NUMERICAL INVESTIGATION OF THE FLOW FIELDS AND THERMAL PATTERNS IN A LARGE COLD STORE

Under Supervision of

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Abstract of MSc Thesis

Refrigeration for the cold storage of foods has been utilized for more than a century. The frozen food industry expanded many times in freezer storage in a few decades after World War II. Its increase due to population growth and global warming. The unreasonable airflow distribution often occurs in the cold store. The unreasonable airflow causes quality decline and large energy consumption.

In the present work, the numerical solutions of the steady- state airflow distributions in an empty industrial cold store filled with pallets of products were studied by CFD commercial code (ANSYS FLUENT 14.5) and investigated using the 3D modelling, which combined SIMPLE algorithm and finite-volume method. Effect of changing of evaporator's numbers and its positions on temperature and velocity distribution inside cold store using standard k-e model with mesh element 4,500,000 tetrahedral was studied. Using different number of evaporators "cooling units" (2, 3, 4, 6) according to load estimation of the cold store and set on different arrangements inside the cold store.

A parametric analysis was performed using the equivalent model with various values of blowing air velocity, number and arrangements of the cooling units. It was found that staggered arrangement more better for cooling effectiveness and uniformity of temperature and velocity in the refrigerated space. And according to the parameters of comparison standard deviation of average temperature of pallets, standard deviation of average temperature of interior, average temperature of pallets, average temperature of interior, uniformity index of pallet average temperature, uniformity index of interior average temperature, uniformity index of interior average velocity and Iso-clip which show the regions which have temperature more than 252K as indication of cooling performance and positions of dead zones. It was found that the temperature and velocity distribution affected with the number and positions of cooling units (Evaporators) and proved that the staggered arrangement of cooling units is better than in-line or opposites arrangements as Haixia, W [15] investigated. In addition, staggered arrangement with low velocity of evaporator's fans not recommended.

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