SNS COLLEGE OF TECHNOLOGY
AN AUTONOMOUS INSTITUTION

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DEPARTMENT OF FOOD TECHNOLOGY

COURSE CODE & NAME: 19FTT301 & Refrigeration & Cold Chain Management

III YEAR / V SEMESTER

UNIT : IV LOW TEMPERATURE STORAGE SYSTEMS

TOPIC 5 : Cryogenics

DEFINITION

The word *cryogenics* literally means "the production of icy cold"; however the term is used today as a synonym for the low-temperature state.

The cryogenic temperature range has been defined as from −150 °C (−238 °F) to absolute zero (−273 °C or −460 °F), the temperature at which molecular motion comes as close as theoretically possible to ceasing completely. Cryogenic cooling uses refrigerants, such as liquid nitrogen or solid carbon dioxide

Largest Cryogenic System

- LHC = Large Hadron Collider
- One of the coldest places on the Earth
- Main magnets operate at 1.9 K (-271.3°C), colder than outer space which is at 2.7 K (-270.5°C)
- Requires 120 tones (120000 kg) of superfluid helium to keep magnets at 1.9 K

PROCESS

- Gases compressed and heated in compressor.
- Heat of gases in removed in condenser and used in compressor.
- Refrigerant in expansion valve for cooling below condensation temperature.
- Now cools the objects to cryogenic temperature and reheating of gases occurs.

PROPERTIES OF CRYOGENIC FLIUDS

S.NO.	NAME	BOILING POINT (K)	LIQUID DENSITY (kg/m^3)	THERMAL CODUCTITVITY ($mWm^{-1}K^{-1}$)
1	HYDROGEN	20.4	71	100
2	NITROGEN	77.3	809	135
3	HELIUM	4.22	125	18.7
4	OXYGEN	90.2	1141	152
5	CARBON-MONOXIDE	81.7	792	-
6	NEONE	27	1205	113

Why LHC required low temperatures?

 Uses powerful electromagnets to keep its high-energy particles on a circular track.
 To provide the strong fields needed to grip its high energy particles, the LHC electromagnets should be superconductors.
 In this way, the LHC magnets can be powered to very high fields and at minimal cost.

 Most materials which become superconducting only do so at *liquid helium temperatures*.
 The critical current at which LHC is operating depends on temperature.
 To maintain the required high currents, the LHC's electromagnets are cooled down to just 1.9 K, at which temperature helium is a superfluid.

APPLICATIONS

Typical applications of cryogenics are:-

1. Low temperature machining
2. Cooling systems in LHC
3. Cryogenic grinding
4. Biological applications

And many others…

Advantages

- It is relatively simple system.
- Enhanced performance
- Super cooling

Disadvantages

- Hazardous conditions at extremely low temperatures
- High energy is required to achieve low temperature.
- Cost of refrigerant is a considerable issue

THANK YOU

THANK YOU...