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Design and Fabrication of Eco-Friendly Cooling Cabinet

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Abstract - We need to feel relax and comfortable in hot and humid condition. This comfortable has become a need now a day. Systems like refrigeration and air conditioning has been increased rapidly to attain comfortable. Air conditioning plays a very important role in thermal comfort. The systems like air conditioning and refrigeration are not suitable for villages due to longer power cut duration and also cost of the product is high. Now in market commercially dominant cooling systems are existed and they can consume high power. So that evaporative cooling pad system is used. When air is pulled through evaporative cooling pads that are saturated with water then cooling effect will be formed due to evaporation of water. In a cooling cabinet cool air fans are used so that reduction in temperature will take place. Solar power systems are considered as one of the sustainable energy system. If we considered solar cooling systems in villages, that will helps in reducing electricity and other features. It is essential that small scale vegetable and fruit producers need to use cold storage methods to maintain freshness and quality of vegetables and fruits. Our aim is to design an efficient cold storage unit using as much natural cooling and ventilation as possible that will store the vegetables and fruits also reduce the electricity cost. A solar powered evaporative cooling system is designed and constructed to increase the self-life of stored vegetables and fruits. Evaporative cooling systems help to save money.

***Key Words*: Evaporation, Temperature, Humidity.**

1. INTRODUCTION

Evaporative cooling is a process which reduces the temperature of a substance due to the cooling effect from the evaporation of water. The conversion of sensible heat to latent heat causes a decrease in temperature and evaporated water gives cooling effect. The cooling system is used in both small and large industry. Several researches are going on to design evaporative coolers in least price. Evaporative cooling can provide longer life to fruits and vegetables. Humidity and hot climate condition can reduce the life span of fruits and vegetables. Market value of fruits and vegetables depend on its freshness and quality. Deterioration of fruits and vegetables is mainly because of temperature fluctuation. At high temperature fruits and vegetables can deteriorate at higher rate. Too lower temperature can also damage some of agriculture produce. Fruits and vegetables are kept in normal humidity condition to maintain quality.

Damaged vegetables have shorter life span and these are kept at lowest safe temperature. Safe temperature can increase the storage life by reducing water loss and lowering respiration rate. In most of the country, the post-harvest fruits and vegetables deteriorated due to lack of proper storage. Refrigerated cold storage is the best method for storage but it is very expensive. Evaporative cold storage is an alternative technique for storage of fruits and vegetables at a least cost. When air passes through wet pad towards preservation area, cooling will takes place. Cold storage plays a vital role in increasing the economy and growth of the country. The effective evaporative cold storage system can store fruits and vegetables temporarily before consumption. Evaporative air coolers are used for humidification, where dry air is humidified during cool weather. During this time windows and doors should be closed. Evaporative air coolers are environment friendly because they don't use any refrigerant gas.

2. OBJECTIVES

1. The main objective of this work is to produce an alternative source of storage for increasing the self-life of vegetables and fruits.
2. Design, construction and testing of storage facility to preserve vegetables using the principle of evaporative cooling.
3. Evaluation of the facility.
4. Constructing the cooling cabinet with a minimum cost and use of natural resources.

3. METHODOLOGY

The methodology for intended work is being planned to be carried out as per the flow chart given below. First carrying out study of the available source of material and understanding the method of evaporating cooling technique. Then the design of the cooling cabinet is made and its fabrication is done, later the testing and evaporation is being carried. It is illustrated in figure 1.

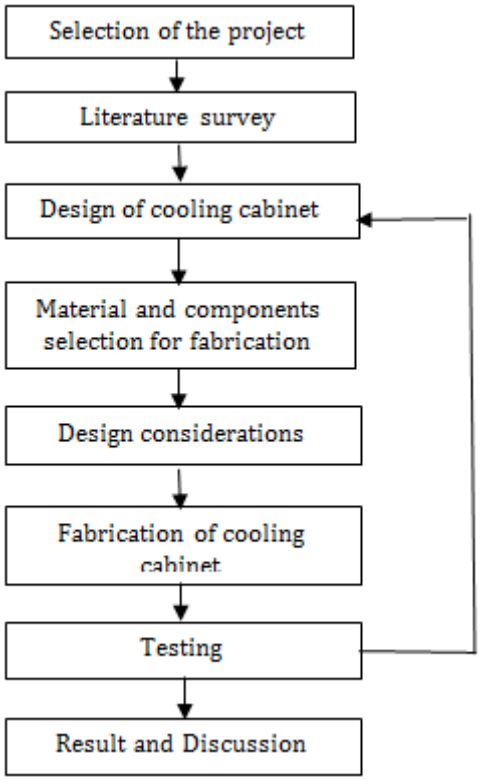

Fig. 1: Flow chart of methodology steps.

Design of cooling cabinet

The design is made in the solid work CAD software packages and the various images are taken for the model and are presented below.

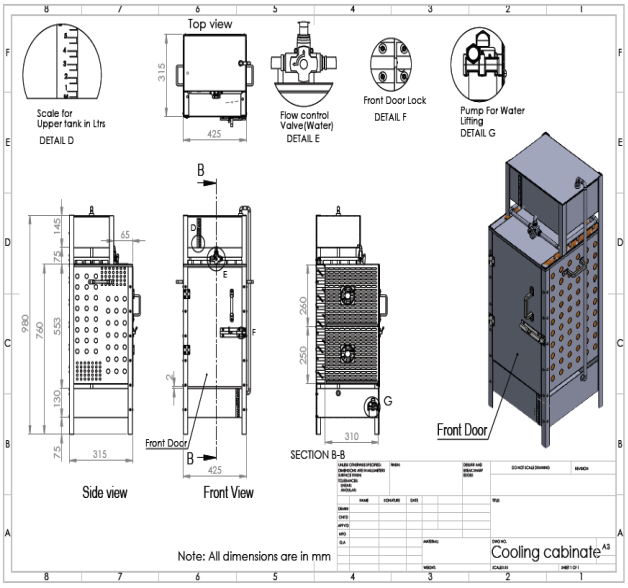

Fig. 2: Structural view of the cooling cabinet.

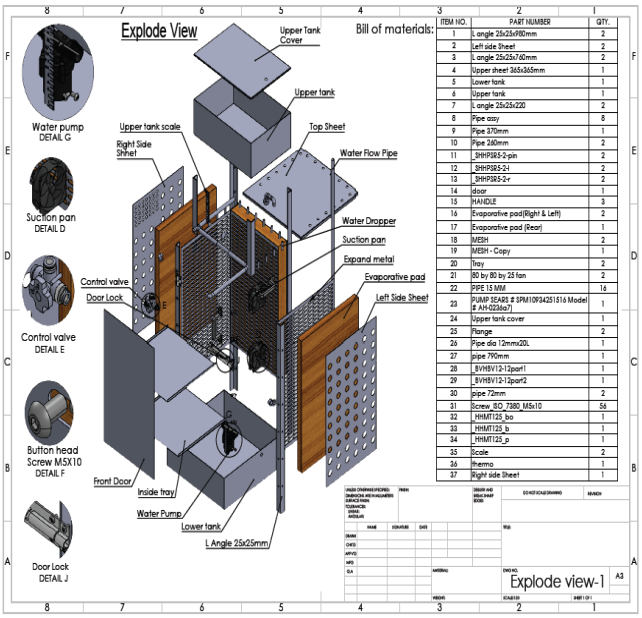

Fig. 2: Exploded view of the cooling cabinet.

4. RESULTS AND DISCUSSION

Fruits and vegetables are kept in cooling cabinet and outside of the cabinet. A comparative study is made to know the lifespan of fruits and vegetables inside and outside of the cooling cabinet. Temperature and humidity plays a very important role in lifespan of fruits and vegetables.

Testing of fruits and vegetables inside the cooling cabinet:

Fig. 4: Testing of fruits and vegetables inside cooling cabinet.

Table 1: Result of fruits and vegetables inside the cooling cabinet

Sl. No	Items	Fresh	Deteriorated
1	Green chilly	Day1(morning)	Day15(morning)
2	Cucumber	Day1(morning)	Day8(morning)
3	Tomato	Day1(morning)	Day13(morning)
4	Bitter gourd	Day1(morning)	Day8(morning)
5	Ladies finger	Day1(morning)	Day12(morning)
6	Ridge gourd	Day1(morning)	Day8(morning)
7	Cluster beans	Day1(morning)	Day15(morning)
8	Brinjal	Day1(morning)	Day10(morning)

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Testing of fruits and vegetables outside of the cooling cabinet:

Table 2: Result of fruits and vegetables outside the cooling cabinet.

Sl. No	Items	Fresh	Deteriorated
1	Green chilly	Day1(morning)	Day5(morning)
2	Cucumber	Day1(morning)	Day4(evening)
3	Tomato	Day1(morning)	Day4(morning)
4	Bitter gourd	Day1(morning)	Day4(morning)
5	Ladies finger	Day1(morning)	Day7(morning)
6	Ridge gourd	Day1(morning)	Day5(morning)
7	Cluster beans	Day1(morning)	Day8(morning)
8	Brinjal	Day1(morning)	Day5(evening)

5. CONCLUSION

Considering natural resources and pollution constraints, an effort has been made to prepare solar powered and eco-friendly cooling cabinet. Hence, it can be concluded that:

The cooling cabinet provides a cost effective method freezing of fruits and vegetables. It is essential for increasing the self-life of fruits and vegetables. The cooling cabinet has been designed and fabricated. It has successfully demonstrated its ability to increase self-life of fruits and vegetables. The equipment has high efficiency and high productivity. The overall equipment cost is less. The equipment has zero maintenance cost.

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