehousing structures Optimize material flow using advanced put away and picking techniques process goods receipts, goods issues and stock transfers quickly and easily.
10.11. Selection Criteria

Although it is possible to manage warehouse inventories using the Inventory Management (IM) application component, the primary difference between managing stock in WM and in IM is that in IM, the system can only display the total stock of a material for a storage location. If a warehouse is small and easily manageable, then the use of IM may be sufficient to fulfill the needs.

WM, on the other hand, offers the capability to manage stock quantities in each individual storage bin in highly complex storage facilities. This means that, with WM, this can optimize the use of all storage bins, mix pallets belonging to several owners in randomly slotted warehouses and know exactly where a particular material is located in the warehousing complex at all times.

10.12. Integration

The Warehouse Management application is fully integrated into the SAP R/3 system. Transactions that are initiated in other SAP components result in corresponding tasks in WM which activate the actual physical transfers within the warehouse. A few of these activities include:

Material movements and changes in material status, such as releasing goods from inspection
Material staging to production supply areas
Picking and shipping goods for sales orders
10.13. Ware House Management system:

Most activities that take place within WM are initiated in Inventory Management. For example, most goods receipts, goods issues and posting changes are initiated in IM and subsequently processed in WM.

WM is also interfaced to Sales and Distribution (SD) through the Shipping module to process delivery documents for both the integrated WM application and the decentralized WM system.
The WM interface to Quality Management (QM) allows warehouse administrators to track and manage inspection lots that are stored in the warehouse. WM is also interfaced to the Production Planning (PP) system to assist in providing materials to supply areas in production.

10.14. Features

WM provides several features that support warehousing activities. These include the following:

10.14.1. Warehouse Structure

Management of complex warehousing facilities to include automatic warehouses, custom-designed storage areas, high rack storage, bulk storage, fixed bin storage and all other commonly used storage areas.

Definition and adaptation of a limitless variety of storage bins for use in specific warehousing complex.

10.14.2. Goods Movements

Processing of all relevant warehousing activities, such as goods receipts, goods issues, deliveries, internal and external stock transfers, automatic replenishment of fixed bins, material staging to production areas and stock difference handling.

Utilization of random slotting for multiple owners of goods.

Implementation of a variety of put away and picking strategies including self-designed strategies.
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Processing of multiple goods movements with transfer requirements and deliveries simultaneously

Storage and retrieval of hazardous materials and all other goods that require special handling

Setup of “forward pick” areas and production supply areas with automated replenishment from case or reserve storage when stock quantities reach a certain threshold

10.15. Controlling

Optimization of capacity and material flow utilizing storage units in the warehouse Monitoring and display of stocks on hand and summary evaluations of all goods movements via warehouse controlling tasks

10.16. Inventory

Capability to maintain up-to-the-minute inventory records with the aid of stock transfer confirmation.

Archiving of records of all goods movements and inventory activity.

With its inventory functions, WM ensures that book inventories in Inventory Management match the stock in the warehouse at any time. Because SAP components are fully integrated, do not need separate interface programs between IM and WM.

10.17. Printing Tasks

Printing (of pallet slips, move orders, delivery slips, inventory documents, and so on) is available for all relevant transactions
Although it is possible to print material documents for each separate transaction in the warehouse, WM facilitates automatic flow through warehousing tasks that are virtually paperless.

**Process House:**

- **B Bins each with a 60 tonne capacity of sugar for the bagging line**
- **Plough separating Sugar to the bagging and baling line**
- **A Bins each with a capacity of 15 tonnes of sugar for the baling line.**
- **Packaging Machine Measures and seals the sugar into, ¼, ½, 1 and 2 kg Branded packets ready for baling.**
- **Manual baling: Manual stacking of branded sugar into bales and sealing and check weighing.**
- **Automatic Baling: The baler weighs stacks and seals sugar into bales for palletizing.**
- **Palletizing: Sealed bales are palletized then transferred to the Warehouse for stacking.**
- **Stacking**

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**IMPLEMENTATION OF SYSTEM APPLICATION PRODUCT (SAP) MATERIALS MANAGEMENT (MM-MODULE) FOR STORING, STOCK POSITION OF GODOWN IN SUGAR INDUSTRY**
CONCLUSION:

The solution from SAP is bound to get the following advantages in sugar industries.

- **Total integrated reliable and real time solution**
  
  SAP is user friendly i.e information will be obtained as and when required.

- **Continues maintaining and evaluation of performances**
  
  The complete process of cane cultivation to shifting of cane can be monitored and evaluate by system only.

- **Effective inventory control**
  
  The holding stock can be accessed and based on this; action can be taken for procurement of needy items.

- **Maximize the utilization of resource**
  
  With the help SAP solution we can utilize the existing resources in the company and avoid unnecessary losses.

- **Gain edge in global competence**
  
  By implementing of SAP, losses can be avoided, recovery has been improved and the company can compete in global level.
COMPLETE BENEFIT TO THE ORGANISATION

Once to implement SAP in sugar industry, the company can able to achieve the targets in the meantime farmers can feel complete satisfaction regarding transparency in the process. In addition to that following advantages can be seen after implementing SAP.

- Increase in yield by timely crushing good quality and matured cane.
- Benefits from the supply of the inputs to the farmers.
- Farmer’s loyalty increase.
- Planning and budgeting and achievement have meager deviation.
- Re-deployment of the human resources.
- Staggered plantation helps the factory to crush throughout the crushing season.