A Review Paper on Evaporator Arrangements in a Cold Storage using CFD

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Abstract-As the demand for refrigeration and Air conditioning has been increased during the last decade, the cold storage system can be used to the economic advantage over conventional plants. Energy conservation is required in the cold storage system so The Design of arrangement is used to Optimization of different parameters of cold storage on the bases of performance experiments. This paper represents the temperature distribution and velocity distribution for axial flow evaporator and mix flow evaporator arrangement in a refrigerated cold storage. A CFD analysis is done under steady state for air flow distribution and temperature distribution using a three dimensional model. In this paper a three dimensional model for a cold storage Many cooling systems are used in cold storages; one of them is Evaporator coil located at the top of one of the wall of cold storage.

Keywords: coefficient, Heat transfer rate, Computational Fluid Dynamics, cooling system.

I. INTRODUCTION

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. For many other products conditions other than temperature might be required. 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. In a packed container moisture percentage will not change.

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 lead to 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.

Effective temperature management is essential to maintain product quality. The temperature of horticultural produce at harvest is close to that of ambient air. Rapid reduction of produce temperature to the optimum storage condition results in the desired produce quality and prolonged storage life. Rapid cooling after harvest is generally referred to as precooling.Forced-air cooling (pressure cooling) is often adopted for precooling of horticultural produce. Forced-air cooling involves creating a pressure gradient to force cold air through container vents.

Artificial lighting. This is a type of slab where we get hollow holes in the slab when the formwork is removed. Firstly the PVC tray (pods) is placed on shuttering, then reinforcement is provided between the pod and steel mesh and is available at the top of the falls and then concrete is filled. Formwork is removed after concrete and PVC pod is not removed. It creates hollow holes in it, in which the holes on one end are closed. For industrial and commercial buildings Concrete waffle slabs are used, while many other construction sites use wood and metal waffle slabs. It is a type of slab that occurs with the holes below, which is the presence of waffles. It is used where much large span is required to avoid several columns in the middle space (eg, auditorium, cinema hall). Therefore, thick slabs are spread between wide beams. The main purpose of working on this technique is for the strong base characteristics of its crack and engagement resistance. Compared to conventional concrete slab, there is a high amount of load in the waffle slab.

II. LITERATURE REVIEW

M.K. Chourasia,et, al. [2005]“Steady state CFD modeling of airflow, heat transfer and moisture loss in a commercial potato cold store” They Conducted a Steady state CFD modeling of airflow pattern, transfer of heat and loss of moisture in a commercial potato cold store. The losses in the stored potatoes have a direct relation to the intricate coupled transport phenomena of heat, mass and momentum transfer therein. Therefore, airflow, heat transfer and moisture loss.

Dr. Manoj Kumar Chourasia [2006]“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 this paper. The problems generally encountered in running a cold storage have also been high-lighted and their probable solutions have also been suggested in this paper.

M.K. Chourasia,et, al. [2007] "Three dimensional modeling on airflow, heat and mass transferin partially impermeable enclosure containing agriculturalproduce 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. The velocity vectors, isotherms and contours of rate of moisture loss were presented during transient cooling as well as at steady state using the commercially available computational fluid dynamics (CFD) code based on the finite volume technique. The CFD model was validated using the experimental data on the time–temperature history as well as weight loss obtained from a bag of potatoes kept in a cold store. The simulated and experimental values on temperature and moisture loss of the product were found to be in good agreement.

PS Transient [2011]: Study how different package vent configurations affect produce temperature distribution during forced convection cooling of produce. The methodology developed in this study can be used as a design tool to provide the homogeneous temperature distribution in ventilated packages during forced convection cooling of produce

Strawberries Steady [2011] Strawberries Steady & transient D-CFD-S & Expt. CR, CU, EC Remark: Study how design of individual clamshells and trays on CR, CU, and EC of forced-air cooling system. Optimization of forced-air cooling system designs. For the same airflow conditions, the new design significantly improves the uniformity and energy efficiency of the process, while still replicating of the cooling rate of commercial designs

PS Transient D-CFD-S & Expt. CT, CR, CU [2012] Study how number of vents positions affects CR and CU. The results show that increasing vent area does not necessarily shorten the cooling time, and it can even increase the cooling time if the vents are not properly distributed on the package walls. Additionally, increasing vent area beyond a specific level cannot have a positive effect on cooling uniformity and time

Corrugated paperboard panel [2012] – FEM & Expt. MS Remark: The work presented studies one possible reason for the discrepancy between the analytical and experimental results for the buckling problem of a simply supported uniaxially compressed corrugated paperboard panel. Some in-sight analysis of the gaps and future trends are given, which would reduce the discrepancy (e.g., considering the difference with a multi-term analytical solution, improving the material modeling of corrugated paperboard and changing the out-of-plane boundary conditions to more closely resemble the experimental conditions)

[2013] Oranges Steady & transient D-CFD-S & Expt. HCT, SECT, CR, CU Remark: Comparison of cooling performance of different package designs based on a single container or stacked on a pallet. The cooling performance of different package designs was evaluated by the CT, and CU and the magnitude of CHTC in a specific container and between different containers [2013] Water-filled plastic spheres Steady & transient D-CFD-S & Expt. HCT, SECT, APD, CU Remark: Study how vent parameters (vent area, shape, number, position) affect cooling efficiency (airflow characteristics, APD, CU, EC). Develop and verify model. Vent size and position more strongly influence the cooling efficiency of horticultural produce than does vent shape. This modelling approach can be used to study any horticultural-produce-packaging system. However, the study used plastic spheres instead of real produce, so the simulation results from the study may be of questionable accuracy

[2013] Grape Transient Porous medium & Expt. CU (temperature and RH) Remark: Study how different package components (box, liner, and pads), product stacking, and cooling procedures affect airflow, heat transfer, and mass transfer processes. The results show that non-perforated liners produce the highest RH inside the package that gives the lowest moisture loss but the highest condensation. The results demonstrate clearly that CFD models may be used to determine the optimum table grape packaging and cooling procedures

[2014] Orange Steady & transient D-CFD-S & Expt. HCT, SECT, APD, CR, CU, EC Remark: Study how cooling conditions (airflow rate and cooling temperature) affect fruit cooling rate and the system energy consumption. This study mainly provides basic information for preliminary design decisions or for altering existing cooling protocols or cooling systems

[2015] Oranges Steady & transient Porous medium & Expt. SECT, CR, CU Remark: Identify differences in cooling rate and uniformity between individual boxes at different heights on a pallet and between individual fruit within a given box. This study proposes strategies for future improvements of the ambient loading protocol,

which includes optimizing box design and stacking on the pallet specifically for vertical airflow and reducing the airflow short circuits between the pallets.

G. Murali , G. Vikram (2016) CFD models having solid field, fluid field and solid-fluid field coalesce are generated for different heat exchangers profile to stimulate turbulence andtemperature contours operating at same condition. Comparing four different heat exchangers,the serial plate has high rate of heat transfer compared with other heat exchangers.

III. CONCLUSION

A three-dimensional CFD simulation was developed to compare airflow and heat transfer models in different airflow patterns in a fully loaded cool storage Dynamic behavior of the fan, and heat exchanger were considered in the model. In this project work two different evaporator arrangements compared and analyzed.

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