EXTRACTION TECHNIQUES

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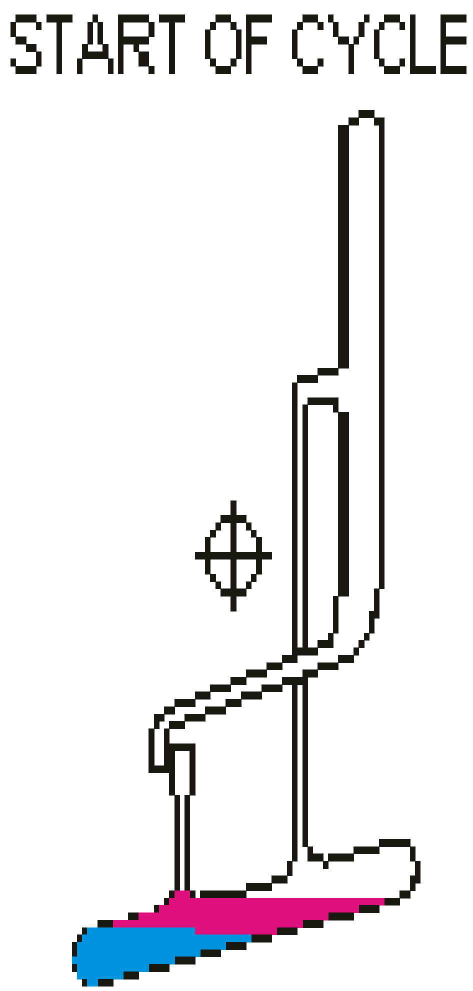
Counter-current extraction(principle)

- In Counter-current extraction, wet raw material ispulverized using toothed isc disintegrators to produce a fine slurry.
- Int his process, the material to be extracted is moved in one direction(generally in the form of a fine slurry) within a cylindrical extractor where it comes in contact with extractionsolvent.
- The further the starting material moves, the more concentrated the extract becomes.
- completed extraction is thus possible when the quantities of solvent and material and their flow rates are optimized.
- The process is highly efficient, requiring little time and posing no risk from high temperature.
- Finally ,sufficient concentrated extract comes out at one end of the extractor while the marc(practically free of visible solvent) falls out from the other end.

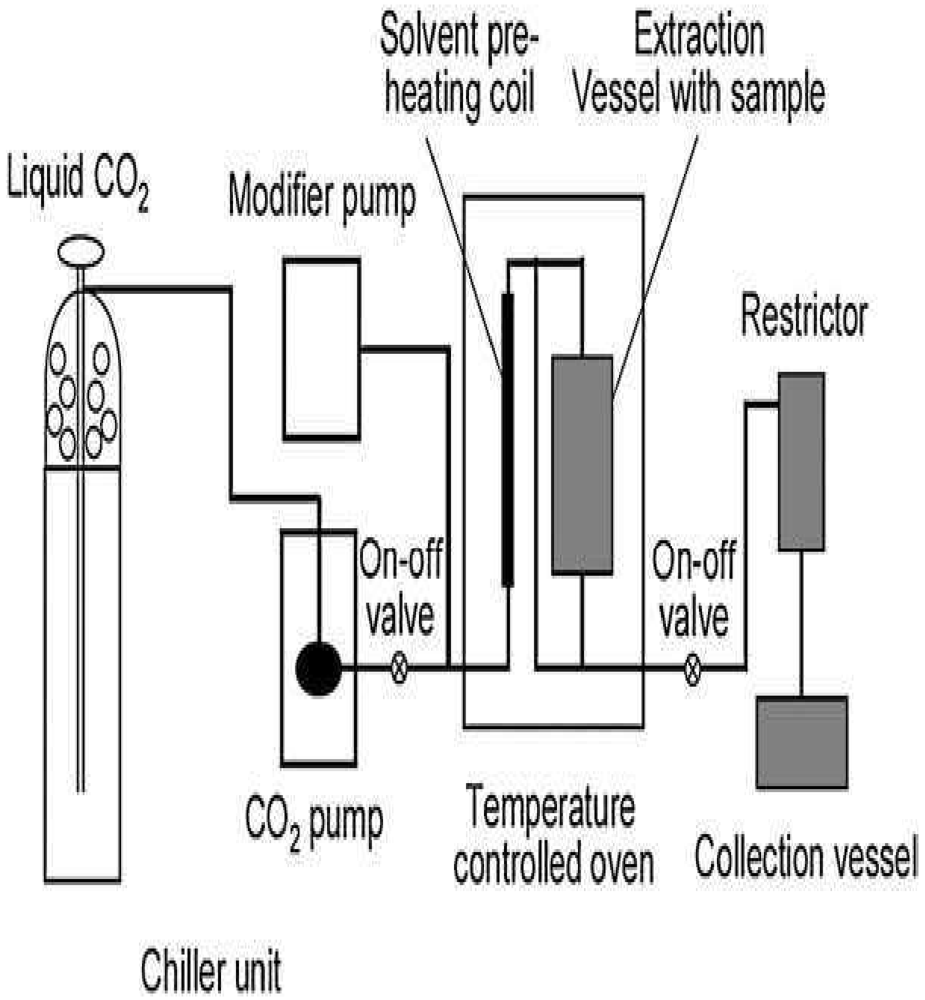


Application

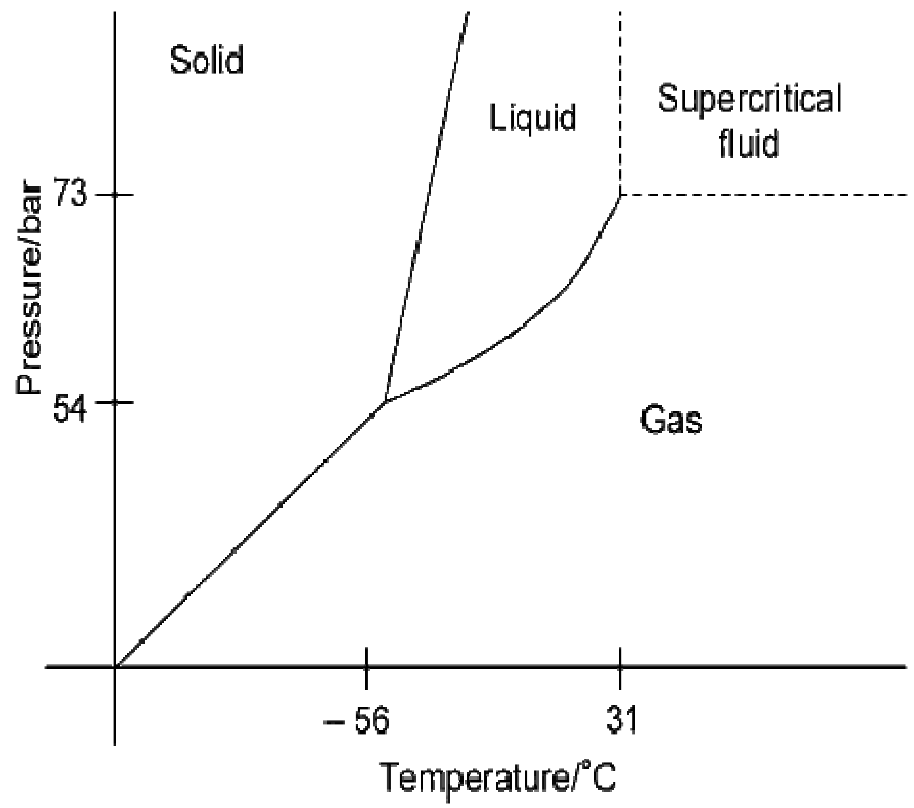
- 1) Oil is to be extracted from soya beans in a counter current stage-contact extraction apparatus, using hexane.
- 2) application have been concerned with the purification and separaion of organic or biochemical compound.
- 3)application in inorganic chemistry seem to confined to separation of the radio-nuclides and a new techniques for the determination of trace elements in geological material.

Supercritical Fluid Extraction (SFE) (principle)

- Supercritical Fluid Extraction (SFE) **is an alteranative** sample preparation method with general goals of reduced use of organic solvents and increase sample throughput.
- The factors to consider include temperature , pressure, sample volume, analyte colletion, modifier(co- solvent) adddition,flow and pressure control, and restrictors.
- Generally, cylindrical extraction vessels are used for SFE and their perfomance is good beyond any doubt.
- The collection of the extracted analyte following SFE is another important step: significant analyte loss can occur during this step, leading the analyst to believe that the actual efficiency was poor.



- Therec are many advantages to the use of CO_2 as the extracting fluid.
- In addition to its favorable physical properties, carbon dioxide is inexpensive, safe and abundant.
- but while carbon dioxide is the preferred fluid for SFE, it possesses several polarity limitations.
- Solvent polarity is important when extracting polar solutes and when strong analyte-matrix interaction are present.
- Organic solvent are frequently added to the carbon dioxide extracting fluid to alleviatw the polarity limitation.
- carbon dioxide, argon is being useds because it is inexpensive and more inert.
- The compounent recovery rates generally increase with increasing pressure or temperature: the highest recovery rates in case of argon are obtained at 500 atm and 150°c



Application

- SFE finds expensive application in the extraction of pesticides
- Environmental samples
- Food and fragrances
- Essential oils
- Polymers and natural product
- Commercial application of the extraction process is its prohibitive capital investment

Solid-phase extraction (SPE) (principle)

- Solid-phase extraction (SPE) is a sample preparation process by which compounds that are dissolved or suspended in a liquid mixture are separated from other compounds in the mixture according to their physical and chemical properties.
- Analytical laboratories use solid phase extractionto concentrate and purify samples for analysis.
- Solid phase extraction can be used to isolate analytes of interest from a wide variety of matrices, including urine, blood, water, beverages, soil, and animal tissue

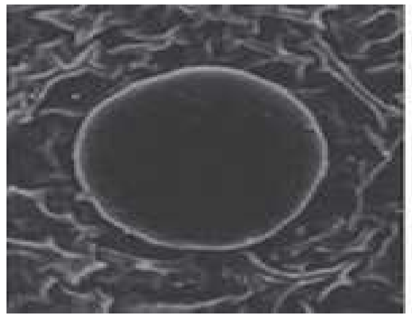
- The result is that either the desired analytes of interest or undesired impurities in the sample are retained on the stationary phase.
- The portion that passes through the stationary phase is collected or discarded, depending on whether it contains the desired analytes or undesired impurities.
- If the portion retained on the stationary phase includes the desired analytes, they can then be removed from the stationary phase for collection in an additional step, in which the stationary phase is rinsed with an appropriate eluent
- SPE uses the affinity of solutes dissolved or suspended in a liquid (known as the mobile phase) for a solid through which the sample is passed (known as the stationary phase) to separate a mixture into desired and undesired components. .

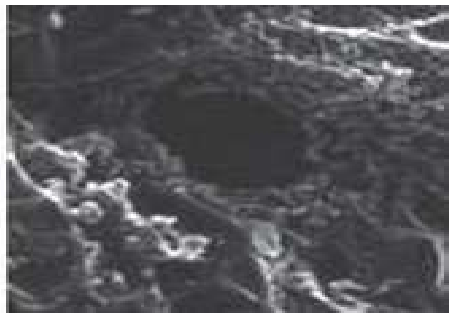
Application

- Technique for extraction orpurification.
- Solid phase extraction procedures are used not only to extract traces of organic compound from environmental samples
- application of solid phase extraction technique in analysis of different compounds in various matrices.

Microwave-assisted extraction (principle)

- This thermal effect is practically in stantaneous at the molecular level but limited to a small area and depth near the surface of the material.
- Microwave radion interects with dipole of polar and polarizable materials.
- The couple forces of electric and magnetic components change direction ripidly. Polar molecules try to orient in the changing field direction and hence get heated.
- In non-polar solvents without polarizable groups, the heating is poor(dielectric absoption only because of atomic and electronic polarizations).





- The rest of the material is heated byconduction.
- Thus, large oparticle or agglomerates of small particles can not be heated uniformly, which is a majordrawback of microwave heating.
- It may be possible to use high power sources to increase the depth of penetration.
- However, microwave radiation exhibits an exponential decay once inside a microwave-absorbing solid.

Application

- Pesticide analyses
- Isolation of important in pharmaceutical compounds
- Extraction of virtually all compounds from all matrices.
- The application of microwave assisted extraction process for isolation and extraction of phytoconstituents from plant material

Ultrasound etraction(sonication) (principle)

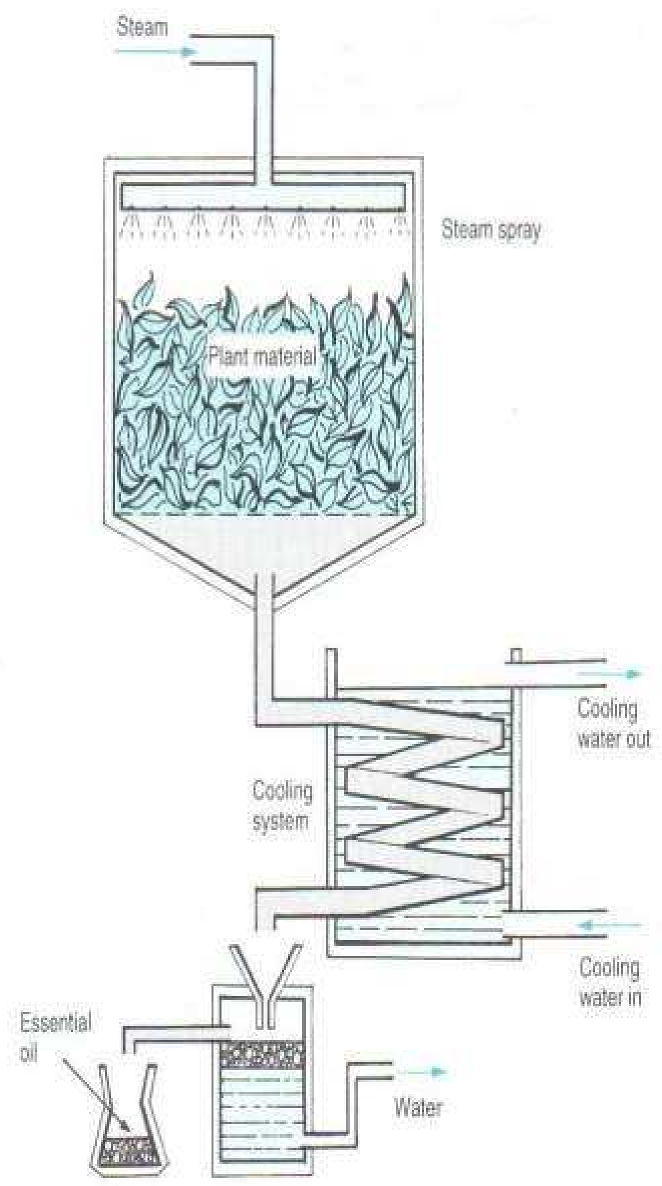
- The procedure involves the use of ultrasound with frequencies ranging from 20 khz; this increases the permeability of cell walls and produces cavitation.
- Athough the process is useful in some cases like etraction of rruwolfia root, its large-sclae application is limited due to the higher costs.
- One disadvantages of the procedure is the occasional but known deterious effect of ultrasound energy(more than 20 khz) on the active constituents of medical plants through formation of free radicals and consequently undesirable changes in the drug molecules.

Applications

- Sonication can be used for the production of nanoparticles, such as nanoemulsions, nanocrystals, liposomes and wax emulsions, as well as for wastewater purification
- extraction of plant oil
- production of biofuels
- crude oil desulphurization, cell disruption,
- polymer and epoxy processing, adhesive thinning, and many other processes.
- It is applied in pharmaceutical, cosmetic, water, food, ink, paint, coating, wood treatment, metalworking, nanocomposite, pesticide, fuel, wood product and many other industries.
- Sonication can also be used to initiate crystallisation processes and even control polymorphic crystallisations.
- It is used to intervene in anti-solvent precipitations (crystallisation) to aid mixing and isolate small crystals.

Phytonics Process (principle)

- A new solvent based on hydrofluorocarbon-134a and a new technology to optimize its remarkable properties in the extraction of plant materials offer significant environmental advantages and health and safety benefits over traditional processes for the production of high quality natural fragrant oils, flavors and biological extracts.
- Advanced Phytonics Limited (Manchester, UK) has developed this patented technology termed "phytonics process".
- The products mostly extracted by this process are fragrant components of essential oils and biological or phytopharmacological extracts which can be used directly without further physical or chemical treatment.



- The properties of the new generation of fluorocarbon solventshave been applied to the extraction of plant materials.
- The core of the solventis 1,1,2,2-tetrafluoroethane, better known as hydrofluorocarbon-134a(HFC-134a). This product was developed as a replacement for chlorofluorocarbons.The boiling point of this solvent is -25° C.
- It is not flammable ortoxic.
- Unlike chlorofluorocarbons, it does not deplete the ozone layer. It hasa vapor pressure of 5.6 bar at ambient temperature. By most standards thisis a poor solvent. For example, it does not mix with mineral oils or triglyceridesand it does not dissolve plant wastes.

- The process is advantageous in that the solvents can be customized:by using modified solvents with HFC-134a, the process can bemade highly selective in extracting a specific class of phytoconstituents.
- Similarly, other modified solvents can be used to extract a broader spectrumof components.
- The biological products made by this process have extremelylow residual solvent.
- The residuals are invariably less than 20 parts perbillion and are frequently below levels of detection.
- These solvents are neitheracidic nor alkaline and, therefore, have only minimal potential reactioneffects on the botanical materials.

- The processing plant is totally sealedso that the solvents are continually recycled and fully recovered at the endof each production cycle. The only utility needed to operate these systemsis electricity and, even then, they do no consume much energy.
- There is noscope for the escape of the solvents.
- Even if some solvents do escape, theycontain no chlorine and therefore pose no threat to the ozone layer.
- Thewaste biomass from these plants is dry and “eco-friendly” to handle.

Applications

- The phytonics process can be used for extraction in biotechnology(e.g for the production of antibiotics), in the herbal drug industry, in thefood, essential oil and flavor industries, and in the production of other pharmacologicallyactive products.
- In particular, it is used in the production of topqualitypharmaceutical-grade extracts, pharmacologically active intermediates,antibiotic extracts and phytopharmaceuticals.
- However, the fact that it is usedin all these areas in no way prevents its use in other areas.

- The technique isbeing used in the extraction of high-quality essential oils, oleoresins, naturalfood colours, flavors and aromatic oils from all manner of plant materials.
- The technique is also used in refining crude products obtained from other extractionprocesses.
- It provides extraction without waxes or other contaminants. Ithelps remove many biocides from contaminated biomass.