Solute, mobile phase, stationary phase

Sample

Solvent

Mobile phase

Eluent

Packed column

Packing is stationary phase.

A + B

Solute (analytes to be separated)

A

B

A

B

A

A

Deterior

Signal

Time or volume

Affinity of A to the stationary phase > that of B

Chromatogram (recorded signal)
<table>
<thead>
<tr>
<th>Classification</th>
<th>Specific Method</th>
<th>Stationary Phase</th>
<th>Type of equilibrium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid chromatography (LC) (Mobile phase a liquid)</td>
<td>Liquid-liquid or partition</td>
<td>Liquid adsorbed onto solid</td>
<td>Partition between immiscible liquids</td>
</tr>
<tr>
<td></td>
<td>Liquid-bonded phase</td>
<td>Organic species bonded to solid surface</td>
<td>Partition between liquid and bonded surface</td>
</tr>
<tr>
<td></td>
<td>Liquid-solid, or adsorption</td>
<td>Solid</td>
<td>Adsorption</td>
</tr>
<tr>
<td>Ion exchange</td>
<td>Ion-exchange resin</td>
<td></td>
<td>Ion exchange</td>
</tr>
<tr>
<td>Size exclusion</td>
<td>Interstices of polymeric solid</td>
<td></td>
<td>Partition/sieving</td>
</tr>
<tr>
<td>Gas chromatography (GC) (Mobile phase a gas)</td>
<td>Gas-liquid</td>
<td>Liquid adsorbed onto solid</td>
<td>Partition between gas and liquid</td>
</tr>
<tr>
<td></td>
<td>Gas-bonded phase</td>
<td>Organic species bonded to solid surface</td>
<td>Partition between gas and bonded liquid</td>
</tr>
<tr>
<td></td>
<td>Gas-solid</td>
<td>Solid</td>
<td>Adsorption</td>
</tr>
<tr>
<td>Supercritical-fluid chromatog. (SFC) (mobile phase a supercritical fluid)</td>
<td>Organic species bonded to solid surface</td>
<td></td>
<td>Partition between supercritical fluid and bonded surface</td>
</tr>
</tbody>
</table>
1. Adsorption chromatography

Solute adsorbed on surface of stationary phase

2. Partition chromatography

Solute dissolved in liquid phase coated on surface of solid support

3. Ion-exchange chromatography

Mobile anions held near cations that are covalently attached to stationary phase

Anion-exchange resin; only anions can be attracted to it

Small molecules penetrate pores of particles

Large molecules are excluded

4. Molecular exclusion chromatography

One kind of molecule in complex mixture becomes attached to molecule that is covalently bound to stationary phase

5. Affinity chromatography

All other molecules simply wash through
The relative retention for two compounds in gas chromatography is 1.068 on a column with a plate height of 0.520 mm. The capacity factor for compound 1 is 5.16.

(a) What length of column will separate the compounds with a resolution of 1.00?

(b) The unretained peak time on the column is 2.00 min. If the number of plates is the same for both compounds, find the retention times and widths of each peak.

**SUMMARY OF CHROMATOGRAPHIC EQUATIONS.**

Adjusted retention time \[ t'_R = t_R - t_w \]

Capacity factor (or Capacity ratio) \[ k' = \frac{t_{R1}'}{t_w} \]

Selectivity coefficient (or Relative retention) \[ a = \frac{t_{R2}'}{t_{R1}'} = \frac{k_{2}'}{k_{1}'} \]

Efficiency (No. of plates) \[ N = 16 \frac{t_R^2}{w^2} = 5.54 \frac{t_{R1/2}^2}{w_{1/2}^2} \]

Plate height \[ HETP = \frac{L}{N} \]

Resolution \[ \text{Resolution} = \frac{\Delta t_R}{w_{av}} \]

\[ \text{Resolution} = \frac{\sqrt{N}}{4} \left( \frac{a-1}{a} \right) \left( \frac{k_{2}'}{1+k_{av}'} \right) \]