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Super Critical Fluid Extraction

Skill Course



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SCFE applications

in the food, pharmaceutical, and fine chemical industries

- Decaffeinating of coffee and tea
- Extraction of essential oils (vegetable and fish oils)
- Extraction of flavors from natural resources (nutraceuticals)
- Extraction of ingredients from spices and red peppers
- Extraction of fat from food products
- Fractionation of polymeric materials
- Extraction from natural products
- Photo–resist cleaning
- Precision part cleaning



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Supercritical Solvent

(pass through)



Solids



Dissolves solute



Extract



Raffinate (**SC solvent**)



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Extraction modes:

At small scale,
solid samples can be extracted in

1. **Static mode** *or*
2. **Dynamic modes** *or*
3. In a **combination of both**.

Under **static conditions**, the supercritical fluid is introduced in the extraction vessel and is kept in contact with the sample for a given extraction time. Once the desired time is achieved, the extract is released through the pressure restrictor to the trapping vessel.

In a **dynamic process**, the supercritical fluid continuously enters the extraction vessel and flows through the sample to the separators for a cascade fractionation.

In the **combined mode**, a static extraction is performed for a period of time, and subsequently a dynamic extraction is carried out.

Medium and large scale SFE are carried out in dynamic conditions



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Modes of SCFE

Static Extraction Mode

- Steady state
- Sample matrix is soaked in a fixed amount of supercritical fluid

Dynamic Extraction Mode

- Non-steady state
- Supercritical fluid continuously passes through the sample matrix



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Advantages of SCFE

- Complete separation of solvent from extract and raffinate
- Continuous process
- Low handling cost
- Solvent recovery is easy
- Versatile and efficient (use of co-solvents and co-solutes)



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Limitations of SCFE

- Prolonged time (penetration of SCF into the interior of a solid is rapid, but solute diffusion from the solid into the SCF).
- Modeling is inaccurate
- Scale is not possible (due to absence of fundamental, molecular-based model of solutes in SCF)
- Expensive
- Consistency & reproducibility may vary in continuous production



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Precautions

- ❖ Adequate contact time (for penetration of solvent into solid particles and diffusion of solute from inside the solid particles to solvent).
- ❖ Equilibrium should be achieved (i.e. proper flow of solvent such that concentration of dissolved solutes in the solvent phase will be below the solubility of solute in solvent)