Chromatographic Figures of Merit

Agilent Technologies
In This Section, We Will Discuss:

- The relevance and use of capacity factor
- The calculation of efficiency or plate number
- How to calculate the resolution between two chromatographic peaks
- Peak symmetry

NOTE: You will need a hard copy of the chromatogram and report from the last laboratory exercise.
Capacity Factor and Relative Retention

- **Capacity factor** is characteristic of a specific compound at a given mobile phase composition, temperature, and column type.
- **Capacity factor** is equal to the number of moles in the stationary phase divided by the number of moles in the mobile phase.

\[
k' = \frac{t_R - t_o}{t_o}
\]

\[
t'_R = t_R - t_o
\]
Calculate Capacity Factor

Capacity Factor is independent of flow rate making day-to-day fluctuations less troublesome.

Calculate the capacity factor for the third major peak in your chromatogram.
Resolution

For equal peak areas, $R$ of 1.5 gives baseline separation.
Calculate Resolution

R - resolution

t_{RB} - retention time of component B

t_{RA} - retention time of component A

w - width at base of peak

w_{1/2} - width at half-height

R = 2 \left( \frac{t_{RB} - t_{RA}}{W_A + W_B} \right)

R = 1.176 \left( \frac{t_{RB} - t_{RA}}{W_{1/2A} + W_{1/2B}} \right)

Calculate the resolution between the 2nd and 3rd chromatographic peaks.
Efficiency

Detector Response

Inject

Time

Low Efficiency

High Efficiency
Calculate Efficiency

Calculate the efficiency of the fourth peak.

\[ N = 16 \left( \frac{t_R}{W_B} \right)^2 = 5.54 \left( \frac{t_R}{W_{1/2}} \right)^2 = 2 \pi \left( \frac{hp_{tr}}{A} \right)^2 \]

\[ \text{HETP} = \frac{L}{N} \]

N: Efficiency
HETP: Height Equivalent to a Theoretical Plate
L: Column Length
hp: Peak Height
A: Peak Area
Peak Symmetry

\[ S = \frac{B}{A} \]

- Excellent: \( S = 1.0 - 1.05 \)
- Acceptable: \( S = 1.2 \)
- Unacceptable: \( S = 2 \)
- Awful: \( S = 4 \)
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These calculations can be done automatically by your ChemStation:

- Select a System Suitability (Performance) report style
- Perform a Sequence Summary Report