References and Notes

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Vacuum Filtration of Large Volumes in the Laboratory

Abstract. Laboratory vacuum filtration of large volumes of liquids may be safely, easily, and economically accomplished without the use of pumps and without the necessity for placing receivers under vacuum. In the method described the lowered pressure is generated by the filtrate as it falls down a vertical tube.

Filtering liquid volumes of tens or hundreds of liters in the laboratory is frequently a difficult task. Normal laboratory procedures are generally limited to small-scale operations, and large-scale equipment is rarely available, and then only at high cost. In a previous publication a method was described whereby vacuum filtration of large volumes with Büchner funnels could be speeded up greatly (*1*). We now extend the method (*2*) by providing a procedure for filtering such volumes without the necessity for putting a large receiver under vacuum (which, because of the danger of implosion, becomes increasingly dangerous with increasingly large receivers) and without using a pump (which may result in contamination or heating of the liquid that is being pumped).

The procedure consists of attaching a long tube to the outlet of the Büchner funnel and allowing the filtrate to fall down the tube into an open container. In this manner a Torricellian vacuum is generated beneath the porcelain plate of the funnel. The appropriate length when filtering aqueous solutions is a minimum of 34 feet, since this will yield the maximum vacuum.

We placed a large table-type Büchner funnel on the sixth floor of the building and ran a length of 8-mm glass and Tygon tubing (supported by a wooden rod) down an open stair well to the third floor. We thus were able to lower the pressure at the filter surface to 30 mm and to filter successfully large quantities of lake water through either paper filters or Millipore membranes (pore diameter, 0.45 μ).

The general arrangement is shown in Fig. 1. A large-bore stopcock, *2*, is connected to the outlet of the Büchner funnel, *1*. The other end of the stopcock is joined to a T-tube, *3*, which has a funnel, *4*, connected to it by a plastic tube, *5*, which can be clamped shut. The third arm of the T is connected to the long vertical tube, *6*. To begin operation the system must be primed as follows:

The stopcock is closed and the clamp at 5 is opened. Distilled water is poured rapidly into the funnel until a substantial part of the vertical tube is filled. Then the clamp is replaced quickly. Next, the Büchner funnel is filled with the liquid to be filtered and the stopcock is opened. Filtration then proceeds until the filter clogs. The stopcock may be used to control the rate of filtration, but it should not be closed completely until the filter is allowed to run dry for changing. Otherwise the filter will float to the surface and particulate matter will escape to the filtrate. Also, as the rate of filtration slows there is a tendency for air to enter the bottom end of the tube. This can be alleviated by immersing the end of the tube in the filtrate.

Aside from being inexpensive, simple, and foolproof, the method has the advantage that, because the receiver is not under vacuum, volatile substances are not pumped off and can be recovered for further concentration by a method such as freezing-out (*3*). Although bubbles form in the liquid because of the low pressure near the top of the long vertical tube, these bubbles dissolve during their passage down the tube as the pressure increases toward the ambient atmospheric pressure. Similarly, highly volatile solvents may be filtered without loss. In cases where it is desirable to limit pressure difference across the filter to avoid rupturing cells, it is necessary only to shorten the vertical tube to the appropriate fraction of 34 feet. In this way it is impossible for the pressure difference to increase accidentally.

The general approach outlined here may also be used with pressure type filters, simply by placing the filter at the bottom of a long tube containing the liquid to be filtered (*3*).

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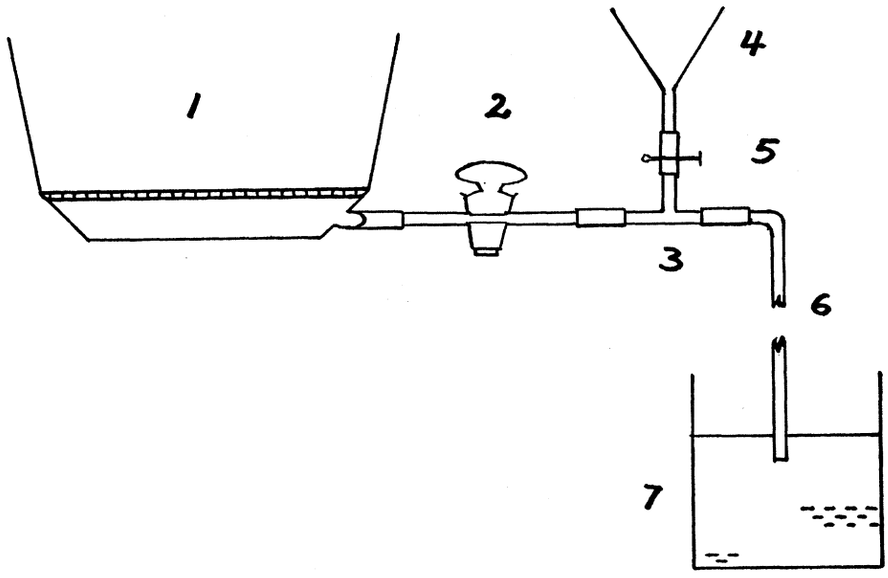

Fig. 1. Arrangement of equipment for large-scale vacuum filtration without pumps.

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