UNIT-V

APPLICATIONS OF LOW TEMPERATURE & REFRIGERATION

ESSAY QUESTIONS

Q. 1. What is Safe Storage Temperatures for Biological Materials.

Good storage practices of biological materials are an essential component of any laboratory. Biological samples often degrade over time when stored at room temperature, but some samples may also lose integrity at low temperatures if subjected to multiple freeze-thaw cycles. The best storage temperature for a given biological sample or reagent often varies depending on the type of biological material, the solution it is suspended in, the sample's intended use, and how long the material will be stored. The most common storage temperatures are bench top/room temperature, refrigerated, freezer, ultra-lowfreezer, and cryogenic freezer storage.

Room Temperature Storage (15°C to 27°C):

Biological materials that have fixed with a preservative such as Bouin's, formalin or alcohol, such as paraffin embedded tissues or biological specimens, can typically be stored at room temperature in a climate-controlled building. While room temperature storage is typically not ideal for samples from which molecular data is desired, it is sometimes possible to obtain DNA results from preserved or dried tissues that have been kept at ambient temperatures. However, the DNA in these tissues

is often highly degraded and only short read lengths are obtained. RNA degrades rapidly at room temperature and typically cannot be isolated from tissues that have not been kept in freezer storage.

Refrigerated Storage (2°C to 5°C) :

While typically a poor option for long-term storage, refrigerated temperatures are optimal for short-term storage of frequently used biological reagents, such as enzymes and antibodies. These reagents will quickly lose integrity if repeatedly frozen and thawed during routine experimental use and typically will remain viable at refrigerated temperatures when used within manufacturer recommended timeframes. Biological materials that will not be used in a short timeframe can be aliquoted and frozen until needed, reducing the number of freeze-thaw cycles they are subjected to.

Freezer Storage (-20°C) :

Many biological materials can be stored at standard freezer temperatures, preferably in appliances without frost free cycles (these cycles require brief periods of thaw to prevent frost accumulation and can degrade biological materials). -20°C freezer storage is ideal for short-term storage of samples and reagents that are not stable at warmer temperatures. DNA and RNA can typically be obtained from tissues that have been suspended in appropriate solutions before freezing at -20°C, though colder temperatures are recommended for long-term storage or for the storage of tissues or cells that are not suspended in a stabilizing solution.

Ultra-low Freezer Storage (-80°C) :

Ultra-low -80°C freezers are a practical option for long-term storage of biological materials. Ultra-low temperatures

prevent the degradation of nucleic acids, proteins, endocrine molecules and many other biological molecules. These temperatures have been shown to maintain the viability of numerous biological assays and reagents through long-term storage. When samples are stored at ultra-low temperatures, it is important to consider freeze-thaw protocols. Cells typically preserve best when frozen slowly (about 1°C a minute), but thawed quickly (such as in a water bath).

Cryogenic Freezer Storage (-150°C to -190°C) :

Cryogenic freezer storage is often deemed the gold standard for long-term storage of biological samples. At these extremely low temperatures all biological activity is suspended and no degradation occurs. Cryogenic freezing is ideal for sensitive samples and specimens which cannot be suspended in a preservative find more information. Like ultra-low temperature freezing, it is important to consider freezing and thawing protocols when utilizing cryogenic freezer storage. Many variables go into making ideal storage temperature decisions for biological materials. For reagents and biological assays, it is often best to follow manufacturer recommendations for both short-term and long-term storage temperatures. When storing precious samples, it is important to consider the sample's molecular structure, the preservatives or solutions it is suspended with, and the degree of biological integrity required for future analytical or research goals. A consultation with a biological storage expert can offer peace of mind for your irreplaceable samples. It is important to find a lab relocation company that understands the complexity of maintaining precise temperature parameters, and regulatory compliance. Lab moving is a complex process, and sample integrity is a priority.

Q. 2. What is freezing of food?

Freezing, in food processing, method of preserving food by lowering the temperature to inhibit microorganism growth.

Freezing is the easiest, most convenient, and least time-consuming method of preserving foods. Most foods freeze well—with the exception of produce with a high-water content, cream-based items, and cooked starchy foods such as cooked noodles and rice.

All fresh produce contains enzymes, compounds that help the plant ripen and mature. During freezing, enzyme action is slowed but not stopped. If not inactivated, these enzymes can cause Color and flavour changes and loss of nutrients during freezer storage. Also, freezing stops, but does not destroy, the microorganisms that cause spoilage or illness.

Inactivation of Enzymes in Vegetables :

Contrary to some publications or folklore, blanching is essential for obtaining top quality frozen vegetables. Blanching vegetables before freezing inactivates the enzymes. During blanching, the vegetable is exposed to boiling water or steam for a brief period. The vegetable is then rapidly cooled in cold water (60 degrees Fahrenheit or below) for the same amount of time to prevent cooking.

Blanching also helps destroy microorganisms on the surface of the vegetables. When blanched, vegetables such as broccoli and spinach become more compact. Following the recommended times for blanching each vegetable is important. Over-blanching results in a cooked product and loss of flavour, Color and nutrients. Under-blanching stimulates enzyme activity and is worse than no blanching at all.The use of microwave ovens for blanching has become popular. However, microwave blanching

is not recommended as it produces uneven results because of varied heat patterns within a microwave oven and from one microwave oven to another. Microwave blanching requires working with only small quantities at a time; there is no time saved when working with large quantities of vegetables.

Prevention of Color Changes in Fruit :

Enzymes in fruits can cause browning and loss of Vitamin C. Fruits are not usually blanched. Instead, ascorbic acid (Vitamin C) is used to control enzymes in frozen fruits. Commercial mixtures of ascorbic acid are available for home use. Citric acid or lemon juice also may be used to prevent darkening of fruits, but they are not as effective as ascorbic acid. Packing fruit in sugar or sugar syrup will also control browning, but not as effectively as ascorbic acid.

Prevention of Off Flavours :

Another type of change that can occur in frozen products is the development of rancid off flavours. This occurs when fat, such as in meat, is exposed to air over a period of time. It can be controlled by using a storage method that does not allow air to reach the product. Therefore, it is always advisable to remove as much air as possible from the freezer bag or container to reduce the amount of air in contact with the product being frozen.

SHORT ANSWER QUESTIONS

Q. 1. How liquid nitrogen used in treatment.

Liquid nitrogen is extremely cold. It will freeze any living tissue it comes into contact with. Applying small amounts of liquid nitrogen to various skin problems is now a standard treatment. The medical term for this treatment is cryotherapy.

1. Liquid nitrogen treats warts and verruca's, skin tags, small fleshy growths and similar small 'lumps and bumps' on the skin are ideal for liquid nitrogen treatment.
2. Try holding a nitrogen cube of ice against your skin for 10-30 seconds. It is uncomfortable but usually not too painful. Liquid nitrogen applied to skin is similar but colder and most people find the discomfort quite bearable.

Q. 4. Explain Working of water Cooler.

Water Cooler is generally used in schools, college, hospitals, factories, offices, stores etc. Basically, there are two types of Water Cooler as follows:

1. Storage type water cooler.
2. Instantaneous type water cooler.

1. Storage type cooler :

Figure shows simple water cooler structure diagram, basic cycle is vapour compression cycle consisting of compressor, condenser, fan with motor, expansion device, filter or strainer,

thermostatic switch and evaporator coil as shown above figure. Temperature is control by thermostatic switch as per our desired temperature. Compressor compresses the Refrigerant R12 vapour to high temperature high pressure vapour is then condensed in condenser by fan motor unit. High pressure high temperature vapour converted into High pressure high temperature liquid in condenser. Liquid refrigerant passes through strainer or filter which removes moisture and impurities if any. The liquid refrigerant is throttled through expansion device (generally capillary tube). In throttling pressure and temperature of liquid drops down. This low-pressure low temperature refrigerant then extracts heat of water from the evaporator tank. By taking heat from water refrigerant evaporates and this vapour refrigerant sucked by compressor and process continues.

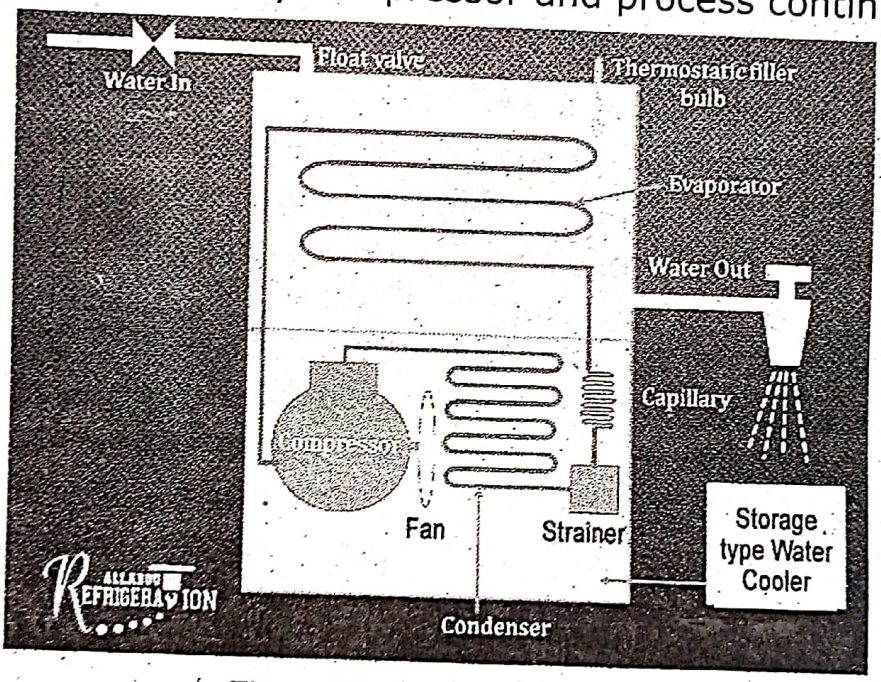

Fig : Storage type cooler

2. Instantaneous type water cooler:

The only difference in instantaneous and storage type is in construction of evaporate as shown below. The storage type cooler has evaporated coils solders on the wall of storage tank. The tank is either of stainless steel or galvanized steel

and water level is maintained by float valve. The Evaporator in instantaneous type consist of two separate coils made of either copper or stainless steel. Copper pipe carries R12 while stainless steel pipe carries water. The two pipe or coils are bound together by soldering. Thermostatic filler bulb is clamped on the water coil just at outlet end in case of instantaneous type, while in storage type it is emerged in the water in the tank.

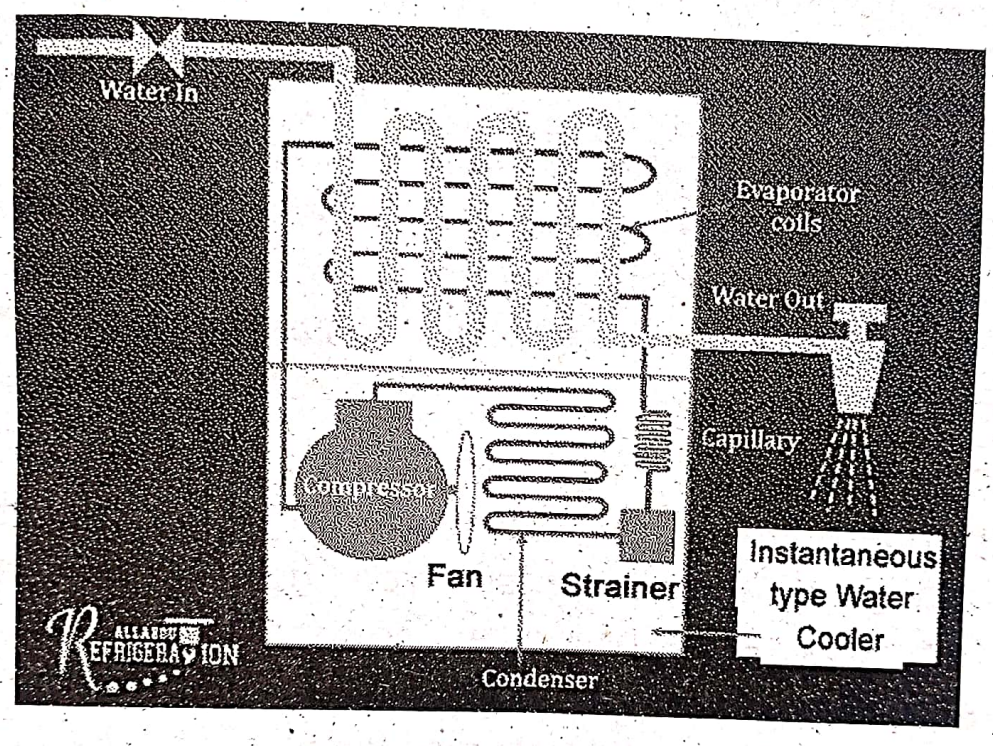

Fig : Instantaneous Type Water Cooler

Q. 5. What is Cold Storage & how does cold storage work?

Cold storage is a facility that primarily stores food items that are short-lived and highly likely to get spoilt under normal conditions. These may include fruits, vegetables, fish, meat etc. These food items are stored under optimum temperature (primarily low) and humid environment as required for individual items. Almost all cold storage rooms are designed such that these properties are pre-configured based on what is being stored. Some cold rooms are made such that these properties are adjustable.

Construction and Working of a Cold Storage Plant :

A cold-storage facility works on a refrigeration system which helps maintain an adequate temperature and environment as per the specifications of each item being stored.

These are the main components of a cold storage room :

(i) **Compressor :** It is the main component that runs the cold room. It is the only device that needs the energy to run. The compressor consumes almost all the power in a cold room. It is used to raise the temperature and pressure of the refrigerant vapour coming out of the Evaporator. As the pressure is increased, the boiling point increases and the compressor can condense the refrigerant (for example, ammonia) at the temperature of the condenser.

(ii) **Condenser :** It is required to remove the heat from the refrigerant and the circulating water. It carries out phase change of the condenser from gas to liquid at high temperature and pressure. The condenser acts as a heat sink and its heat exchange efficiency determines the efficiency of the cold storage plant.

(iii) **Receiver :** The high-pressure liquid condensate is stored here. It is here that the refrigerant comes after phase change from the condenser. After it has reached the receiver component, the liquid refrigerant goes to the expansion valve to decrease the temperature and pressure.

(iv) **Expansion Valve :** It reduces the temperature and pressure of the refrigerant using a throttling device. The throttling process occurs through friction and there is a change in the temperature and pressure of the refrigerant. Its pressure changes from that in the Receiver to that in the Evaporator.

VERY SHORT ANSWER QUESTIONS

Q. 1. How are food items freeze dried?

Freeze drying food uses a process called lyophilization to lower the temperature of the product to below freezing, and then a high-pressure vacuum is applied to extract the water in the form of vapour. The vapour collects on a condenser, turns back to ice and is removed.

Q. 2. What is the most important use of nitrogen?

The nitrogen cycle, in which atmospheric nitrogen is converted into different organic compounds, is one the most crucial natural processes to sustain living organisms. During the cycle, bacteria in the soil process or "fix" atmospheric nitrogen into ammonia, which plants need in order to grow.

Q. 3. Who uses liquid hydrogen?

Liquid hydrogen is a common liquid rocket fuel for rocketry applications — both NASA and the United States Air Force operate a large number of liquid hydrogen tanks with an individual capacity up to 3.8 million litters (1 million U.S. gallons).

Q. 4. Why are superconducting magnets used for MRI?

They can create intense magnetic fields because, when the magnet is in its superconducting state, the wire surrounding the magnet has no electrical resistance. This gives the magnet the opportunity to conduct much larger electrical currents than the average electromagnet.

Q. 5. What is a cryogenic propulsion system?

Cryogenic Engine. A cryogenic engine/ cryogenic stage is the last stage of space launch vehicles which makes use of Cryogenics. Cryogenics is the study of the production and behaviour of materials at extremely low temperatures (below -150 degree Centigrade) to lift and place the heavier objects in space.

Q. 6. What is food preservation and its method?

Food preservation is known "as the science which deals with the process of prevention of decay or spoilage of food thus allowing it to be stored in a fit condition for future use". Preservation ensures that the quality, edibility and the nutritive value of the food remains intact.

Q. 7. What does cryogenic treatment do for metal?

Cryogenic hardening is able to make metal objects and workpieces more resistance to wear and tear. Metal doesn't just become harder through cryogenic hardening; it becomes tougher and more resistant to wear. As a result, cryogenic hardening is performed to increase the usable life of metal objects and workpieces.

Q. 8. What is meant by desalination of water?

It can be defined as any process which removes excess salts and minerals from water (or) the chemical process of changing seawater into potable water are called desalination. These processes may be used for municipal, industrial or any commercial uses.