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Super Critical Fluid Extraction

Skill Course



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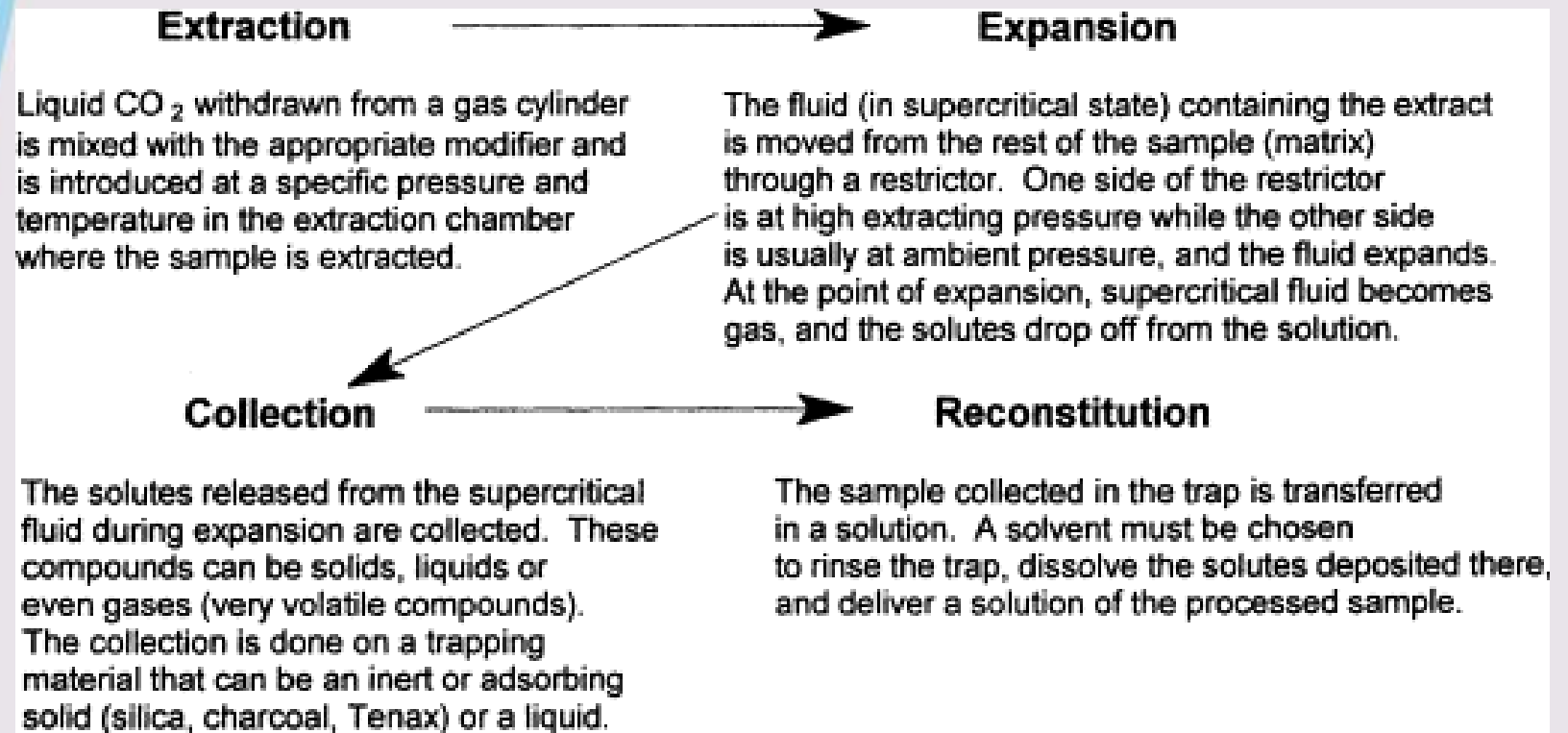
1. Principle of SCFE
2. Instrumentation



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Main functions performed in the SFE process

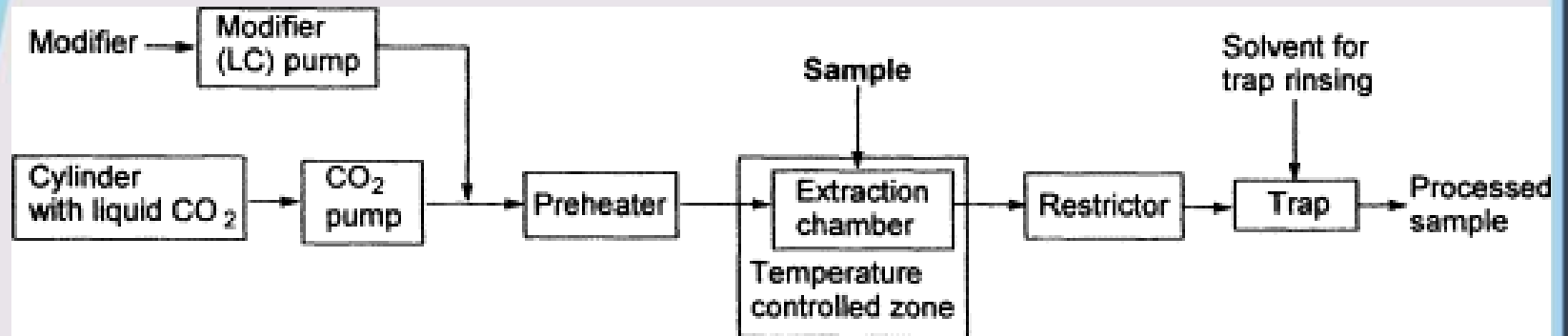




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Flow diagram of the SFE process



SCFE Systems



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- ❖ Supercritical Fluid Extraction (SCFE) Systems extract chemical compounds using supercritical carbon dioxide instead of an organic solvent.
- ❖ The supercritical fluid state occurs when a fluid is above its critical temperature (T_c) and critical pressure (P_c), when it is between the typical gas and liquid state.
- ❖ Manipulating the temperature and pressure of the fluid can solubilize the material of interest and selectively extract it.

SCF Systems



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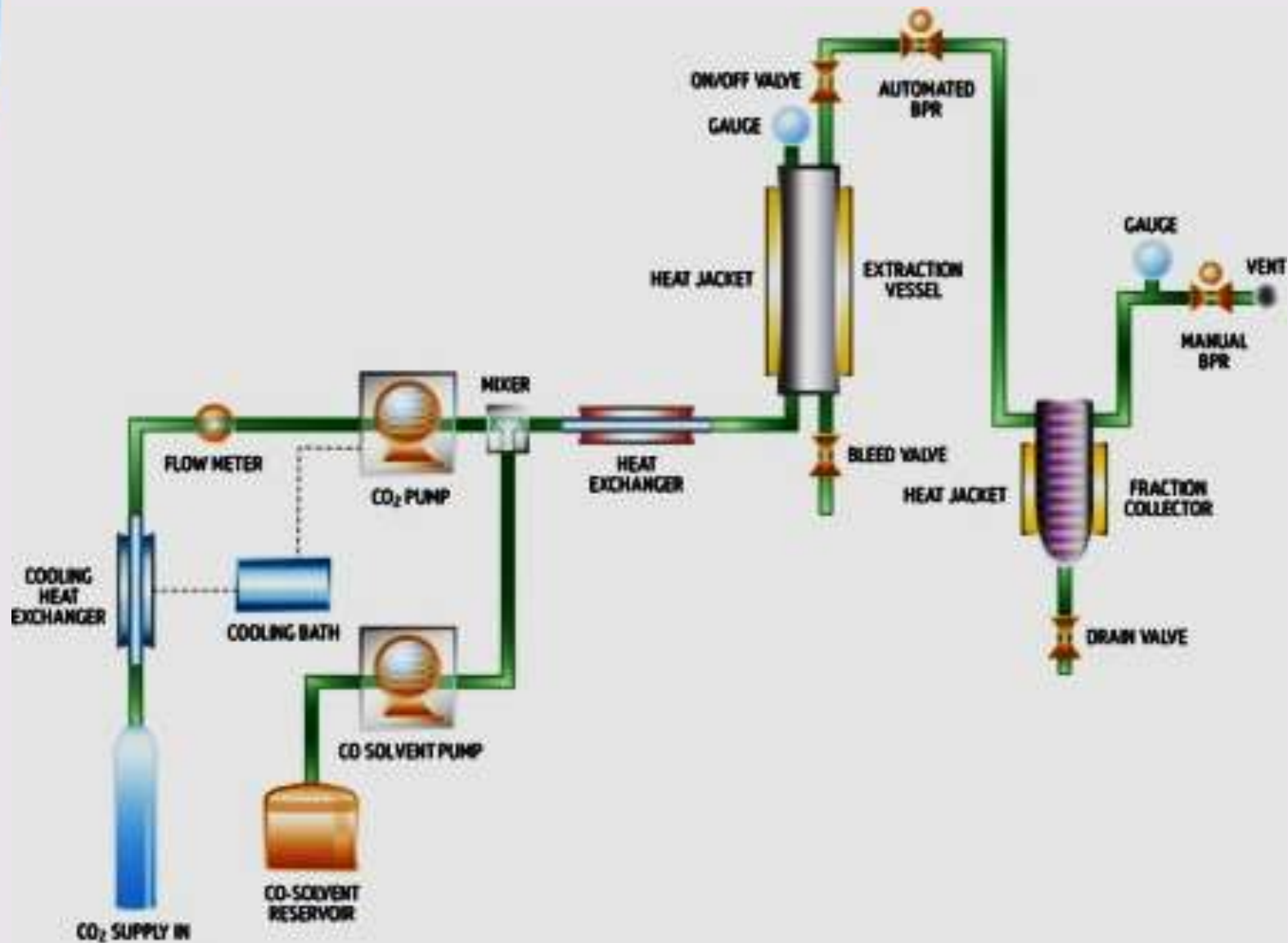
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- ❖ The sample is placed in an extraction vessel and pressurized with CO_2 to dissolve the sample.
- ❖ Transferred to a fraction collector, the contents are depressurized and the CO_2 loses its solvating power causing the desired material to precipitate.
- ❖ The condensed CO_2 can be recycled.



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Components of a commercial SCFE plant

- **Extractors**
- **Separators**
- **CO₂ hold-up tank**
- **Heat exchangers**

The extraction process works in a closed loop with constant circulation of CO₂ in the system. It is a semi-batch operation with typical batch time of 2 to 4 hours.



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Hold up tank and heat exchanger

- CO₂ is liquefied and fed to the hold-up tank through a heat exchanger (Condenser).
- Liquid CO₂ is then fed to the high-pressure metering pump, through a heat exchanger (sub-cooler) to ensure supply of CO₂ in liquid form.
- Supercritical temperature is achieved by heating the high-pressure liquid from the pump discharge in a heat exchanger (pre-heater).
- A small quantity of other solvents such as water, ethanol etc. can be added in to the CO₂ stream through an entrainer pump.

Extractor



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- This supercritical fluid then flows through the extractors containing raw material powder.
- The raw material powder, to be extracted is placed in these extractors with help of perforated baskets.
- Extractors are equipped with specially designed quick acting closures for easy and fast opening.
- The supercritical CO₂ with dissolved extract then flows to separators.

Separator



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- In the separators, lower temperature and pressure conditions are maintained for recovery of the extract from the CO₂ stream.
- Thus with proper selection of conditions, fractionation of extract can be achieved by using two separators operating in series.
- Separator-1 is maintained at supercritical conditions, where typically high molecular weight components of the extract precipitate.
- Whereas in separator-2 sub-critical conditions are maintained for complete recovery of any extract from CO₂ stream.
- The CO₂ vapor leaving separator-2 is condensed and fed back to CO₂ hold-up tank.