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## A Research on the Control of Climatic Environment in Cold Storages located in the Anatolian Side of Istanbul

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**Abstract** This research was carried out in order to inspect the current climatic environment of cold storage facilities in the Anatolian Side of Istanbul Province and to investigate the compliance of the cooling systems applied in the warehouses with TS 9048 and TS 4855 standards. 12 enterprises for which permission was obtained were selected as research materials. As a result of the research, it has been determined that foodstuffs driven from animals are mostly stored in cold storages, and 75% of the companies use ammonia gas and 25% of them use freon gas as the cooling agent in the cooling systems. Sandwich panels as wall insulation material in 83.4% of the warehouses and EPS as the base insulation material in 50% of the warehouses were in the first place. As a result, it has been determined that the structural features of the warehouses comply with the TS 9048 standard and in terms of controlling the climatic environment, the applied cooling systems comply with the TS 4855 standard. It is recommended to use ammonia in tanks with a capacity of more than 500 tons and freon gas in tanks up to 2000 tons as a refrigerant.

**Keywords** Climatic Environment, Cold Storages, Freon gas

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### Introduction

Cold storages are facilities with all kinds of cooling equipment, insulated in a way not to be affected by external conditions, temperature, and humidity conditions that can be adjusted according to the types of the stored products, and they're established for the storage of perishable foodstuffs [1].

Preserving the quality of stored agricultural or animal products for a long time is possible by providing the desired climatic environmental conditions in the warehouse. The main climatic environmental conditions are effective in storage; temperature, humidity, ventilation, air composition, and air movement. The efficient storage of products depends on carefully adjusting these factors, directing the ambient conditions appropriately, and performing controls at certain time intervals [2].

The temperature level in cold storages varies depending on the stored product. Cooling the product at low temperatures decreases the vapor pressure in the product, reducing water loss. The relative humidity is one of the environmental factors that are important in maintaining the quality of stored agricultural products. In warehouses protected from low temperatures in winter and high temperatures in summer, the temperature varies between 4-10°C and the relative humidity around 85-90% during a long storage period [1]. Ventilation speed can range from 0.25 to 3.0 m/s [3].

The quality of the insulation is very important in terms of the profitability and continuity of the cold storage and the protection of the product quality. The saving type of insulation is thermal insulation. For this reason, thermal insulation is at the forefront of insulation types. Thermal insulation is based on two main concepts; energy and environment [4; 5].



The properties of fluids used in cooling systems should be able to evaporate under applicable pressures and the evaporation temperature should be very low. There should be no chemical decomposition or burning. Moreover, it should not be toxic and should not react while in contact with metal surfaces. It must be able to operate at low power, have a low cost and it also must be easily obtainable. The most used refrigerants are ammonia and freon group gases.

This research was carried out in order to inspect the current climatic environment of cold storage facilities in the Anatolian Side of Istanbul Province and to investigate the compliance of the cooling systems applied in the warehouses with the TS 9048 and TS 4855 standards.

### Material and Method

The storing process of foodstuffs driven from animals in storage located in the Turkish province of Istanbul, in the Marmara region which is located in the Anatolian side of the province, has been selected as the research material. The geographical location of the research area is between 41° 01' north latitude and 28° 58' east longitude and its height is 40 m on average above sea level [6]. The research was carried out in 12 businesses from which permission was obtained from the relevant institutions.

The research was carried out in three stages as fieldwork, survey, and office work. In the field studies, subjects such as ventilation, insulation conditions, and cooling techniques applied were determined by on-site measurements and observations. In the survey study; The business owners were interviewed face to face and information about the businesses and the problems they faced were obtained. In the office work; The data obtained in the first two stages have been evaluated in terms of compliance with the project principles standards such as TS 9048 cold storage building standards published by the Turkish Standards Institute and TS 4855 warehouse cooling system standards.

### Results and Discussion

Controlling the climatic environment in cold storage rooms is extremely important in terms of product storage. For this purpose, cold storages should be equipped with the necessary equipment and temperature and humidity should be adjusted automatically. In the TS-9048 standard, devices that measure temperature and humidity should be available in all warehouses at the workplace, these devices should be visible from the outside, and can be observed by a center where temperature and humidity can be monitored. Indicator accuracy of instruments used in temperature measurements should be 0.1 °C [7]. In the workplace, it should be checked whether the cooling system works efficiently every day, the operations performed should be recorded, the cooling installation should be designed in accordance with TS 4855. All rooms in the workplace should have a ventilation and humidification system that varies depending on the product quality [8].

Temperature, humidity, fresh air supply, and ventilation controls are fully automatic in 63% and semi-automatic in 27% of the businesses we surveyed. The owners of the businesses stated that they did not experience any problems in the ventilation of the warehouses, temperature, and humidity control.

**Table 1:** The refrigerant used in cold storage, cooling system and pre-cooling examination

		Number of businesses	Percent (%)
Coolant	Ammonia	9	75
	Freon	3	25
	Domestic	3	25
Cooling system	Imported	7	58
	Both of them	2	17
Pre-cooling system	Available	8	67
	Unavailable	4	33

The properties of the refrigerants used in cold storages should be able to evaporate under applicable pressures and the evaporation temperature should be quite low. There should be no chemical decomposition or burning. Moreover, it should not be toxic and should not react while in contact with metal surfaces. It must be able to operate at low power levels, low cost, and easily obtainable [7; 8]. From this perspective, it is appropriate to use ammonia and freon group gases as refrigerants in cold storage where the research is conducted [9]. They



recommend the use of ammonia and freon group gases as a refrigerant in cold storages due to their economic and ease of use.

The distribution of refrigerant, cooling system, and pre-cooling used in cold storage in the research area is given in Table 1.

Table 1 When examined, the rate of operation using ammonia gas as a refrigerant is 75% and the rate of operation using freon gas is 25% in the enterprises where the research was conducted. Generally, it is suitable to use R-12, R-22, and ammonia, which are derivatives of Freon gas, as a refrigerant in commercial cold storages [9]. The cold storage cooling system is used by 58% of the enterprises, 25% domestic, and 17% both. 67% of businesses While there is a pre-cooling system, 33% of them do not. According to the TS-9048 standard, there is a requirement to have a pre-cooling system, especially in warehouses where animal foods are stored.

As a refrigerant, ammonia has been widely used in industrial applications for a quite long time. It is recommended to be used in large warehouses especially those which have a capacity of over 500 tons [1]. Freon is an artificial gas commonly used in industrial refrigeration and its chemical name is R-404 A, known as HFC (Hydrofluorocarbon). Today, freon systems are a good refrigerant for cold storage up to 2000 tons [9].

Ventilation forms the basis of air conditioning systems. Mechanical ventilation systems are preferred and applied in order to provide controlled ventilation in cold storage. The natural ventilation system is widely used for the ventilation of closed areas other than cold storage. Ventilation systems applied in the companies where the research was conducted are given in Table 2.

**Table 2:** Ventilation systems currently applied in businesses

Ventilation system	Number of businesses	Percent (%)
Natural	-	-
Mechanical	8	66
Combined	4	33
Total	12	100

As shown in Table 2, 66% of enterprises use mechanical ventilation systems, and 33% use combined ventilation systems. The air of each room can be cleaned automatically by installing a central ventilation system in the cold storage depots built in recent years.

Insulation in cold storage is very important in terms of the profitability and continuity of the warehouse and the protection of the product quality. In the TS-4855 standard, the importance of heat and moisture insulation in cold storage depots for energy-saving and quality preservation of the stored product is pointed out [8]. The wall insulation materials used in the cold storage rooms where the study was conducted are given in Table 3.

**Table 3:** Types and distribution of insulation material used in walls

Insulation materials	Number of businesses	Percent (%)
Polyurethane	1	8.3
Styrofoam	1	8.3
Sandwich panel	10	83.4
Total	12	100

As showed in Table 3, it has been determined that 83.4% of the operation depots use sandwich panel, 8.3% polyurethane, and 8.3% polyurethane material as wall insulation material. The type and distribution of insulation material used in the floor insulation of the warehouses are also given in Table 4.

**Table 4:** Types and distribution of insulation material used on the floor of the storage

Insulation materials	Number of businesses	Percent (%)
EPS	6	50
PU foam	5	41.7
PU panel	1	8.3
Total	12	100

In the survey, it was determined that 50% EPS, 41.7% PU foam, and 8.3% PU panel were used as the base insulation material. Insulation materials used for wall and floor insulation in research warehouses conform to the TS 9048 standard.



In cold storage applications, insulation is necessary not only for energy saving but also for a successful storing process. Depending on the air zones, the difference between the room air temperature and the interior surface temperature should be less than 2 degrees and the insulation material should be thick enough to meet this requirement [8]. He also stated that the insulation efficiency should not exceed 0.3 Kcal/h°Cm<sup>2</sup> in fresh storage rooms and 0.17 Kcal/h°Cm<sup>2</sup> in frozen storage rooms in order to provide homogeneous heating in the room. He stated that it is necessary to use materials with sufficient and good water vapor permeability as the insulation material as well as thermal insulation resistance and moisture insulation should be made against water vapor flow on the outer surface of the insulation.

### **Conclusion**

Controlling the climatic environment in cold storage rooms is extremely important in terms of product storage. For this purpose, cold storages should be equipped with the necessary equipment and temperature and humidity should be adjusted automatically. In the cooling system, it would be appropriate to use ammonia as a refrigerant in tanks with a capacity of over 500 tons, and freon gas in tanks up to 2000 tons. The principles specified in TS-9048 and TS 4855 standards should be complied with in designing air conditioning of cold storages.

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