How ILE works

Immobilized Liquid Extraction (ILE) is a form of liquid/liquid extraction where the "organic" phase is immobilized on a surface. This surface may be the inside of an autosampler vial, the inside surface of a bottle or vial cap, the inside surface of a disposable pipette or tip, or a number of other possibilities. The "organic" phase, or sorptive coating, is typically a non-extractable homogeneous elastomer that is above its glass transition temperature (T_g) into which targeted analyte(s) dissolve. The most commonly used hydrophobic elastomer is polydimethylsiloxane (PDMS), although fluoro, phenyl and cyano siloxanes may add selectivity to the extraction process.

In ILE, the "organic" phase extracts the target compounds by exposing an aqueous matrix to the immobilized liquid phase. A simple example of an ILE extraction consists of placing an ILE cap on a bottle or vial containing an aqueous sample. The vessel is agitated such that the cap comes in contact with the aqueous liquid. Agitation can be provided by a wrist shaker, sonicator or a number of other methods. Upon completion of the extraction, the cap, which now contains the analyte(s), is removed and placed on a vial containing a small amount of solvent. The analytes are then "back-extracted" into the solvent, thus completing the sample preparation process.

ILE shares many of its fundamental principles with LLE, SPME and SBSE. The extraction is performed by an equilibrium process that depends on the analyte's partition ratio between the aqueous phase and the immobilized organic phase ($K_{PDMS\ /\ W}$), and on the phase ratio (?).

The partition ratio, $K_{PDMS\ /\ W}$, is defined as the quotient of the concentration of the analyte in the sorbent by the concentration of the analyte in the aqueous phase at equilibrium:

The phase ratio, ?, is defined as the quotient of the volume of the aqueous phase by the volume of the sorbent:

From only the phase ratio and partition ratio values, one can easily calculate expected extraction efficiency.

$$K_{PDMS/W} = \frac{C_{PDMS}}{C_{water}} \qquad K_{PDMS/W} \simeq K_{O/W}$$

$$\beta = \frac{V_{water}}{V_{PDMS}}$$

$$\%\mathrm{Recovery} = 100 \cdot \frac{\frac{K_{PDMS}}{\beta}}{1 + \frac{K_{PDMS}}{\beta}}$$

Note: It has been shown that the partition ratio for PDMS/Water is approximately equal to the partition ratio for octanol/water, hence one can estimate extraction efficiency using published data.