1.9 Supercritical fluids (SCF) - properties and applications

Supercritical fluids have many interesting properties, especially they have unique solvent properties:

- The liquid-like density promotes solubility of many substances in supercritical fluids.
- Simultaneously supercritical fluids show significantly small surface tension, allowing for highly efficient and harmless drying conditions.
- Supercritical fluids although being a fluid provide gas-like viscosity and diffusivity.

Application in science and technology of supercritical fluids include

- Hydrothermal recrystallization of quartz by SC-water
- SC-CO_2: Decaffeination of green coffee beans, extraction of hops for beer production, production of essential oils
- Many SCF are completely miscible with H_2. This leads to much higher concentrations of H_2 compared to conventional solvents which is very useful for hydrogenations.
- SCF have high solvent power to fluorinated compounds, which is very important for polymerization reactions.
- Environmentally acceptable alternative to conventional solvents, so-called "Clean Technology"
- Rapid expansion of SCF solutions leads to precipitation of finely dispersed solids (e.g. non-aggregated NP).

As visible in Fig. 1.4 CO_2 has an easily accessible critical temperature of 31.4°C but at high pressures above 70 atm. The table below shows the critical parameters for several relevant supercritical fluids. So either you have to use extremely low temperatures or extremely high pressures, which explains why supercritical fluids are not used in everyday life.

	p_c/atm	V_c/cm^{3}mol^{-1}	T_c/K	Z_c	T_B/K
Ar	48.0	75.3	150.7	0.292	411.5
CO_2	72.9	94.9	304.2	0.274	714.8
He	2.26	57.8	5.2	0.305	22.64
O_2	50.14	78.0	154.8	0.308	405.9