

Lesson.27 Types of Cooling Load

INTRODUCTION

The total amount of heat required to be removed from the space in order to bring it at the desired temperature by the air conditioning and refrigeration equipment is known as cooling load. The purpose of load estimation is to determine the size of the equipment. Cooling load on refrigeration equipment is the summation of heat given up by different sources.

27.1 COMMON SOURCES OF HEAT

1. Heat that leaks into the refrigerated space from the outside by conduction through the insulated walls.
2. Heat that enters the space by direct radiation through glass or other transparent material
3. Heat that is brought into the space by warm outside air entering the space through open doors or through cracks around window and doors.
4. Heat given off by a warm product
5. Heat given off by a people occupying the refrigerated space
6. Heat given off by any heat-producing equipment located inside the space eg. Motors, lights, electronic equipment, material handling equipments etc.

27.2 TOTAL COOLING LOAD

The total cooling load is divided into four separate loads;

1. The wall gain load
2. The air change load,
3. The product load,
4. The miscellaneous or supplementary load.

27.2.1 Wall gain load

Wall gain load or wall leakage load is a measure of heat flow rate by conduction through the walls of refrigerated space from the outside to the inside. There is no perfect insulation i.e. there is always a certain amount of heat passing from the outside to the inside. The heat gain through walls, floor & ceiling vary with

- The types of insulation
- Thickness of insulation
- Construction material
- Outside wall area
- Temperature difference between refrigerated space and ambient air

27.2.2 Air change load

When the door of a refrigerated space is opened, warm outside air enters the space to replace the more dense cold air that is lost from the refrigerated space through the open door. The heat which must be removed from this warm outside air to reduce its temperature and moisture content to the space design conditions, becomes a part of the total cooling load. This is called the air change load.

$$\text{Air change load, } Q_a = m (h_o - h_i) \dots\dots\dots (27.1)$$

Where, m= mass of air entering, kg /h

h_o = Enthalpy of outside air, kJ/kg dry air

h_i = Enthalpy of inside air, kJ/kg dry air

Fruits and vegetables respire even at low temperature storage Heat produced due to respiration of the fruits and vegetables, is required to be considered for cold storages. It can be calculated as

$$Q_r = m_p (\text{kg/h}) \times \text{Respirate rate (kJ/kg)} \dots\dots\dots (27.2)$$

Where, Q_r = Respiration load

m_p = mass

27.2.3 The product load

Product load is the heat that must be removed from the refrigerated product in order to reduce the temperature of the product to the desired level. The term product means any material whose temperature is to be reduced. When, the product is to be frozen, in this the latent heat removed is also a part of the product load.

27.2.4 Miscellaneous load

This load takes into account all miscellaneous sources of heat. Chief among them are people working in or otherwise occupying the refrigerated space, along with lights or other electrical equipment operating inside the space.