Cryogenic mediums/media/liquids and gases

Within cryogenics there is a diverse range of liquids that exhibit remarkable properties that have revolutionized various industries. To be considered a cryogenic liquid, these cryogens are in their gas state at normal temperatures but turn into their liquid form once in these dangerously low temperatures. While these cryogenic liquids possess many common traits, it is the subtle differences among them that have a profound impact on their performance in specific applications. The selection of cryogenic liquids involves a comprehensive evaluation of factors such as temperature requirements, physical and chemical properties, safety considerations, cost, purity, and application-specific needs. This process and careful consideration ensure that the selected cryogenic liquid adheres to the unique requirements of the intended application while ensuring safety, efficiency, and economic viability.

Regardless of these characteristics, cryogenic liquids can be classified into three groups. Inert gases that do not exhibit any chemical reactions like burning or combustion. Examples of this are helium, nitrogen, neon, argon and krypton. Flammable gases that are gases produced by cryogenic liquids and can burn in the air are methane, hydrogen and liquefied natural gas. Last is oxygen, materials classified as “non-combustible” will burn when exposed to liquid oxygen. This reaction can be explosive, therefore, hazards and precautions associated with handling liquid oxygen must be considered separately.

Cryogenic Production and Transfer

The liquids used in cryogenic applications all have common properties such as their ability to cool and freeze materials, but each are differentiated on a number of properties such as boiling point, density and specific applications. Comparing these properties of just a few cryogenic liquids will show the slight differences that can make huge impacts on how your application runs. Starting with liquid nitrogen, one of the most common cryogenic liquids. It’s a colorless, tasteless and odorless inert gas with a boiling point of 196 degrees Celsius. Because liquid nitrogen can be extracted from the ambient air, it is relatively environmentally friendly and affordable to use in cryogenic systems. Nitrogen is used to shrink and weld components in the automotive industry, test products in the electronics industry, cool foodstuffs in the food industry, and preserve medicines or biological materials in the pharmaceutical and medical industry.

Helium is a colorless and odorless noble gas that has the lowest boiling point, making it the coldest cryogenic liquid. For helium to maintain its liquid state, a temperature of minus 269 degrees Celsius is required, making helium a great contender for the aerospace industry with such cold deep space temperatures as well as serving as a pressurizer for ground and flight fluid systems. It is also used in the automotive sector for testing components and in diving, together with oxygen, to enable divers to dive deeper by reducing breathing resistance at depth. The electronics industry also uses helium for manufacturing semiconductors and other components, cooling parts rapidly to improve their performance. In the medical field, it is used to capture high-resolution images in magnetic resonance imaging (MRI).

Next up is Hydrogen, a colorless and odorless flammable gas. Hydrogen must be produced from natural gas or water as it does not exist in its pure form naturally. Hydrogen has become an increasingly popular renewable fuel and energy solution. Stored at -252.8 degrees Celsius, liquid hydrogen is used in rocket fuel and space exploration, the process of cooling superconducting magnets and industrial cooling as well as various medical research and labs. Some other increasingly common cryogenic liquids are neon, oxygen, argon and Fluorine.

In summary, while cryogenic liquids share many similarities, it is the nuanced differences among them that make each liquid uniquely suited for specific applications. By carefully considering factors such as boiling point, storage temperature, flammability, and specific gravity, scientists and engineers can harness the power of cryogenics to achieve remarkable advancements in various fields, from medicine and aerospace to energy and materials science.