SOLVENT EXTRACTION

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OUTLINE

- What is Solvent Extraction ?
- Application
- Solvent Extraction Method

INTRODUCTION

- Solvent extraction is a method for separating a substance from one or more others by using a solvent.
- It involves contacting the original mixture(feed) which contains one or more of desired components(solutes) with a second liquid(solvent) which is immiscible or partially immiscible with the original solution.

APPLICATION

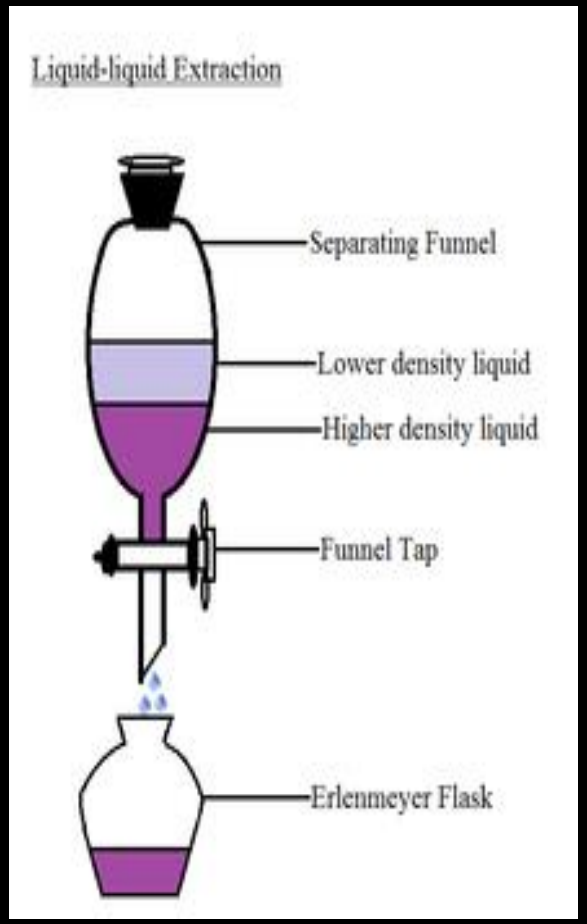
FEED	SOLVENT	SOLUTE
Petroleum fractions in boiling range from kerosene to lubricating oil	Liquid Sulphur dioxide	Aromatics and Sulphur containing compounds
Petroleum stocks of wide boiling range	A mixture of diethylene glycol and water	High purity aromatics benzene toluene and xylenes
Coke oven oil	Diethylene glycol water	aromatics
Gas liquor	benzene	phenols
Vegetables oil and animal fats	propane	Unsaturated glycerides and vitamins
Soyabean meal and fermented beer	butanol	bacitracin

SOLVENT EXTRACTION METHOD

1. Liquid-liquid extraction

- method to separate compounds based on their relative solubilities in two different immiscible liquids, usually water and an organic solvent.
- It is an extraction of a substance from one liquid into another liquid phase
- Liquid–liquid extraction is a basic technique in chemical laboratories, where it is performed using a variety of apparatus, from separatory funnels to countercurrent distribution equipment.
- Volatile solvents such as hexane, benzene, ether, ethyl acetate, and dichloromethane are usually used for the extraction of semi-volatile compounds from water.

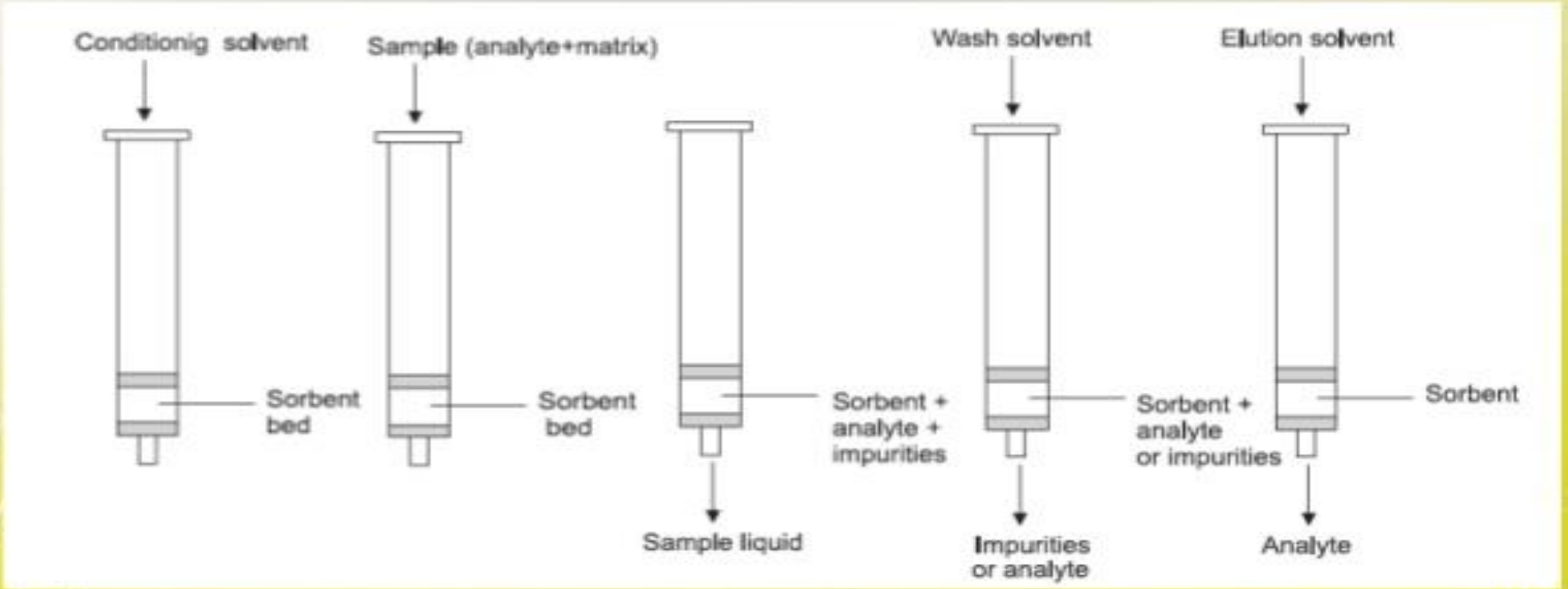
- Extraction is commonly achieved by shaking the water sample and solvent in a separating funnel.
- However, occasionally large amounts of emulsion are formed, and it is difficult to separate the solvent from the aqueous phase.
- Continuous liquid-liquid extraction methods repeatedly circulate solvent in special glassware but, although this method has good extraction efficiency, it is not suitable for thermally unstable compounds because the extraction time is long.



2.Solid-Phase Extraction (SPE)

- Solid phase extraction (SPE) is a more rapid, modern alternative to liquid-liquid extraction.
- Analytical laboratories use solid phase extraction to 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.
- 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.

SPE procedure

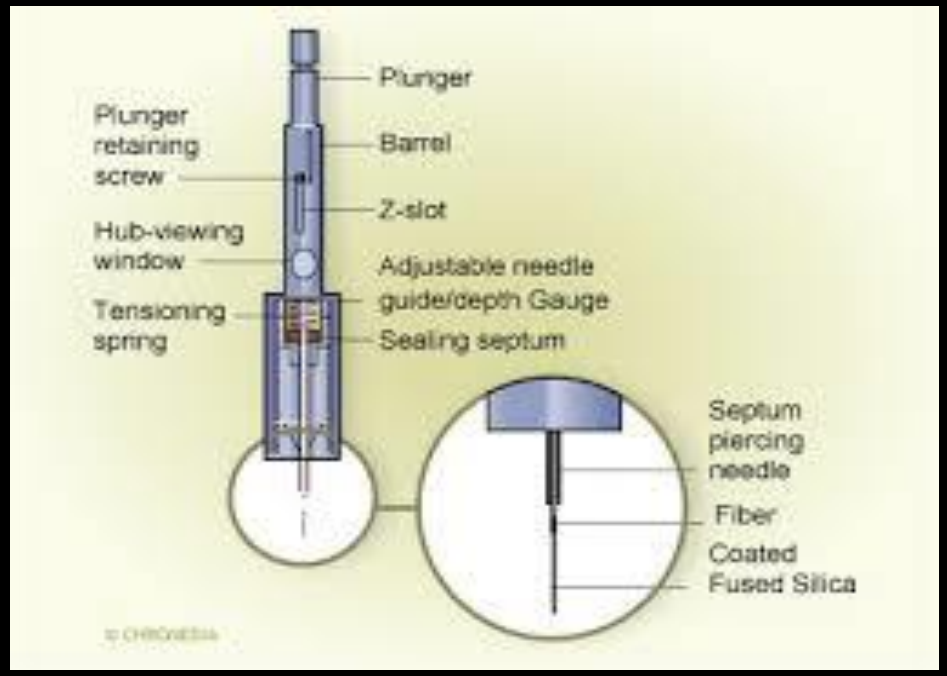


Disadvantages :

- Although solvent use is small, the solvent flow rate affects the recovery rate.
- For samples which include suspended solid (SS), it is necessary to separate SS composition.
- For samples which are heavily contaminated, it is possible to get analyte break through.

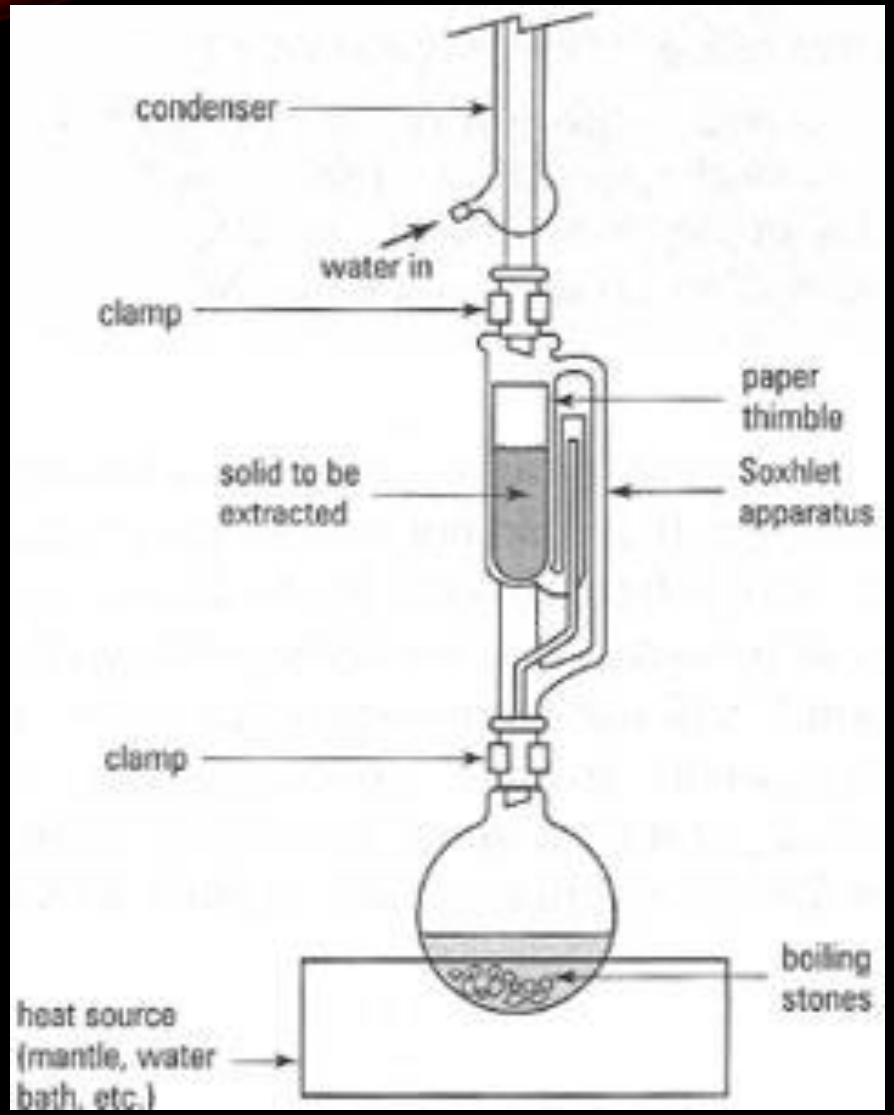
3. **Solid phase microextraction (SPME)**

- A solid phase extraction sampling technique that involves the use of a fiber coated with an extracting phase, that can be a liquid (polymer) or a solid (sorbent), which extracts different kinds of analytes (including both volatile and non-volatile) from different kinds of media, that can be in liquid or gas phase.



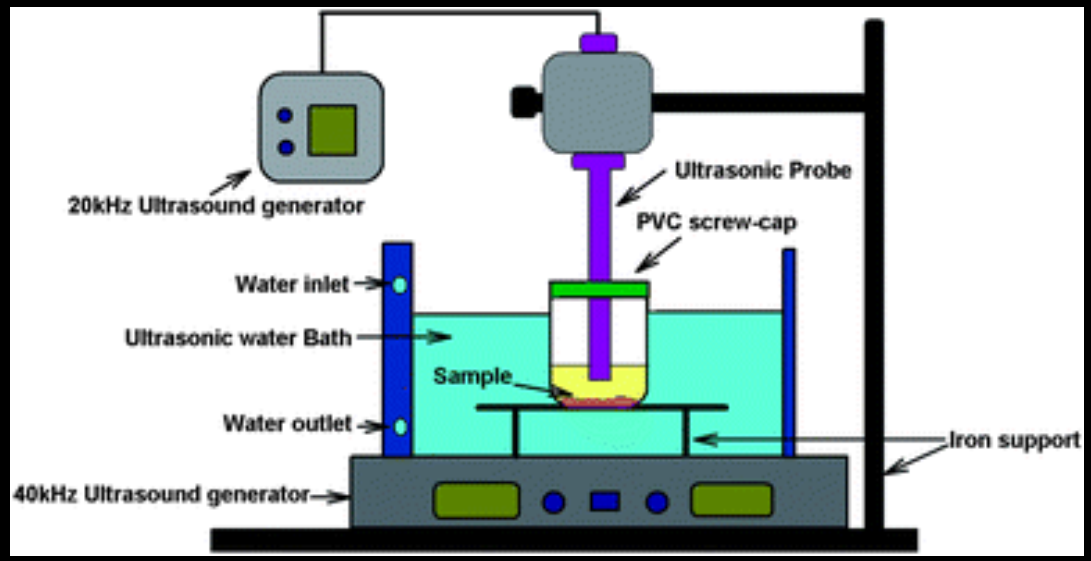
4. Soxhlet extraction

- It was originally designed for the extraction of a lipid from a solid material.
- This is the most common method for extraction of organic compounds from solid samples, and is used as an extraction rate standard for the newly developed extraction method known as supercritical fluid extraction.
- Non-polar solvents such as benzene or dichloromethane, polar solvents such as methanol, or mixtures of polar and non-polar solvents whose boiling points are close to those of ethanol / benzene, or acetone / hexane are used.
- However, soxhlet extraction takes long time to get high extraction efficiency, and is not suitable for organic compounds which are thermally unstable.


condenser
water in
clamp
paper thimble
solid to be extracted
Soxhlet apparatus
clamp
boiling stones
heat source (mantle, water bath, etc.)

5.Ultrasonic extraction

- Ultrasonic extraction uses ultrasonic vibrations to extract samples with polar solvents in an ultrasonic bath.
- This is often used for chemical extraction from solid samples because it’s simple.
- removal and recovery of organic analytes from a permeable solid matrix by means of a solvent which is energized by sound energy at frequencies in excess of those audible to the human ear.



6.Purge and Trap Method (P&T)

- This method, also known as the dynamic headspace method, removes (separates) volatile compounds from the sample matrix (in this case, water) by passing an inert gas such as helium or nitrogen through the matrix (purging).
- The target, volatile compounds are desorbed from the aqueous phase to the gas phase (purged) and are then separated from the stream of gas (trapped) by adsorbent filters.
- The adsorbent material is then heated in a stream of carrier gas (usually pure helium).

7. Headspace method (HS)

- Also known as the static headspace method, this method is less sensitive (ppb level) compared to the purge & trap method, but operation is simple, easily automated.
- The sample is placed in a sealed container, and left at a constant temperature until the gas and liquid phase are in equilibrium.
- The target substances in the gas phase (headspace) are collected by gas tight syringe.
- Calibration curve are made by dissolving the target chemicals in purified water, and then treated in the same manner.
- However, the air-liquid phase equilibrium is very much affected by matrix in which the sample is dissolved, so in a lot of cases standards dissolved in purified water might not be appropriate surrogates from which to prepare calibration curves.
- For example, it is easy to analyse fatty acids in alkaline solution, if first the solution containing the fatty acids is acidified by sulfuric acid.

References

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