OPERATION OF SMART REFRIGERATION LOGISTICS CENTER BASED ON COLD CHAIN SYSTEM

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Abstract - This paper focuses on the frozen storage warehouse located in Busan area, and it is because Busan is the most dense area in Korea. Pusan is a port city, and almost all of the frozenrefrigerated cargo imported from abroad is concentrated. By taking advantage of its strength as afishery industry as well as importing, Busan is building the largest international fishery logisticsbase in Northeast Asia and plays an important role in the export of refrigerated cargo is. Therefore,although the freezing and chilling facilities seem to be developed with the latest technology, the reality is not so. Most of them are functioning as a warehouse, that is, a storage function, and aconsiderable number of refrigerated warehouses are in a state of aging. Therefore, in this paper,the facility and function restructuring of the freezing storage warehouse have been set as asolution task, and the introduction of the cold chain system containing the latest smart technologyhas been proposed as a solution.

Keywords - Smart Logistics, Cold Chain System, Refrigeration Logistics Center, Operating System

I. INTRODUCTION

In order to efficiently manage frozen and refrigerated goods, the role of thefrozen storage warehouse is important. When the role of the refrigeratedwarehouse is largely categorized, it can be classified into three kinds of storage, transportation, and shipping agency.
However, most of the refrigerationwarehouses in the nation are operated mainly by thestorage function, and theyare not equipped with competitiveness for various logistics services which arerecently required. Also, domestic and international multinational logisticscompanies have entered into freezing and refrigeration business, so the domesticfreezing and refrigeration industry is having difficulty in management.Currently, there are 804 refrigerated warehouses nationwide. Among them, thereare 120 companies (about 15%) in Busan and more than 50% of the nation'sfreezing and refrigerating capacity is being carried out. In this regard, it can beseen that the refrigeration warehouses in Busan have a large and important rolein freezing and refrigeration logistics. The location of the freezing / chillingfacility is more efficient in carrying out the logistics process in the regionadjacent to the import route. This is the reason why the largest number ofrefrigerated warehouses are operating in Busan. However, as mentioned above,the freezing and cold storage warehouse in Busan is also centered on thestorage function.There are 32 (27%) of the 120 companies that have been agedmore than 31 years. In order to improve the domestic refrigeration logisticsprocess, it is necessary to revitalize overall logistics operation. However, in Korea, refrigerated warehouses, which are located in Busan port,are experiencing difficulties in competitiveness and management due towarehousing functions. As a result, the lack of customized logistics services bycustomer needs and the establishment of a collaborative global business networkare insufficient.

Until now, refrigerated warehouses have been mainly operatedfor storage, and related researches have limitations on the presentation ofdirection to smart refrigeration logistics center by evaluating efficiency ofstorage and technical improvement of operating facilities.

In this paper, we have proposed a cold chain system which contains the latestsmart technology as a solution to the facility and function reorganization of therefrigeration warehouse.Review StageSubmit your manuscript electronically for review.

II. REFRIGERATED LOGISTICS INDUSTRY

Generally speaking, the term "freezing refrigeration" refers to the operation ofcooling or freezing fish foods and refrig- erating them, and the facility isdefined as a refrigerated warehouse. However, the Food Industry Promotion Actdoes not define refrigeration refrigeration if it is frozen by processing meat orwhen the refrigeration capacity is less than 5 tons. The freezing and refrigerating industry is part of the national industry as aeconomy by improving dietary life and hiring idle workers in the region throughthe role of processing, exporting and storing agricultural, Industry. In addition, ithas a function to stabilize the price of food through freezing and refrigeratingbusiness, thereby facilitating income and consumption life of fishermen alongwith national economic development, and playing a big role in increasingcompetitiveness of food logistics industry.

A. Features of a frozen storage warehouse

The business activities of a freezing and cold storage warehouse are basicallysimilar to ordinary warehouses, but they have the characteristics of a freezingand cold storage warehouse. First, the number of operators, refrigeration and freezing capacity are

increasingyear by year, and the number of freezing and refrigerated warehouses existingin the consumption area is relatively lower than the production area.
Second, the quantity of goods and the quantity of stocks are increasing everyyear in view of the trend of refrigeration and freezing capacity, and the increasetrend of seafood is expected to continue in the future considering additionalopening.

Third, most of the stored items are aquatic products, and they are generallycomposed of 60% of marine products, 20% of livestock products, 10% ofagricultural products, 5% of frozen foods and others. Fourth, from the viewpoint of the cost structure of the refrigerated warehouse,it is a business that has more expensive facilities and cooling facilities thanordinary warehouses, and relies heavily on depreciation and power costs of thefacility because its operation depends on electricity. Fifth, frozen and refrigerated warehouses tend to require more capital in theearly stage because they require more facility cost than general warehouses.

B. Cold Chain Systems

Compared to the general logistics center handling room temperature, thefreezing and refrigeration logistics center deals with the logistics process of thecargo with the characteristics requiring temperature control, that is, the freezingrefrigerated cargo.
Therefore, it is necessary to maintain the best qualitycondition by properly controlling the temperature and humidity of theindispensable. The Cold ChainSystem guarantees the quality and safety ofproducts through constant temperature control throughout production, storage,transportation, sale and consumption of temperature sensitive products such asagricultural, fishery, aquatic products, foodstuffs, This is a logistics system.
Figure 1 shows the purpose of extending the freshness and the value of theproduct by properly maintaining these refrigeratedgoodsat the appropriatetemperature. Classification of cold chain systems is divided into maintechnologies including pre-cooling, packaging, transport, storage, and consumercold storage facilities and assistive technologies that perform other functions.

C. Application of cold chain system

A company is a freezing and refrigeratingautomation logistics center equippedwith automation system completed in Busan New Port in Busan New Port inDecember 2015. It has a land area of 11,329.60m2 and a total floor space of24,395.42m2, Is a 90,000-ton storage center with a nominal tonnage of 90,000tons.
Songjeong-dong Logistics Center, the first freezing and refrigeratingautomation logistics center in Pusan New Port, boasts the best logistics locationas the center of maritime logistics and distribution in Northeast Asia.Songjeong-dong automated logistics system, constructed by Shinsegae E & C, isan automated logistics center that automatically stores and stores frozen cargoin the extreme environment of minus 25 ℃. Its storage efficiency is 9 timeshigher than general warehouse, minimizes energy loss, Is an automated logisticssystem upgraded to maximize the customer's sales capability. 1 basement floor,6 aboveground floors Total floor space 7375 pyung It is a logistics centerconsisting of entrance and exit with a storage capacity of 43000 pallets, amanual warehouse, a quench room, and a refrigeration automation logisticscenter.

The automated warehouse part is designed as a building rack type basedon stable structure facilities that can stand the C class in the side of the coastand can be built safely in the factory. , A building rack serves as a buildingstructure as well as a product storage.
As shown in <Table 1>, frozen food (F class) consists of ice cream, aquaticproducts, livestock products, processed frozen foods and bread, and frozen foodsC) is made up of food, dairy products, foodstuffs, agricultural products, andfruits. In addition, other products such as chocolate and other products areAbbreviations and AcronymsDefine abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations such as SI, ac, and dc do not have to be defined.
Abbreviations that incorporate periods should not have spaces: write “C.N.R.S.,” not “C. N. R. S.” Do not use abbreviations in the title unless they are unavoidable (for example, “INTERNATIONAL JOURNAL OF ENGINEERING AND INNOVATIVE TECHNOLOGY” in the title of this article).

D. Application technology of cold chain system

- **Packing technology**

end. Roll cabinet technologyThe roll cabinet is an easy-to-find type of refrigerated container that issimilar to a general refrigerator. It can accommodate a variety of products bydividing the temperature by temperature. It can be moved because it is notfixed type. It is also characterized by the use of refrigerant without mechanicalcooling. The roll cabinet is introduced and the elasticeffect is used according to thesituation. First, various product groups that require different temperatures can besubdivided into desired temperature ranges and managed according to thecharacteristics of the products. During the transportation, it is common tomanage in two stages of refrigeration and refrigeration, but by using the rollcabinet, it is possible to finely divide into three sections or four sections tomanage the cargo For example, cereals can be completed at room temperature,fruits and vegetables at 10 to 14 ° C, refrigerated products at 2 to 4 ° C, andrefrigerated products at -18 ° C. Second, because it is a non-fixed type mobile container, it can be loaded in avehicle.
If it is carried out only on the contrary, it can be

transported to awarehouse or a showcase such as a wholesale market or a mart, Thetemperature deviation can be minimized. Third, because it uses dry ice, which is a cryogenic material rather than amechanical cooling method, as a refrigerant, it does not require a separate powersource, so it can reduce the cost of distribution such as fuel.

IoT fusion packaging technology

At the heart of the cold chain system is packaging technology. However, it isdifficult to keep the temperature inside the container constant due to the lack oftemperature maintenance performance, which is commonly used in the freezingand refrigerated logistics delivery. Therefore, there is a high risk of deteriorationin the delivery process, The waste is large, and the temperature and humidity ofthe inside of the container and changes in the state of the product can not beconfirmed during delivery. In order to secure these disadvantages, the smartrefrigeration logistics center, which will be introduced in the future, will utilizespecial (PCM: Phase Change Materials) container to maintain temperature andhumidity through constant temperature maintenance and RFID / USN, , Securityinformation of opening and closing, etc., monitoring of the products will be ableto get the effect of deterioration and damage security.

It can be used forexpress service of high-priced cargoes sensitiveto temperature and externalimpact, such as fresh food, high-performance electronic and medical products.

Transportation technology

A. PCM

Domestic refrigerated refrigerated cargo is transported to a vehicle replacing arefrigerated refrigerated car by using a freezing / refrigerated vehicle or astyrofoam box and a refrigerant which are transported by using a refrigeratingmachine to a vehicle, . Therefore, new technologies should be applied to improvethe efficiency of refrigerated car. First, it is necessary to make a vehicle using PCM technology in a refrigerated car or to maintain the proper temperature byusing a twin freezer. It is also necessary to cope with a change in the volumeof cargo by dividing into a refrigerator and a freezer by using a movablepartition inside a vehicle. It is necessary to install an air shutter or a dual heatsink door inside the vehicle to solve the temperature change during the up anddown movements and to cut off the external temperature and measure thetemperature and humidity which can not be confirmed during operation usingRFID / USN technology in real time To the logistics center to preciselyunderstand the difference between the temperature and humidity generated insidethe vehicle, so that the product sensitive to temperature changes such as freshfood or cosmetics should be managed safely.

B. RFID-based temperature management system

Recently, distributors have managed to manage the temperature andtemperature records by interval for the delivery quantity. However, there is stilla lot of temperature monitoring in the loading space, not the temperature ofindividual products. Consumers who have received the product have complainedthat they can understand the status of the product after opening the package.

The RFID-based temperature management system suggested as a solution is toattach a passive RFID temperature tag to the outside of the packaging box sothat consumers scan the QR code attached to the package after receiving theproduct through the smartphone, So that the product management state of theentire transportation process can be provided to the customers.

Storage technology

A. Real-time WMS monitoring using RFID / USN and 3D technology

It is necessary to precisely manage the location and information of the cargo.

However, the storage place for the domestic refrigeration warehouse is composedof several layers such as 3 and 5 stages. It is difficult to grasp the informationof the products stored in each floor by managing the system or themanagement based on the memory of the worker. The smart refrigerationlogistics center, which will be built in Busan New Port in the future, will utilizethe RFID / USN for each rack cell in the forklift or warehouse to enhance theproductivity of the forklift and to keep the information of the products stored inthe cell in real time Information on the products stored in layers from the firstlayer using the 3D technology is displayed on the touch screen screen in 3Dimage, and the information on the inventory status by the expiration date of theproduct, the progress of the packaging, the inventory status by the number ofdays stored, It will be possible to manage warehouses more efficiently with theconveyor system incorporating RFID technology.

CONCLUSION

In this study, the current situation of the domestic refrigeration warehouseand the improvement of the function were studied. In particular, the frozenstorage warehouse in Busan, which is adjacent to the harbor, has a largevolume of cargoes due to the development of fishery industry. However, And itis not responding adequately to changes in the internal and external" environment. In addition, although the imports of aquatic products haveincreased recently, there is a problem that the frozen storage warehouses inBusan can not keep up with the demands of the consumers in terms of qualityand merely perform the conventional storage function. In other words, individual products requiring proper temperature are classified and

transported and storedonly as frozen and refrigerated products. In order to solve this problem, we have developed the function of WMS as awhole by not only storing and storing the frozen refrigerated warehouseoperated by the simple storage function, but also realizing the input and outputefficiency, real time information of the cargo information and providing it to theshippers. As a solution, we combined smart technology with cooling function,which is the basic function of cold chain system, which is the basis of freezingand refrigeration. In terms of packaging technology, real-time WMS monitoringusing RFID / USN and 3D technology, activation of MPS using object Internet,Smart WMS , Picking work using artificial intelligence transportation robot,packaging using self-driven roller conveyor system, activation of inspectionwork and reduction of energy loss, and other measures include changing theperception of shippers, opening the legal system, and leading large-scalelogistics companies

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