International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review for the Improvement of Cooling Capacity of Cold Storage System

Nishant Raj, Kashiram Kadwe

Madhyanchal Proffesional University, Bhopal, M.P., India,

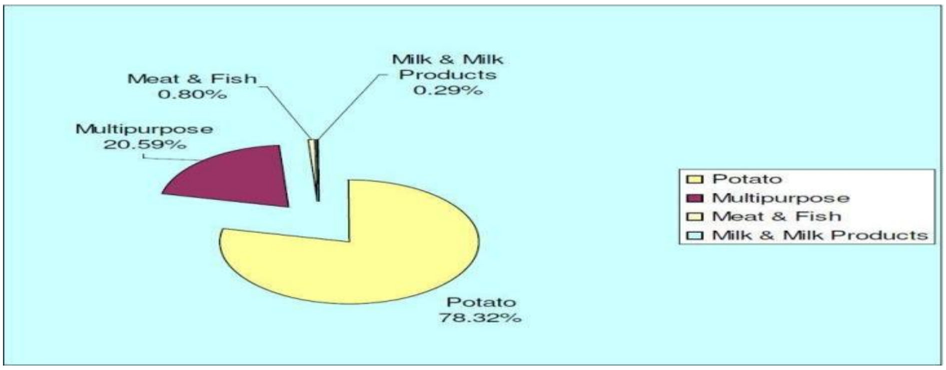
A B S T R A C T

This study represents the cooling capacity of cold storage system by going through the detail study of various previous research work publications. Air circulation can be possible better by experimental analysis with help of hot wire anemometer. This paper explains how the researchers uses the case study method and then applies the method to an example case study project designed to examine how one set the parameters, which factor they have considered and which methods/approach they have adopted to evaluate, humidity, and temperature distribution and air circulation and other related factors for different types of cold storage plant. It also highlights the concepts that related to recent developments in this field. This paper begins by presenting the need for this research and some of past research efforts in the field of large cooling

Keywords: Cold storage; Frozen food; Air circulation analysis, Temperaturedistribution

1.INTRODUCTION

Design of cold storage to be effective and economic is an important criterion in business as ineffective design may lead to financial loss and in some cases may leadto unsafe operation of the system. Beside from the loss of capital due to degradation of quality of the products, there is also power loss and in the country like India, it becomes of greater importance to save as much of power as possible. Cold storages are the facilities where perishable foodstuffs are stored under controlled temperatures with the purpose of maintaining quality. Preservation of food can be done under frozen or chilled temperatures. A cold storage is a place where the various items such as vegetables fruits, medicines etc. are stored to protect them from getting spoiled and to prolong their preservation period. This is done by storing the products at their preservation temperature and humidity etc. Preservation temperature is defined as the temperature at which its respiration rate in Cold storage will not be harm materials as long as the cooling and warming is done in a controlled manner, while keeping the moisture content of the components fixed. Moisture content is an intrinsic property that is influenced by the humidity present in the air, and second, by temperature.



The distribution of Cold Storage capacities in India, Commodity wise

1.1 Principle of Food Preservation:-

Removal of micro-organisms: This is done by removing air, water (moisture), decreasing or increasing temperatures and it can also be done by increasing the concentration of salt or sugar or acid in food items. By this process the several types of food agents are preserved. For example the green leafy vegetables having the waterso that the water is extracted from the vegetables and then these are preserved.

Inactivating enzymes: -The enzymes that available in the food commodity and this can be in activated by the changing of the moisture and temperature conditions of the food agents. If you want to preserve the peas by using this method, the peas put in the vessel for the boiling then the enzyme inactivated and it safely preserved.

1.2 Method of Food Preservation:-

1.4.1 Decreasing Temperature:-Decreasing temperature method is also one of the most important methods to save the foods. The enzyme and micro organism are in- activated of the food items by the decreasing the temperature of the preserving food agents. And then the foods are protected for the long time. This is the method that are used mostly in the home and as well as in the food preserving industries. The refrigerators are working on this method. Foods can be sealed at low temperature .the low temperature format is given below-

1. Refrigeration 40 C-70 C
2. Cold Storage 10 C-40 C
3. Freezing 180 C or below

1.4.2-Increasing Temperature: -This method is generally used in home to preserve the food stuff. By increasing the temperature of the food stuffs, the enzymes and micro organism get destroyed. There are various methods to preserve the food stuffs by use the increase the temperature But there are mainly two methods that used to preserve the food at high temperatures:-

1.4.2.1-Pasteurization:-Pasteurization is one of the methods of preservation of the foodstuff, where the food stuffs are heated up to the high temperature and then cooled suddenly. Due to sudden decrease in temperature harmful micro organism are not able to withstand the sudden changed in temperature and then it get destroyed to the micro organism.

1.4.2.2-Sterilization:-Meaning of sterilization is that the free from alive micro organism. This method are used at the high temperature, due to the high temperature of the food product, the all micro organism get destroyed of the preserving food.

1.4.3-Freezing: - In this process the preservation of food at low temperature, due to the lowering of the temperature of the food commodity or environment the organism growth will be unstable and then the micro organism will not survive.

1.4.4-Dehydration:- Various types of items is preserved by the dehydration method. Dehydration means that the remove the moisture or water from the preserving food items. There is one of the most usable method in the society that is the drying the food items in the sun light. Now this method is elaborated in detailed the some food items are dried in the sun light such as Potatoes, grapes, onion, raw mangos and cauliflower etc.

1.4.5- Salting: - Salting is the processes of the preservation of the foods by which the moisture contain of the foods are extracted out. Due to the lack of moisture, the organism will die and hence the food will get the preserved for the long period.

1.4.6 -Sugaring: - Sugaring is the method that similar to the pickling method. Sugaring method is the process of drying a food first by dehydration then it is packingwith the sugar.

1.4.7-Pickling:- This is also food preservation method .The foods are dipping in the some chemical liquid that prevent to the growth of the micro organism. Peppers, cucumber and few vegetables are preserved by the pickling method. The liquids are used in which the foods are dipped for example- alcohol, brine and oils etc. the pickling can be done by two method chemical pickling and fermentation.

1.4.8-Smoking:-In this method the preserving food are exposed in the smoke. The smoke generated by the burning plant material such as wood. The smoke deposits on the foods in the form of paralysis.

1.3 Types of cold storage

The cold storage can be classified in following types:

i.Multipurpose Cold Stores: -These are designed for handling and storing a varietyof products simultaneously throughout the year. The products that can be stored inthis type of cold chamber are potato, fruits like mango, banana, dairy products etc.

ii. Bulk Cold Stores: -These type of cold storage facility store only single type ofcommodity for a long term duration such as storage of potato, apple etc.

ii. Small cold stores with precooking facilities:- These are used for storing contemporary fruits and vegetables, chiefly, for export oriented things like Grapes etc. The major portion of those units is in Maharashtra however the trendis currently reading in different states like state, Andhra and Gujarat etc

iii. Frozen food stores with or without process:- Frozen food stores with or without process and state change facility for meat, poultry, dairy merchandise, fish and processed fruits and vegetables.

1.4-Design and operation of cooling component:-

The salient components of vapor compression refrigeration system used in Indian cold storage system are: evaporator, compressor, condenser and manually operated expansion valve. Since the refrigeration system is the major consumer of electrical energy in potato cold storage, an improvement in design and operation of the components leads to proportionate saving in energy

2. LITERATURE REVIEW

A uniform cooling and cold storage of fresh produce are difficult to obtain in industrial cooling rooms because of an uneven distribution of the airflow .The airflow distribution is dependent on the produce the cooling medium the geometry and characteristic of the cooling room. The velocity distribution can be determined based on the conservation equations for mass and momentum. An analytical solution can be found only in simple cases. The variables can be examined experimentally but this isa tedious, costly, time-consuming method and furthermore, it is only applicable to existing storage rooms. With the increasing availability and power of computers together with ancient solution algorithms and processing facilities, the governing fluid own equations can now be solved numerically. This can be done by choosing such an arrangement of the evaporator among the available that is capable enough to cool down the product temperature as soon as possible. However, the following studies were useful in setting up proper air circulation in this research.

Son H.Ho,Luis Rosario, Muhammad M. Rahaman et.al [1]“Numerical simulation of temperature and velocity in refrigerated warehouses”. In this paper numerical modeling can be used to predict fluid flow and heat transfer and to assess thermal uniformity in refrigerated warehouses. This paper also present the simulation of 3-D models and 2-D ones can be used tot o reducing computing cost. And it was found the result of high degree accuracy. A 3-D simulation model increased the velocity in cooling unit and hence the better cooling effectiveness and uniformity (lower maximum and mean temperatures and lower spatial standarddeviation) can be achieved.

Majid Sajadiye et, al. [2] A Multi scale 3-Dimensional CFD Model of a Full Loaded Cool Storage”. In order to reduce the computational costs, the porous media parameters of the bed of the products inside the vented containers were extracted using a series of wind tunnel CFD simulations and then applied in the cool storage model. The model was validated against experiments by means of velocity, product temperature, and product weight loss measurements in cool storage.

M.K. Chourasia, et, al. [3]“CFD simulation of effects of operating parameters and product on heat transfer and moisture loss in the stack of bagged potatoes “In this paper a CFD simulation on effects of operating parameters and product on heat transfer and moisture loss in the stack of bagged potatoes. The heat and mass transfer within the stacked bags of potato depend on many parameters of both product and operating conditions. Most important factor are: rate of metabolic heat generation, porosity of the bulk medium, diameter of the product, resistance of the product ,skin preventing moisture loss, and temperature as well as RH of the storage air. Therefore, the effect of the parameters of the product and the operating conditions on heat and mass transfer in the stack of bagged potatoes during the transient cooling and at steady state were studied using the CFD modeling approach.

M.L.Hoang et,al.[4]“ Analysis of the air flow in cold store by means of computational fluid dynamics” presented an analysis of air flow in a cold storage using CFD approach employing the Reynolds-averaged Naviour –Stokes equations with the k-∈tturbulence model .A comparison with experimental measurements showed an averaged difference of 26% between calculated and measured air velocities, it becomes only possible to have a qualitative insight into the air flow pattern for different product stacks, different fan rotation speeds and different room designs, without the need of experimental determination of boundary conditions for the velocity.

Ugwu et, al. [5] “Design and a cold storage on the basis of the country population, and the location of the country”. Objective of this research was to determine atmospheric temperature and relative humidity distributions of two different cold stores which have two different cooling systems. One of the cold store which is called as Cold store-I, has classical cooling system such as compressor, condenser and evaporator. Second called Cold store-II, has air conditioning system for cooling, cold air ventilation and aspiration systems,and humidification system. Computational fluid dynamics was used for modeling and distribution of temperature and relative humidity of cold store walls. Storage temperature and relative humidity were assumed 2o C and 90%, respectively.

M.K. Chourasia, et, al. [6] “Simulation of Effect of Stack Dimensions and Stacking Arrangement on Cool down Characteristics of Potato in a Cold Store by Computational Fluid Dynamics.”They Developed a Simulation of Effect of Stack Dimensions and Stacking Arrangement on cool down characteristics of Potato in a Cold Store by Computational Fluid Dynamics and validating the same with the existing prevailing situation. A satisfactory agreement was found between the experimental transient temperature data, as obtained in a commercial potato cold store, and simulated one, with an average temperature difference of 1.4+-0.98^{0}C.

Dr. M.K. Chourasia and Prof. Tridib Kumar Goswami et al [7] “Efficient design, operation, maintenance and management of cold storage “This paper deals with different aspects of design of cold storage and its improvement over the existing ones. Cold air flow being one of the key components in establishing the performance of a cold storage, a CFD analysis has been done and the results have been discussed in thispaper.

M.K. Chourasia , et, al. [8] “Three dimensional modeling on airflow, heat and mass transfer in partially impermeable enclosure containing agricultural produce during natural convective cooling” A three dimensional model was developed to simulate the transport phenomena in heat and mass generating porous medium cooled under natural convective environment. Unlike the previous works on this aspect, the present model was aimed for bulk stored agricultural produce contained in a permeable package placed on a hard surface. This situation made the bottom of the package impermeable to fluid flow as well as moisture transfer and adiabatic to heat transfer.

S.Duret, H.M.Hoang and D.Flick et.al [9] “Experimental characterization of air flow, heat and mass transfer in a cold room filled with food products”. This research presents the Experimental investigation was performed in cold room filled with four apple pallets. Based on the experimental air velocity field, a simplified air flow was proposed. The understanding of heat and mass transfer of cold storage was performed by the interpreting the measured value of air velocity, temperatures (air and products), convective heat transfer coefficient and weight loss.

Tapsobaand, and Denis Flick et .al [10] "Airflow patterns in an enclosure loaded with slotted pallets". In this study, experimental and numerical simulations with the fluent CFD code were carried out in order to characterize velocities and air flow pattern through out a vehicle enclosure loaded with two rows of slotted pallets. A satisfactory agreement is found between numerical and experimental data concerning the jet decay and velocity profiles above and inside the slotted pallets. To analyze the uniformity and ventilation a numerical approach is performed to separately calculate the local ventilation efficiency and the fresh air renewal within the palates.

Margeirsson and Sigurjon [11] *"Numerical modeling of airflow and temperature distribution in a cold store"* was performed using the Computational Fluid Dynamics (CFD). The aspects which were investigated include the influence of wind velocity outside the building. In this paper the given sub article are given below-

Kim et al, [i].Computational Fluid Dynamics model was developed to estimate distribution of temperature and relative humidity in greenhouses. The model was validated with data from a fog-cooling experiment in a single-span greenhouse.

Xhie et al, [ii] Computational fluid dynamics (CFD) has been used in many fields which is related with fluid flow. The cooling rate and quality of food stuffs in a cold store are highly dependent on the temperature field which is closely related to flow field.

Objective of this research was to investigate temperature and relative humidity distributions of two different cold stores have two different cooling systems. Computational fluid dynamics was used for modeling of temperature and relative humidity distribution on cold store walls. Storage temperature and relative humidity were assumed 2 ^{0}C and 90%, respectively.

H.B. Nahor et al. [12]"A transient three-dimensional CFD model was developed" to calculate the velocity, temperature and moisture distribution in an existing empty and loaded cool store. An average accuracy of 22% on the velocity magnitudes inside the empty cold store was achieved and the prevent temperature distribution found more uniform than the predicted results. In the loaded cold storage an average accuracy of 20% on the velocity magnitudes was observed

Serap Akdemir and Selcuk Arin et,al [13]studied the spatial distribution of the ambient temperature, relative humidity and air velocity in cold store. Their results areachieved at ceiling, medium and floor level in the cold store and for different storage temperatures (0 ºC, 1 ºC, 2 ºC and 3 ºC). Mapping software was presented to show the variability. Also, they indicated that the spatial distribution of the temperature and the relative humidity was not uniform in the cold store.

Baired and Gaffney et, al [14] developed a numerical model for predicting transient heat transfer in the pre cooling operation. The numerical model and proceduresallowed calculations of cooling rates in beds of fruits and vegetables as a function of product size, air velocity air temperature and the depth of bulk load. Baired et al. proposed the design criteria for efficient and cost effective forced air cooling systems for fruits and vegetables. The criteria covered the effect of many parameters including initial product temperature, desired final product temperature flow rate and relative humidity of the cooling air ambient temperature, etc.

Nicouline et, al[15] Computer modeling of commercial refrigerated ware house facilities studied the use of general purpose transient computer models for simulating the energy performance of large commercial refrigeration system typically found in food processing facilities to predict facility performance and estimating cost of cold storage plant. This is validated by warehouse loading door infiltration calculations evaporator model, single stage and multistage compressor models and defrost energy requirements was used.

Smale et,al [16]"A review of numerical model of air flow in refrigerated food applications". Using these techniques of focusing on CFD and briefly on other including the Lattice Boltzmann Method (LBM) and network model to the prediction of air flow in refrigerated food storage applications including cool stores, transport equipment and retail display cabinets.

T.K.Goswami et al [17]. "Use of liquid nitrogen in CA storage: Theoretical analysis and experimental validation": - Liquid nitrogen (LN2) is a colorless, odorless, low boiling cryogenic liquid. Due to its inertness and high expansion ratio (646 between liquid and gaseous N2 at 0 ºC), it is an excellent material for rapid purging of the initial O2 gas from the space of the controlled atmosphere (CA) storage. The present study establishes a relationship for predicting the amount of LN2 required for reducing O2 concentration in the CA storage.

G.G. Maidment et al [18]"The use of CHP and absorption was cooling in cold storage:" - In recent years, it has become standard practice to consider combined heat and power (CHP) systems early in the design stage of commercial buildings. With new initiatives from the UK government on reduced energy use, energy efficient systems such as CHP have been considered for a wider application particularly within industrial building design. The viability of CHP in a typical cold storage application is described in this paper. The electrical energy and heating requirements are darned and used to assess the annual energy consumption of a traditional cold storage design using a thermal model

M. Al-Nim Et Al [19]. "A night cold storage system enhanced by radioactive was cooling- a modified Australian cooling system" - A mathematical model describing the performance of a modified Australian cooling system is presented. The modified Australian cooling system is a night cold storage system enhanced by radioactive cooling. The working fluid in the modified cooling system is cooled by passing the fluid through a radioactive cooling panel which cools itself by long-wave thermal radiation to the cold sky temperature. An analytical, closed form solution is presented which predicts the temperature response of the modified system. The analytical solutions are verified experimentally; where it is found that both theoretical andexperimental results are in a good agreement.

C. Zamfirescu Et Al [20]. "Tree-shaped structures for cold storage" - This paper explores the application of constructed design to tree-shaped networks for cold storage. The objective is the maximization of ice production per unit volume, for specified operating conditions (temperature difference, pressure drop, storage time, construction material). Constructed design starts from the smallest scale (elemental volume) and proceeds toward larger and more complex assemblies of elements. Two geometries were optimized at the smallest scale: ice production on parallel plates and on parallel cylinders. The cylindrical geometry offers a greater ice production density. At the next larger scale, the ice production was maximized on arrays of tubes assembled as „Z-shaped registers". The optimization of geometry yielded the spacing between tubes, and the tube diameter and length. The road toward larger and more complex assemblies and the emergence of dendrites flow architecture are discussed.

U. Stritih Et Al [21]. "Experimental investigation of energy saving in buildings with PCM cold storage" - This article presents an experimental analysis of cooling buildings using night-time cold accumulation in a phase change material (PCM), otherwise known as the "free-cooling principle". Studies of the ceiling and floor free- cooling principle, as well as passive cooling, are presented. The free-cooling principle is explained and some of the types of

PCMs suitable for summer cooling are listed. An experiment was conducted using paraffin with a melting point of 22 ºC as the PCM to store cold during the night-time and to cool hot air during the daytime in summer.

CHIN-HSIANG CHENG Et Al [22]. "Shape identification for water–ice interface within the cylindrical capsule in cold storage system by inverse heat transfer method"- In this study, the inverse heat transfer method is applied to shape identification for the ice layer within the cylindrical capsule in cold storage system. The approach is constructed by combining the curvilinear grid generation scheme, the direct problem solver, the conjugate gradient optimization method, and theredistribution method. According to the practical condition of freezing ice, shape identification for the water–ice interface based on the data of the outer surface temperature is attempted. Results show that the profile of the water–ice interface is possible to be identified by using the inverse heat transfer approach and the accuracy of the ice shape identification is dependent on the uncertainty of the outer surface temperature data, the Biot number, the thickness of the ice layer, and the geometric configuration as well.

M. Serra Et Al [23]."Quantification of biolysis and lipid oxidation during cold storage of yogurts produced from milk treated by ultra-high pressure homogenization" - The degree of biolysis and lipid oxidation in yogurts from UHPH- treated milk was investigated because of their potential impact on the final flavor of the product. Yogurts were prepared from milks that were UHPH-treated at 200 and 300 MPa at 30 ºC and 40 ºC, and compared to yogurts prepared from milk that was heat-treated at 90 ºC for 90 s, homogenized at 15 MPa and enriched with 3% of skim milk powder. Results showed that the degree of biolysis was similar between all samples, excepting those from UHPH-treated milk at 200 MPa at 30 ºC. Lipid oxidation did not take place to a great extent in any sample thanks to the storage conditions; however, malondialdehyde was detected in higher amounts in yogurts from the heat-treated milk.

3 CONCLUSION

From the above survey we conclude that there are various techniques utilized for the development of cold storage but all the set up are expensive. India is a contry which requires low cost equipment. So with the advancement of technology economical cold storege system will be developed in future for increasing the application of this system. More research are carried out for developing economical cold storage devices so that it will easily adapted in rural as well as urban areas.

REFERENCES

[1]. **Son H. Ho, Luis Rosario,Muhammad M. Rahaman*** Numerical simulation of temperature and velocity in refrigerated warehouse IJR33(2010)1015-1025 DOME University of South Florida,4202 E.Fowler Avenue,ENB 118,Tampa,FL33620,USA

[2]. **Seyed Majid Sajadiye*, Hojjat Ahmadi, Maryam Zolfaghari, Seyed Saeid Mohtasebi, Younes Mostofi, and Amir Raja**--A Multi-Scale Three-Dimensional CFD Model of a Full Loaded Cool Storage.doi 10.1515/ijfe- 2012-0015 International Journal of Food Engineering 2013

[3]. **M.K. Chourasia and T.K. Goswami** -CFD simulation of effects of operatingparameters and product on heat transfer and moisture loss in thestack of bagged potatoes-Journal of Food Engineering 80 (2007) 947–960

[4]. **M.L.Hoang *,Pvervoven, j. De Baerdemaeker ,B.M.Nicolai, "** Analysis of the air flow in a cold store by means of CFD" International journal of refrigeration23 (2000)127-140

[5]. **Environs Ugwu, Hyginus Ubabuike*, Ogbonnaya, Ezenwa Alfred,** Design and Adaptation of a Commercial Cold Storage Room for Umudike Community ,IOSR Journal of Engineering May. 2012, Vol. 2(5) pp: 1234- 1250

[6]. **M.K. Chourasia; T.K. Goswami,** Simulation of Effect of Stack Dimensions andStacking Arrangement on Cooldown Characteristics of Potato in a Cold Store by Computational Fluid Dynamics. Bios stems Engineering (2007) 96 (4), 503–515

[7]. **M.K. Chourasia,1, T.K. Goswami,***"Steady state CFD modeling of airflow, heat transfer and moisture loss in a commercial potato cold store"***,**International Journal of Refrigeration 30 (2007) pp.672-689.

[8]. **M.K. Chourasia a, T.K. Goswami,***"Three dimensional modeling on airflow, heat and mass transfer in partially impermeable enclosure containing agricultural produce during natural convective Cooling*"**,**Energy Conversion and management 48 (2007) 2136-2148.

[9]. **S.Duret, H.M.Hoang and D.Flick,O.Laguerre***"Experimental characterization of air flow, heat and mass transfer in a cold room filled with food products* ".IJR 46 (2014)17-25 accepted 12 July 2014 Irstea,UR GPAN,1 rue Pierre-Gilles de Gennes, 92761 Antony, France

[10]. **MitoubkietaTapsoba Jean Moureh and Denis Flick** *"Airflow patterns in anenclosure loaded with slotted pallets".*International journal of refrigeration 29 (2006) pp 899-910 Cemagref, BP.44, 92163 Antony Cedex, France.

[11]. **Margeirsson and Sigurjon***"Numerical modeling of airflow and temperature distribution in a cold store"* ", Ph.D. Thesis, University of Iceland, 2008.

[12]. **H.B. Nahor, M.L. Hoang, P. Verboven**,"*CFD model of the airflow, heat and mass transfer in cool stores", International Journal of Refrigeration,* Vol. 28, Issue 3, pp. 368–380, 2005.

[13]. **Serap Akdemir And Selcuk Arin**,*"Spatial Variabilty of Ambient Temperature, Relative Humidity and Air velocity in a Cold Store",* Journal of Central European Agriculture, vol. 7, No.1, pp. 101-110, 2006.

[14]. **Baired,C.D, and Gaffney,J.J,1976.***A numerical procedure for calculating heat transfer in bulk loads of fruits or vegetables.*ASHRAE Transactions94(1), pp 1434-1454

[15]. **Nicouline, CV, Jacob,P.C., Tory S.** *Computer modeling of commercial refrigerated ware house facilities*" .in proceeding of the 1988 ACEEESummerstudy on energy efficiency in industry,pp.15-27

[16]. **Smale , N.J,Moureh,J., Cortella,G,2006.**"*A review of numerical model of air flow in refrigerated food applications*."International journal ofRefrigeration29(6) pp 911-930

[17]. M.K. Chourasia, T.K.Goswami(2001) Losses of potatoes in cold storage vis-à-vis types, mechanism and influential factors, Journal Food Science Technology 38 (2001) 301-313.

[18]. M.K.Chourasia, T.K.Goswami, K.Chowdhury (1999).Temperature profile during cold storage of bagged potatoes, Effects of geometric and operating parameters. Transactions of the ASAE, 42(5), 1345–1351.

[19]. G.G.Maidment,G.T. Prosser(1998) Investigation into the Viability of CHP in Cold Storage Facilities, in: International Institute of Refrigeration Conference, Refrigerated Transport, Storage and Display Conference, Cambridge, 29 March, 1998.

[20]. M.A. Al-Nim, M. Abu-Qudais, M. Mashaqi(1996).Dynamic behavior of a packed bed energy storage system, Energy Conversion and Management 37 (1) (1996) 23

[21]. U.Stritih, V.Butala (2007). Energy saving in building with PCM cold storage. International Journal of Energy Research 31 (15), 1532-1544

[22]. Cheng CH, Wu CY(2000). An approach combining body-fitted grid generation and conjugate gradient methods for shape design in heat conduction problems. Numerical Heat Transfer Part B 2000; 37:69–83

[23]. Serra, M., Trujillo, A.J., Quevedo, J.M.,Guam is, B., Ferragut, V.(2007). Acid Coagulation properties and suitability for yogurt production of cows‟ milk treated by high-pressure homogenization. International Dairy Journal 17, 782–790

[24]. American Society of Heating, Refrigeration and Air Condition Engineers, Inc.– ASHRAE Handbooks