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SEED PRESERVATION USING REFRIGERATION

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***Abstract*:** *Seeds have the power to regenerate species. Seed preservation is an important activity in building food security, as well as restoring agricultural biodiversity. Seed storage is the preservation of seed with its original quality until it is needed for planting. The capacity of seed to endure moisture loss permits the seed to remain viable in a dry environment. Harrington thumb rule for seed storage states that for every decrease of 1% seed moisture content, the life of the seed doubles. For every decrease of 5^oC in storage temp the life of the seed doubles (applies between 0^oC to 50^oC). The most used storage condition for seed preservation is around 12^oC and 40 Rh. In this work, vegetable seeds is preserved by providing a suitable refrigeration system to maintain the favourable condition that helps in storage of seeds for long duration without losing its germinating capability. The refrigeration system along with the control system is designed for vegetable seed preservation in this project.*

Keywords: *preservation chamber, seeds, temperature and RH, control panel.*

1. INTRODUCTION

Seed Preservation chamber is room in which a proper temperature and humidity are maintained to help the seeds storing. Seeds are the primary genetic connection between two generations of a plant species, seeds should have a high ability for storage. Seeds should be stored to maintain their vitality and germination potential. It is possible to maintain the strength of seedling at room temperature climates, but they must be appropriately adjusted to the local humidity and temperature in tropical and subtropical climates. Human and animal existence is dependent on plants, and some plants can only be developed from seed. So, seed preservation is very important. The storage phase starts as soon as the seeds achieve physiological development in the field and lasts until they are planted in the respective season. The important implication of this is that only high-quality seed should be carried over. The medium quality seed may be stored only for the next plating seasons. The low-quality seed should be rejected. For preservation of different plant seeds requires almost same temperature and relative humidity. Table 1 shows the favourable temperature and relative humidity for the seeds.

Table 1: Recommended storage condition and approximate length of seed storage:

Vegetable	Temperature (°C)	Relative humidity %	Approximate length of storage (year)
Asparagus	20-30	40-60	2-3
Brinjal	25-30	40-60	2-3
Broccoli	15-20	35-55	2-3
Brussels sprouts	15-20	35-55	2-3
Capsicum	20-30	45-65	2-3
Carrot	15-20	40-55	1-2
Cauliflower	15-20	35-55	2-3
Chillies	25-30	45-60	2
Celery	15-20	40-50	2-3
Corn	11-15	35-55	1-2
Cucumber	25-30	45-65	3-4
Garden beet	15-25	40-60	2-3
Garden pea	15-25	40-60	2-3
Knolkhol	15-20	40-55	2-3
Lettuce	15-20	40-55	2-3
Lima bean	25-30	45-65	1-2
Muskmelon	25-30	45-65	3-4
Onion	15-20	40-55	1-2
Okra	25-30	40-65	2
Pumpkin	25-30	45-65	3-4
Radish	20-24	40-60	2-3
Snapbean	25-30	45-60	2-3
Spinach	20-25	40-60	1-2
Squash	25-30	45-65	3-4
Tomato	25-30	40-65	2-3
Turnip	15-20	40-60	3-4
Watermelon	25-30	45-65	3-4
Parsnip	15-20	40-60	1-2
Parsley	15-20	40-60	1-2

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2. REFRIGERATION SYSTEM

The refrigeration system consists of a compressor, condenser, expansion valve, evaporator, oil separator, receiver, solenoid evolve, accumulator, and air heater as shown in Fig 1. In this refrigeration system, the primary purpose is to maintain the temperature and relative humidity based on dew point temperature with out using dehumidifiers. The refrigerant R404A used in the refrigeration sytem.

For getting low RH, normally dehumidifiers are used, but in this work, The refrigeration system is being used to acquire the required relative humidity. The technique here is to just reduce the temperature of the evaporator coils lesser than the dew point temperature of the room condition (Temperature & RH). The dew point temperature is the temperature at which the moisture in the air starts condensing as the temperature of the coils is lesser than the dew point temperature, when the airflow over the coils the moisture in the air is condensed. So that the RH is reduced in a way it achieve's the required RH. Coming to temperature control most of the cooling capacity is provided by the evaporator is first used for extracting that latent heat of moisture in the air, so as RH reduces at the same time temperature will not reduce rapidly after achieving the RH. If the temperature is achived first but humidity is not achieved in this condition the compressor still runs to get the required humidity level. Due to this temperature falls much below than the desired temperature which is to be maintianed in the room. To maintian this desired temperature the heaters are used in the refrigeration system.

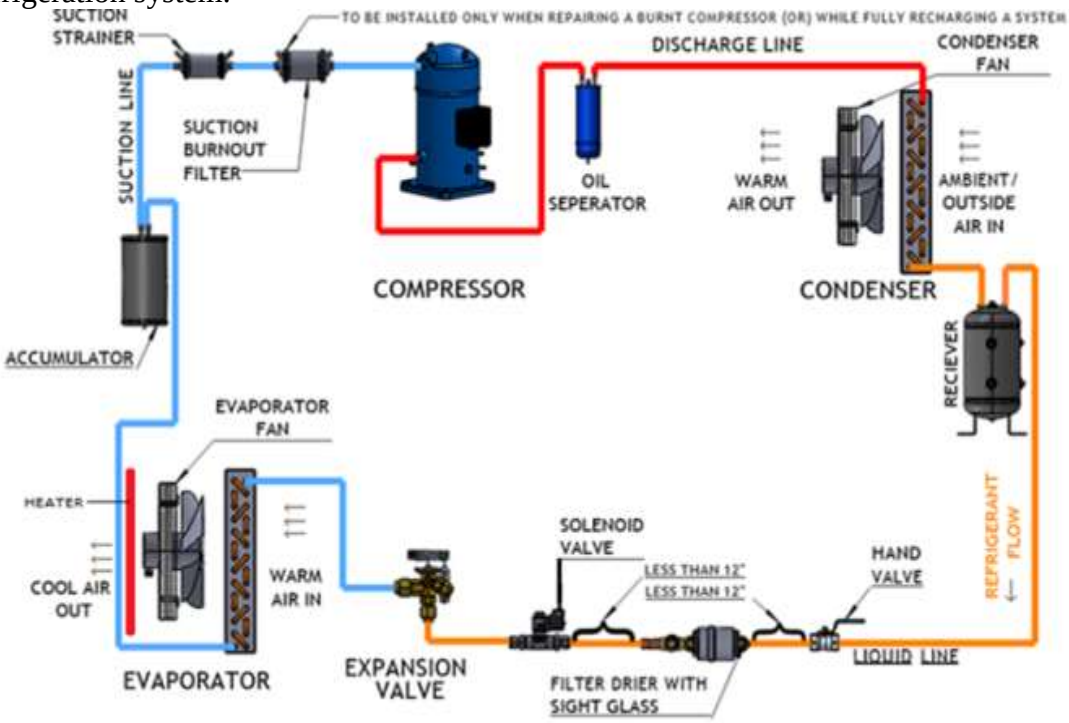

Fig. 1 Refrigeration Circuit Diagram

3. METHODOLOGY

The refrigeration system is designed for the controlling the temperature and RH. The cooling load is calculated using the Frascold selection software by giving the desired conditions 12°C and 40% and the existing room dimensions. The existing room is replicated in Solidworks 2020 for locating all positions of IDUs in the room for installations. The installation is carried out based on the design provided. The control logic is developed and control panels are installed to control the system to acquire desired conditions in the room for preservation of the seeds.

4. WORKING LOGIC IN CONTROL PANEL

The preservation chamber control panel works based on the logic provided below with the help of controller and contactors.

A. Cooling Mode

Cooling mode starts when Sensed Room Temp > Set Room Temp.

Compressor: Compressor starts operating when Sensed Room Temp > Set Room Temp.

a) Switch on the Compressor if the Sensed Room Temp greater than the Set Room Temp.
b) Switch off the Compressor when Set Room Temp is achieved.
c) Alarm – HP Trip – Compressor off.
d) Alarm (Compressor Fault) - If compressor did not turn on within settable duration of time (in mins) after turning on the system.

B. Heating Mode

Heating mode starts when Sensed Room Temp < Set Room Temp.

Air Heater: Heater starts operating when Sensed Room Temp < Set Room Temp.

a) Switch on the Heater if the Sensed Room Temp is less than the Set Room Temp.
b) Switch off the Heater when Set Room Temp is achieved.
c) Alarm (Heater Fault – No Rise of Temp) - If Room Temp is not increasing even after settable duration of time (in mins).

C. Humidity Control

a) If RH is less than X% (settable) then compressor starts to reduce moisture in the air in the room.
b) If RH reaches Y% (settable) then compressor stops working.
c) If RH is greater than Z% (settable) – RH Overshoot alarm.
d) If RH is less than R% (Settable) – RH Undershoot alarm.

5. CONCLUSION

The temperature and relative humidity sensors are linked to the preservation chamber's control panel. The control system maintains the temperature and relative humidity based on the pre-programmed temperature and relative humidity settings in the control panel. The NTC (Negative temperature co-efficient) sensor measures temperature and relative humidity. The logic utilized for handling the system for keeping temperature and humidity using a control panel was effectively applied to control the humidity (40≤5%) and temperature (12±2ºC), which are suitable for the seeds storage. Desired conditions can be observed in the HMI provided in the control panel.

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