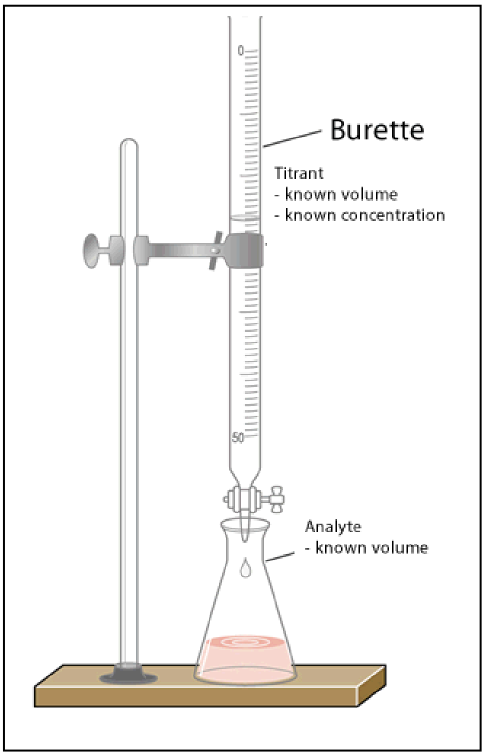
Lesson 3 – dilution before titration

When using a concentrated original sample, it may be necessary to dilute the sample before titrating. The reason for this is that it would take more volume than can be held in the burette to reach the end point. Dilution involves a pipette and a volumetric flask.

More on dilution and accuracy at the end of this lesson.

All titrations procedures have a common theme, the following must be known accurately.
- The concentration and the volume of the titrant delivered into the conical flask.

- The volume of the analyte placed in the conical flask.



Let's look at an example.
The HCl acid concentration of a brand of brick cleaner is to be determined using volumetric analysis. Since the original solution is concentrated, it is decided to dilute a sample of this brick cleaner before titrating.
A 25.00 mL aliquot is taken from the original bottle of brick cleaner and placed in a 250 mL volumetric flask and made to the mark using distilled water.
A volume of 20.00 mL was transferred from the volumetric flask to a 100mL conical flask and titrated to the end point using a standard solution of 0.143 M $NaHCO_3$. An average titre of 25.16 mL was obtained. Find the concentration of HCl in the original sample in %m/v.

a) Write the balanced overall equation for the reaction taking place in the conical flask between the HCl and the $NaHCO_3$.

b) Find the mol of $NaHCO_3$ in the average titre

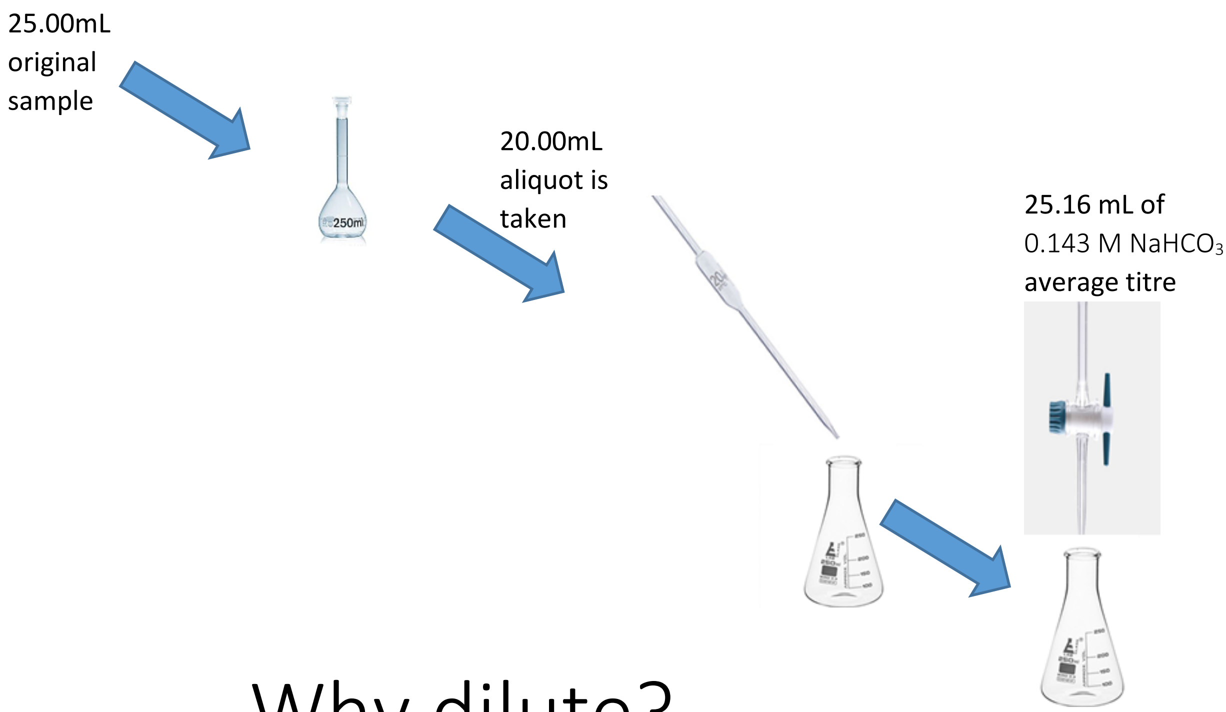
c) Find the mol of HCl in the conical flask.

d) Find the concentration, in mol/L, of HCl in the volumetric flask

e) Find the concentration in mol/L in the original undiluted sample

f) Find the concentration of HCl, in %m/v, in the original sample .

Unpacking all this information is difficult so draw a flow diagram.



Why dilute?

A sample is diluted to achieve greater accuracy when titrating.

1. By diluting the sample placed in the conical flask, the titre delivered falls comfortably within the range of the burette without the need to refill. Since the error for every reading is +/- 0.05 mL and there are two readings for every titre without the need to refill taking the error for each reading to +/- 0.10 mL. Hence having to refill the burette mid-titration will increase the error by +/- 0.10 mL every time refilling is required.
2. If the concentrated, unknown sample is placed in the burette then errors will occur due to to the high concentration. Since there is only one drop difference between the titre needed to reach the equivalence point and the titre needed to reach the end point in a titration, using a concentrated solution as the titrant would give a greater error in the calculation of the unknown concentration. This is because one drop one or two drops equates to a volume of 0.10mL and in a concentrated solution that represents a greater number of mol than in a dilute solution hence the error is greater when determining the mole of unknown. Solutions used in titration are usually in the range between 0.010 and 0.100M.
3. Using highly concentrated samples as the titrant usually results in very small titres. This results in significant errors as the inherent error of 0.10 mL for each titre is now a greater percentage of the overall titre.
   Eg assume a titre of 5.00 mL was achieved using a concentrated titrant.
   The percent error is (0.10/5.00) X 100 = 2.0% .
   If, however, the titre was 25.00 mL the percent error would be (0.10/25.00) X 100 = 0.40%