INTERNAL STANDARDS

SDSU CHEM 251

INTERNAL STANDARDS

- **External standards** and **standard addition** work well when all solutions can be treated equally throughout the preparation and analysis.

- **Internal standards** are required when the solution may change during preparation/analysis (e.g. solvent evaporation) impacting the concentration of the analyte measured.

- By including a known standard into the solution containing the sample changes in the solution can be compensated for.

INTERNAL STANDARDS

- A single internal standard does not require the knowledge of the sensitivity of the signal for both the analyte and internal standard.
- The relationship between the concentrations of the internal standard and the analyte and their signals can be established as a ratio (*K*) of their sensitivities.

$$S_A = k_A C_A$$

$$S_{IS} = k_{IS} C_{IS}$$

$$\frac{S_A}{S_{IS}} = \frac{k_A C_A}{k_{IS} C_{IS}} = K \times \frac{C_A}{C_{IS}}$$

$$K = \left(\frac{C_{IS}}{C_A}\right)_{std} \times \left(\frac{S_A}{S_{IS}}\right)_{std}$$

$$C_A = \frac{C_{IS}}{K} \times \left(\frac{S_A}{S_{IS}}\right)_{samp}$$

MULTIPLE INTERNAL STANDARDS

- Single point internal standards are just as limited as other single point calibrations, therefore it is preferable to do multiple internal standards.

- This can be done with a series of solutions, containing the same concentration of internal standard, with a range of sample concentrations - plotting the ratio of the signal of the analyte and internal standard versus the concentration of analyte yields a linear plot.

- In other instances, where obtaining the same concentration of the internal standard in each solution is unlikely, the analysis can be done by plotting the ratio of the signals versus the ratio of the weight of the sample and internal standard (e.g. GC lab)

SINGLE POINT INTERNAL STANDARD

Toluene can be used as an internal standard for the analysis of ethylbenzene (EB) contamination in benzene samples. A standard benzene solution containing 1.75 ppb EB and 2.25 ppb toluene yields a signal ratio ($S_{EB}/S_{Tol.}$) of 2.37.

A 2.25 mL sample of benzene is spiked with 0.250 mL of a 6.00 ppb toluene standard. The signal for EB (S_A) as determined to be 52.96, while the signal for toluene (S_{IS}) was found to be 8.704. What is the concentration of ethylbenzene in the benzene sample?

$$\frac{S_A}{S_{IS}} = \frac{k_A C_A}{k_{IS} C_{IS}} = K \times \frac{C_A}{C_{IS}}$$

$$K = \left(\frac{C_{IS}}{C_A}\right)_{std} \times \left(\frac{S_A}{S_{IS}}\right)_{std}$$

$$K = \left(\frac{2.25\,ppb}{1.75\,ppb}\right) \times (2.37) = 3.05$$

$$V_A = 2.25 mL$$
$$V_{IS} = 0.250 mL$$
$$S_A = 52.96$$
$$S_{IS} = 8.704$$
$$K = 3.05$$
$$C_{IS} = 6.00\,ppb$$
$$C_A = ?$$

$$K = \left(\frac{C_{IS} \times \frac{V_{IS}}{V_F}}{C_A \times \frac{V_A}{V_F}}\right) \times \left(\frac{S_A}{S_{IS}}\right)$$

$$C_A = \left(\frac{C_{IS} \times \frac{V_{IS}}{V_F}}{K \times \frac{V_A}{V_F}}\right) \times \left(\frac{S_A}{S_{IS}}\right)$$

$$C_A = \left(\frac{6.00\,ppb \times \frac{0.250 mL}{2.500 mL}}{3.05 \times \frac{2.25 mL}{2.500 mL}}\right) \times \left(\frac{52.96}{8.704}\right)$$

$$C_A = 1.33\,ppb$$