

FILTRATION TECHNIQUES

Filtration, the technique used to separate solids from liquids, is the act of pouring a mixture onto a membrane (filter paper) that allows the passage of liquid (the filtrate) and results in the collection of the solid. Two filtration techniques are generally used in chemical separations in general chemistry lab: "gravity" filtration and "vacuum" filtration.

Gravity Filtration

Gravity filtration uses a polyethylene or glass funnel with a stem and filter paper. Filter paper can have pore sizes ranging from small to large to permit slow to fast filtering. The paper is folded in half (Figure 1), then folded in quarters, and the tip of one corner is torn off to allow for a snug fit in the funnel cone. (If the paper has been pre-weighed, the torn corner piece must be saved to add to the post-filter weighing to avoid any errors.) The paper cone is fitted to the funnel so three thicknesses of the paper line one-half of the cone and one thickness lines the opposite half (Figure 1). Now place the funnel into a beaker and wet the filter paper completely

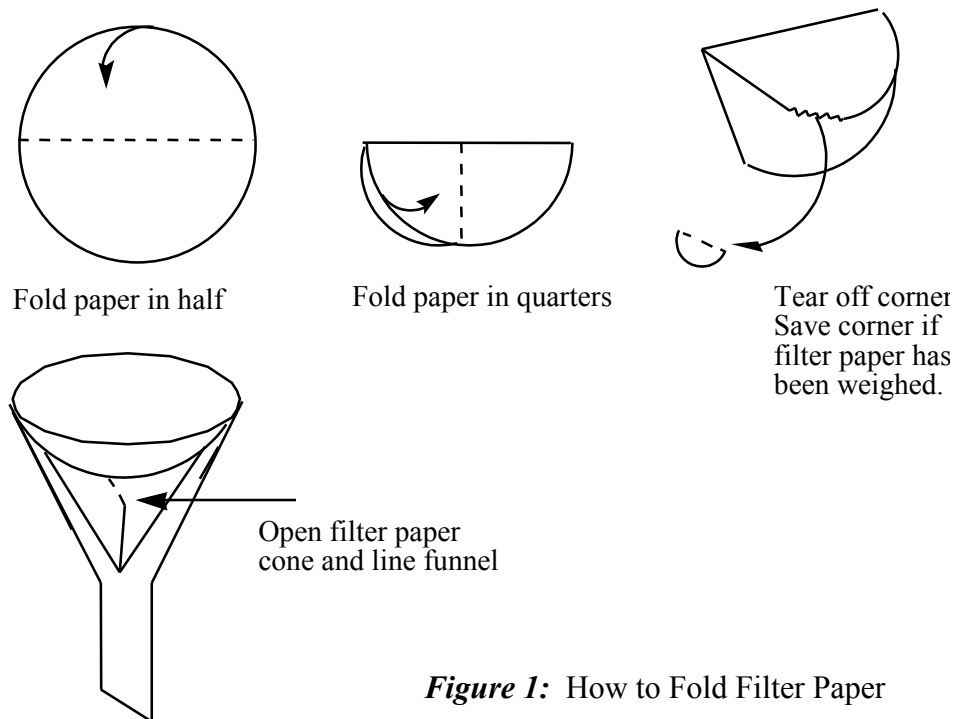


Figure 1: How to Fold Filter Paper

with the dominant solvent or solvents in the mixture to be filtered. This step adheres the filter paper to the funnel walls preventing solid from escaping. Then, support the funnel with a clamp

or ring (if necessary) and place a clean beaker beneath the funnel so the stem rests against the side of the beaker (this prevents splattering).

Before filtering, allow most of the solid in the mixture to settle. Now pour the supernatant liquid (the liquid standing over the solid in a mixture) through the filter first. This will allow the initial part of the filtration to proceed faster and may prevent clogging of the filter by the solid. To prevent splattering pour the liquid down a glass rod as shown in Figure 2.

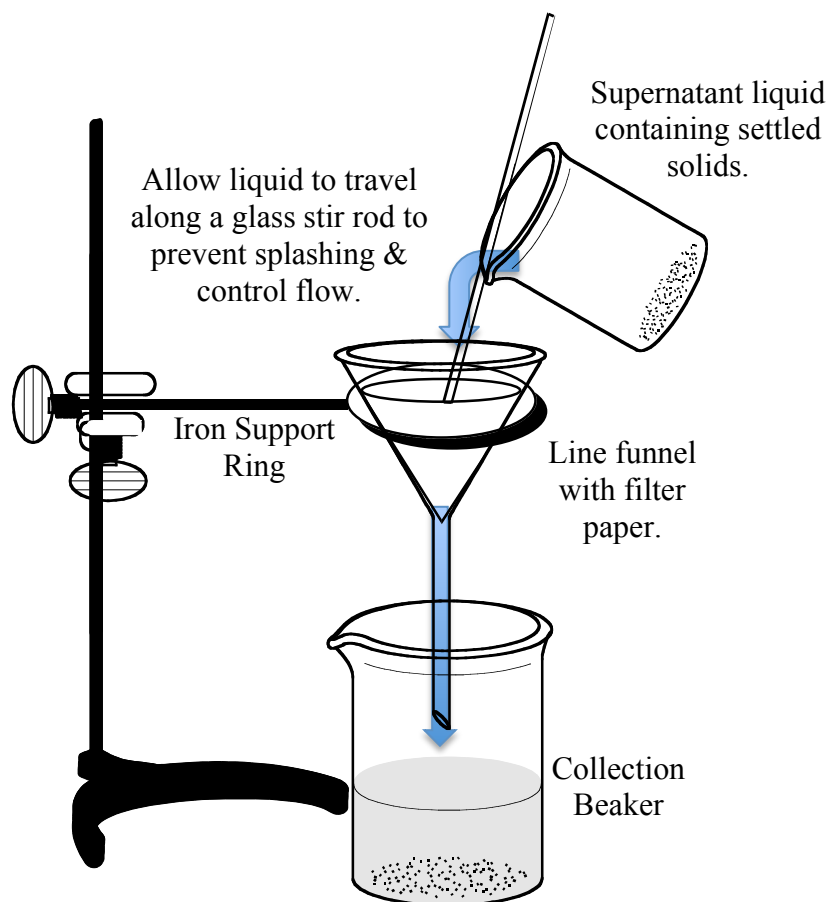


Figure 2. Gravity Filtration

Scrape the solid onto the filter with a rubber policeman or spatula. Rinse the spatula, glass rod and beaker and pour the washings into the filter funnel. If the remaining solid residue is to be washed, rinse with three small portions (a few milliliters each) of an appropriate solvent. If the solid is to be saved, remove the filter paper carefully and place it on a watch glass to dry. Caution: Wet filter paper tears easily.

Sometimes the filtrate is tested to determine if a product or reactant has or has not passed through the filter. The test depends on what is being separated. For example: All barium ions (Ba^{2+}) should have removed from solution by the formation of the precipitate BaSO_4 . To check this a few drops of Na_2SO_4 solution can be added to a small portion of the filtrate. If no BaSO_4 precipitate forms, the filtration was successful. If a precipitate forms, additional precipitating (sulfate ion containing) reagents must be added to the filtrate and the resulting mixture must be filtered again.

Vacuum (or Suction) Filtration

Vacuum filtration uses a Buchner (pronounced "byook-ner") funnel and a water aspirator assembly. A Buchner funnel is a flat bottomed, porous, circular porcelain bowl with a short stem. The stem is fitted with a rubber stopper and inserted in the mouth of a side arm filter flask. Circular filter paper, the same diameter as the bowl, is placed on the flat bottom and wetted with the appropriate solvent to create a seal before starting the filtration.

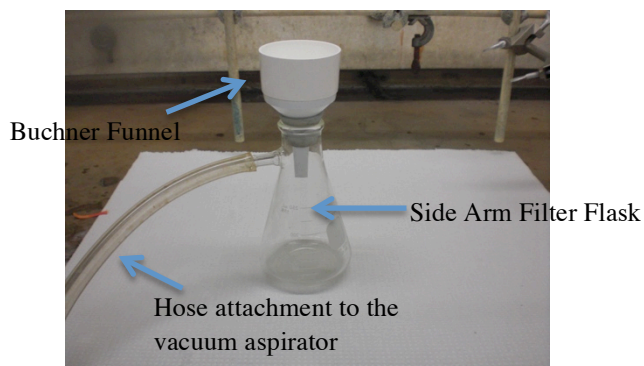


Figure 3. Buchner Funnel on a side arm filter flask.

The hose in the above figure is attaches the side arm of the filter flask to a vacuum aspirator in the hood or at the lab bench. This vacuum aspirator creates the suction that pulls liquid through the filter and filter paper.

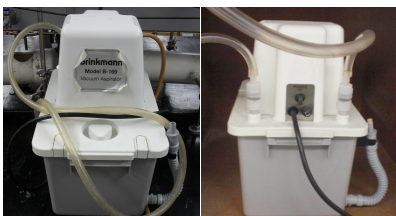


Figure 4. Vacuum Aspirator (front & rear views)

Figure 5 shows the entire set-up consisting of a Buchner funnel, the side arm flask, and the vacuum aspirator. When the water aspirator is turned on the flow of water creates suction. The

hose is part of the filtration system and should be heavy enough to prevent pinching or collapse under external atmospheric pressure.

To filter a sample, turn on the aspirator and carry out the filtration in the same manner described for gravity filtration. (Note: NEVER pry off the funnel if the system is under vacuum! Water can flash back into the collection flask or the filter paper can be damaged resulting in the loss of filtered solid.) Turn off the water aspirator before carefully removing the wet filter paper without tearing. Reaction byproducts (either the solid or filtrate) should be placed into appropriate labeled containers in the hood.



Figure 5.
Vacuum Filtration Assembly

Review Questions:

- Define Terms:
 - a) filtrate
 - b) supernatant liquid
 - c) water aspirator
 - d) gravity filtration
 - e) vacuum filtration
- Why do we wet the filter paper when setting it into the funnel before filtering a solution?
- When using gravity filtration, air bubbles in the liquid in the funnel stem indicates what type of problem? If this problem is not corrected can solids leak through the funnel into the filtrate?
- When using gravity filtration, where should the funnel stem be placed? Why?
- For best results, should the solid be washed with a single large washing or with several small washings?
- What type of funnel should be used in gravity filtration? in vacuum filtration?
- When using vacuum filtration, why should you never pry off the funnel while the system is under vacuum?
- List some advantages and disadvantages of using:
 - a) gravity filtration
 - b) vacuum filtration

