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The Future in Cryogenics

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Abstract:- Cryogenics study is very important in future in many ways as people have been working through materials in many ways and gone through struggling path to invent or discover things. So now some thought why not try differently and this idea brought a huge and most beautiful branch into existence which solves some problems astonishingly. I don't say that I am one of them but I want to be like one of them who dived deep to experience the beauty of science. This branch has been in existence from a couple of decades or may be more. This article just gives a pinch of extension to the ocean of cryogenics.

I. INTRODUCTION

Cryogenics is about the behavior of cells, organisms, working of electronic appliances etc at very low temperatures thus making effective use of them. Temperature range in which this is applicable is -100.15 ^{0}Celsius to -273.15 ^{0}Celsius which is generally used in kelvin scale as 173K to absolute zero.

II. RESEARCH ELABORATION

Main branches in cryogenics are-

➢ *Superconductivity*

Superconductivity is a low temperature phenomenon where a metal loses all electrical resistance below a certain temperature called critical temperature.

➢ *Superfluidity*

Superfluidity is a phenomenon which occurs at cryogenic temperatures which is a characteristic of a fluid with zero viscosity without loss of kinetic energy

These branches have wide applications which can be used as supplement in turn reducing usage, making things effective for a better future. It can also be practiced in medicine. However, Cryogenics is regarded with skepticism within the mainstream scientific community and is not part of normal medical practice. We can make tough chambers using cryogenic materials so that it is not damaged by machine parts, long lasting and can be effectively used in many areas.

Cryogenics has a research prospects in the following areas:

- Large scale refrigeration and liquefaction
- Cryogenics for fusion
- Superconducting wires and cables
- Space cryogenics
- Refrigeration and Liquefaction of gases are historically at the root of cryogenics, as they constitute the enabling technology which gave access to the low temperature domain. They have developed over the years along several lines to become a specialized subject, which should deserve a thorough implementation.
- Fusion of hydrogen is under study by mankind for more than 30 years. This study helps in meeting needs of mankind for an alternative source of energy as this results in a lower viscous liquid which can be used as a lubricant in machinery.
- Nb-Ti and Nb3-Sn are well established as commercial superconductors for NMR and MRI. These may also help in devices like high magnetic field testing equipment. Future markets in particle accelerators and fusion reactors drive further developments. The ability to use nitrogen as coolant for conductors such as BI-223 is important for applications like power transmission lines. Further technology improvement, high efficiency and economic viability is very important for this to be successful. According to my study, MgB2 offers potential to satisfy the above conditions instead of a liquid nitrogen cooling which is due to high critical temperature of it.
- Cryogenics play a key role on broad science missions mainly in the domain of cosmology and astrophysics. In fact fusion astrophysics devices need a detector operating between 50mK to 100mK with cryogenic electronic devices. Significant efforts are required to increase the technological and economic viability of such devices.

III. ADVANTAGES

➢ *Space Tech. Applications*

- Cooling of IR sensors, cold probes,
- Rocket Propulsion
- Space simulation chambers

➢ *Mechanical Engineering*

- Cryogenic heat treatment of materials in order to enhance their properties
- Recycling of materials (PVC, Rubber)
- Magnetic Separation (e.g. for enhancing the brightness of kaolin, this is the clay improving the quality of ultra high purity quartz.)

➢ *Superconductivity*

- Super conducting transformer and generator

- Maglev locomotion
- NMR and MRI

➢ *Gas Industry Applications*
- Liquefaction of gases

➢ High Energy Physics:
- ITER
- CERN

IV. DISADVANTAGES

- Handling and storage of cryogenic gases can be dangerous
- Low temperature hazard and oxygen enrichment/deficiency hazard (Asphyxiation)
- Chances of Explosion

V. CONCLUSION

This paper presents basic ideas and principles of cryogenics which if used will be useful for mankind may be now or for the future to make efficiency systems in many area of science and technology, sometimes as an alternative source of energy also. Many other subjects not addressed here also pertain to cryogenic engineering, such as materials at low temperature, storage, handling and transfer of fluids, two-phase flow and discharge, vacuum and leak-tightness technology, instrumentation (in particular thermometry), process control, impurity control and safety.

REFERENCES

[1]. K. Mendelssohn, The quest for absolute zero, 2nd edition, Taylor & Francis, London (1977).
[2]. J. Wilks& D.S. Betts, An introduction to liquid helium, 2nd edition, Oxford Science Publications, Clarendon Press, Oxford (1987).
[3]. cryogenicssociety.org.
[4]. www.journals.elsevier.com.
[5]. www.indian-cryogenics.com.