Filtration

Filtration involves the separation of insoluble solid materials from a liquid. In this operation, the liquid passes through a porous barrier (sintered glass or filter paper) and the solid is retained by the barrier. The liquid can be made to pass through the barrier by gravity alone, in which case the procedure is called a gravity filtration. Alternatively, the liquid can be caused to pass through by a combination of gravity and air pressure. Such an operation is called a vacuum or suction filtration.

Gravity Filtration

A piece of filter paper and a conical glass funnel to support it are all that are required for gravity filtration. In order to maximize the rate at which the liquid flows through the filter paper, the paper should be folded as indicated in Figure 1. The folded paper is then dropped into the funnel (see Figure 2). The funnel is best supported in an iron ring, as shown in the figure. The material to be filtered is poured into the filter paper cone, in portions if necessary. This operation is used with a stemless funnel in hot filtration during recrystallization, or in removal of a drying agent from a solution.

Figure 1. Folding of filter paper for gravity filtration: (a) Fold the filter paper circle (11 cm diameter) in half. (b) Crease the half to divide it into eight equal pie-shaped sections; it is easiest to make the creases in the numerical order shown. (c) Turn the piece over and pleat it into a fan by folding each pie-shaped section in half in the direction opposite to the previous creases. (d) Pull the two sides apart.

Figure 2. Arrangement of filter paper, funnel, and flask for gravity filtration
For smaller amounts, as in microscale work, a Pasteur dropping pipette can be used instead of the glass funnel, and a tiny piece of cotton or glass wool pushed down into the narrow part of the tip can serve as the filter.

**Vacuum or Suction Filtration**

In vacuum or suction filtration, a partial vacuum is created below the filter, causing the air pressure on the surface of the liquid to increase the rate of flow through the filter. A typical apparatus is illustrated in Figure 3.

A circle of filter paper just large enough to cover the holes in the bottom of the Hirsch or Buchner funnel should be used. A common error is to try to use a piece of filter paper so large that it must be turned up at the edges. If this is done, it is almost impossible to create a vacuum in the suction flask. Not only will the filtration take much longer, but any material that flows over the edge of the filter paper will run down into the suction flask without being filtered.

Filtration is done by connecting the side arm of the suction flask to the source of vacuum, which is almost always the water aspirator. The tubing used for all connections to the source of vacuum must be thick-wall tubing. The thin-wall or surgical tubing will collapse on evacuation of the system.

![Figure 3. Apparatus for vacuum filtration.](image)

When a water aspirator is used, the flask should be connected to the aspirator through a trap, as shown in Figure 3. The trap prevents water from the aspirator from being sucked back into the filter flask. Turn the aspirator on just a little at first so as to create a gentle vacuum, wet the filter paper with a small portion of the same solvent used in the solution being filtered while making sure that the paper is being pushed down over the holes, and pour the mixture to be filtered onto the center of the paper. Once the mixture has been added, the vacuum can be increased. When using the water aspirator, be sure to release the vacuum at the trap before turning off the water. Suction filtration is used to collect a solid after recrystallization.