CO2 CHARACTERISTICS

Pure CO_2 is at ambient pressure and temperature a colorless and, at low concentrations, odorless gas with a density of 1.98 kg/m3, which makes it heavier than air. CO_2 is not very reactive, as it is fully oxidized, and not flammable. Figure 5 shows the pressure-temperature phase diagram of pure CO_2. The axes correspond to the pressure (bara) and temperature (°C). The phase diagram shows the phase boundaries lines between the three phases of solid, liquid, and gaseous CO_2. At a phase boundary two phases will be present at once. CO_2 is at atmospheric pressure and temperature a vapor. At atmospheric pressure the gas deposits directly to the solid state at temperatures below −78 °C and solid CO_2 sublimes directly to gas phase at temperature above −78 °C. The triple point (the combination of pressure and temperature where CO_2 is present in all 3 physical phases) is at 5.2 bara and −56.6 ºC. Liquid CO_2 can only be formed at a pressure and temperature higher than the triple point. The critical point (where liquid and vapor densities become equal and the phase boundary disappears, forming a dense phase) is at a pressure of 72.83 bara and a temperature of 31.1º C. The CO_2 has a relatively low critical pressure with a relatively large density in combination with a low viscosity, which makes pipeline transport under these conditions attractive.

But the density varies heavily with temperature. The Joule-Thompson effect in CO_2 will cause low temperatures to appear at depressurization, which could lead to material embrittlement.

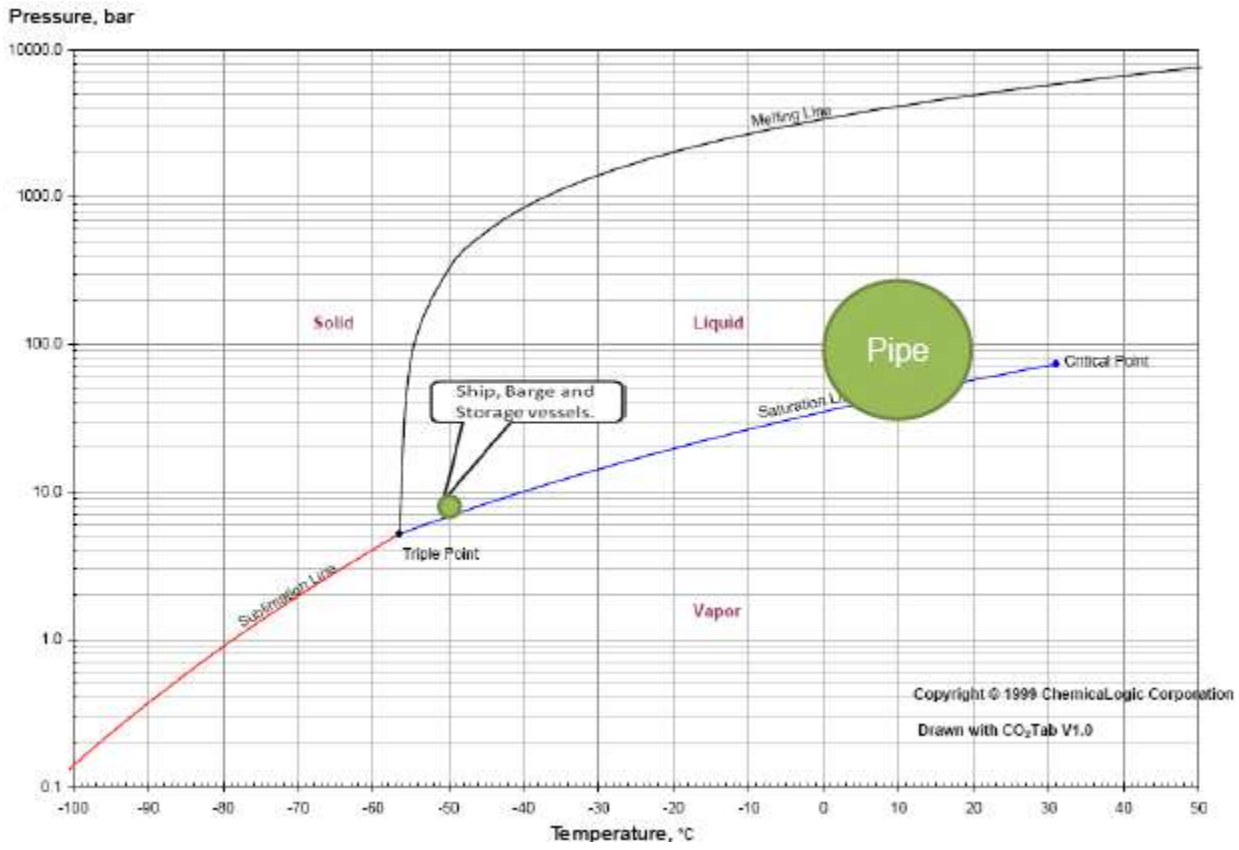

Figure 5: Phase diagram of CO_2

The general operating window of the LLSC (for shipment, pipelines and terminal) is depicted in the phase diagram. The CO_2 process conditions for transport per ship are chosen near the triple point because of the highest density and thereby maximizing the transport capacity.

The CO_2 process conditions for transport per pipeline depends on whether it is a pipeline from the emitter to the terminal or from the terminal to one of the sinks. The most energy efficient phase to transport CO_2 in pipelines is in dense phase condition.

Source: http://hub.globalccsinstitute.com/publications/co2-liquid-logistics-shipping-concept-llsc-safety-health-and-environment-she-report/31