FILTRATION IN AQUARIUM

4.2.1 Introduction

Filtration of aquarium water is an essential element of water management. The process serves two purposes:

1. Maintenance of good water quality.
2. Partial correction (within certain limits) when the water goes wrong.

Good quality of water means a water that ensures a proper environment for fish to "drink", "breathe", "move" and even "pass metabolites" (excreta, urine and carbon-di-oxide) into it without becoming harmful to fish's health and well-being. A water is said to be of good quality when its contents (chemicals, dissolved gases, organic matter) or condition (temperature and turbulence) are in a state which is good for fish, and is free from undesirable suspended particles and pollution. Pollution may arise from intrinsic (developing within the aquarium) or extrinsic (accidentally introduced) factors and will make the water wrong, weakly harmful or lethal to fish. Even a very well planned and properly stocked aquarium will need filtration in the long run.

In a filtration process the aquarium water is allowed to pass through a filter medium to cleanse it and is finally returned to it. Filtration is done basically in three ways:

(a) Mechanical filtration : Solid suspended particles are trapped and filtered out just mechanically.

(b) Chemical filtration : Harmful soluble chemical contents of water as those which alter its pH, impart it hardness or fish's metabolites are rendered harmless by changing their chemical composition chemically.

(c) Biological filtration : Conversion of ammonia and nitrite which are highly toxic into non-toxic nitrates is done biologically by using a population of bacteria to feed upon the excretory products and similar detritus wastes.

Except the chemical filtration, mechanical and biological filtration combine in any filter eventually. All the three kinds of filtration process may be incorporated in a single filter. Accordingly, in a filter one or more filter media are used.

One has to be prudent in deciding which filtration to choose for a given aquarium. A number of factors need to be considered such as size, effective water volume and movement / turbulence and metabolic loading due to fish / other animals (stocking density and feeding and locomotory habit). On the other hand, it is also important to monitor filtration efficiency (filter volume and turnover rate) of the filter used in the aquarium which may be done by estimating the concentration of ammonia (NH_3), nitrites (NO_2) and nitrates (NO_3).

Filtration also helps in aeration by circulating the water of the tank irrespective of whether water is power driven or air-driven.

4.2.2 Filter media

A number of filter media are available. The more common ones are given in Table.

Filter media

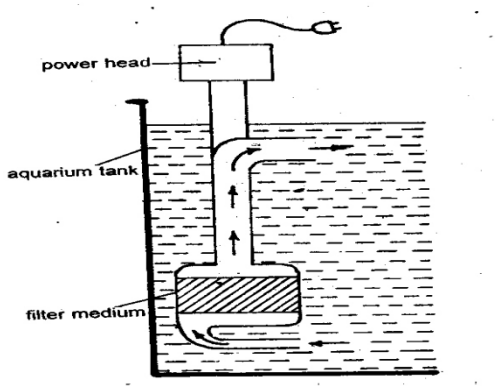
Sl.No.	Filter Medium	Working	Items removed
1.	Nylon floss	Mechanical	Solid suspended particles
2.	Filter (glass) wool	do	do
3.	Plastic foam	do	do
4.	Sand	do	do
5.	Gravel	do	do
6.	Diatomite (diatomaceous earth)	do	do
7.	Sponge	do	do
8.	Diatom Skeleton	do	do
9.	Activated charcoal	Chemical	(CO_2, pH& hardness)
10.	Limestone chips	do	(pH& hardness)
11.	Coral sand	do	do
12.	Peat	do	do
13.	Resin (zeolite)	do	Hardness & NH_3

Infact, all media work mechanically, and biologically if left undisturbed over long period. In the latter case, all media will be eventually colonized by bacteria. Plastic, glass and gravel may offer good bed (surface area) for bacteria to grow on.

Of all the filter media, the cheapest are floss, foam and gravel. Peat, on the other hand, is not long lasting and needs replacement at quick intervals (as it is quickly exhausted).

4.2.3 Filters

Conventional filters are usually designed on two working-principles:
A. Aquarium water is siphoned into filter unit where it is allowed to slowly pass through one or more filter media before being pumped up or air-lifted and returned to the aquarium tank.
B. Aquarium water is allowed to pass through the substrate at the bottom in a continuous circulation which is maintained either by air-lifting or by powerhead.
Most filters combine filtration with aeration (for optimizing dissolved oxygen concentration of aquarium water). Various measures are taken for aeration.



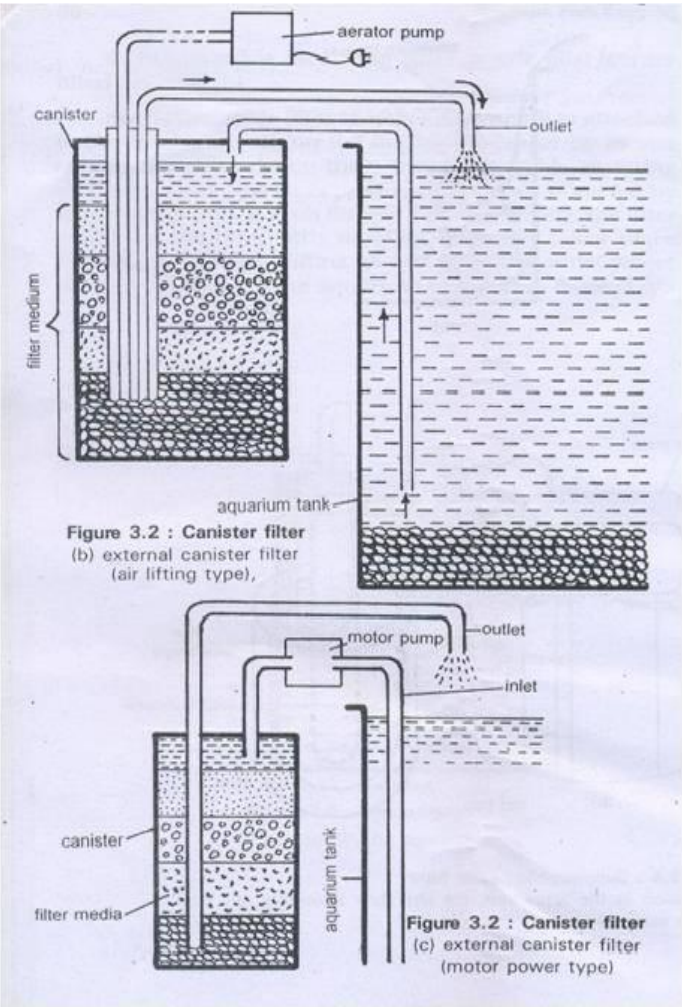
Canister Filter

4.2.4 Canister filter (external or internal type)

It is a self-contained unit comprising of a container, provided with an aerator or an electric pump. It operates on principle 'A' described above. It may be situated inside or outside the aquarium. The external types have inlet and outlet pipes while the internal types are provided with slits for the purpose. The filter media used include nylon floss, glass wool, foam, activated charcoal, resin etc. It may be used for mechanical, biological and / or chemical (optional) filtration by combining it with a subgravel filter.

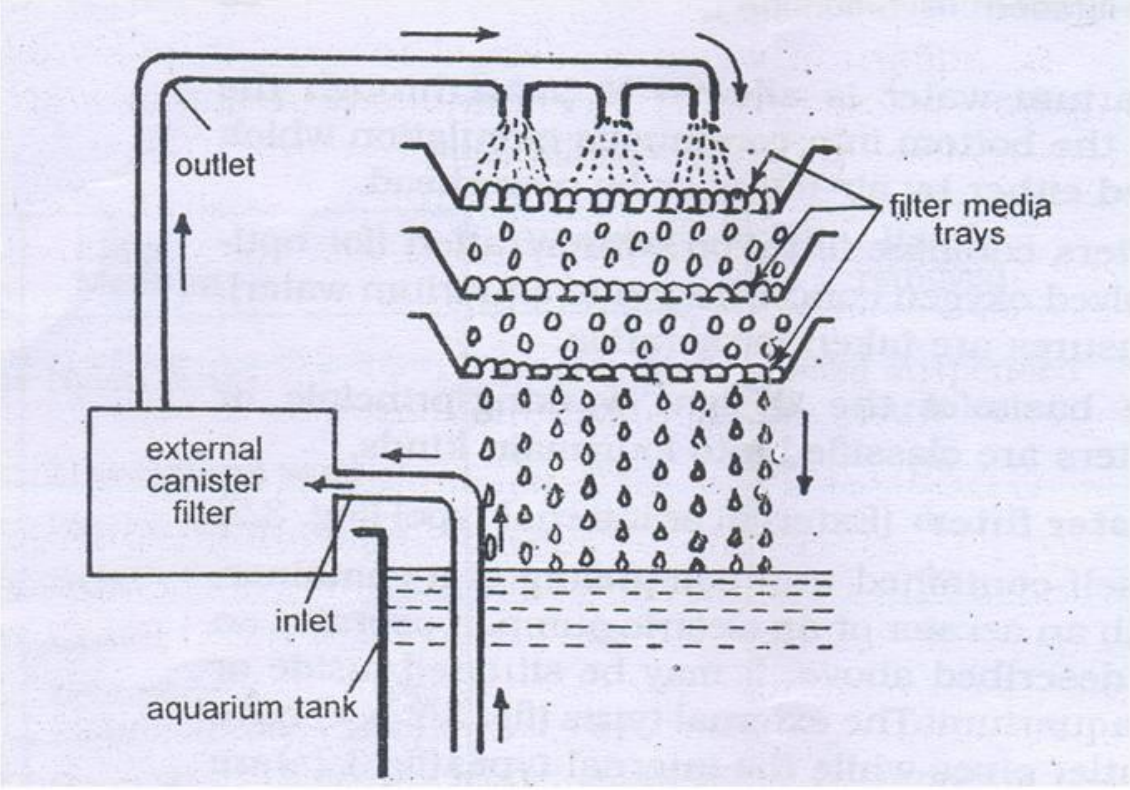
It is used for both freshwater (air-lifting type) and marine aquarium (power lifting type). The power driven type can remove all solid debris and maintains a constant forceful circulation of water dislodging food particles trapped in gravel or corals.

Canister filter
(b) external canister filter (air lifting type)
(c) external canister filter (motor power type)



4.2.5 Trickle filter

It is a modified version of external canister filter. A stack of several trays with perforated bottoms are placed above the aquarium and used in conjunction with an external canister filter. The aquarium water after initial filtration in the canister filter is sprayed into the top tray from where it trickles from one tray to the other and is finally returned to the aquarium. The trays are part-filled with filter media and thus reinforce filtration. The main advantage of the trays atmospheric oxygen. Optimization of oxygen uptake of water results in enhanced bacterial activity.



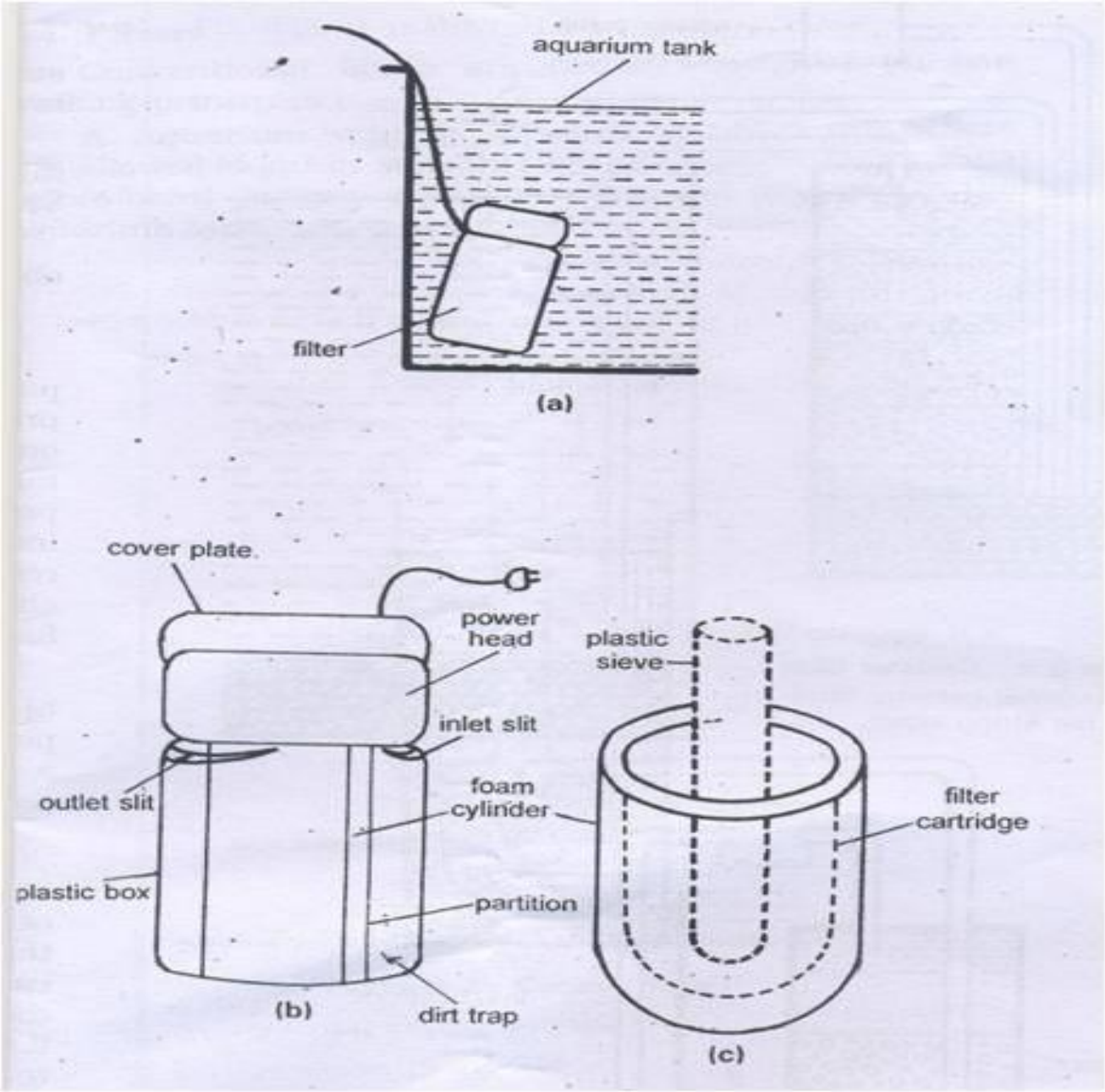
4.2.6 Submersible power filter (box filter / corner filter)

It is a very compact filter that works under submerged condition at any depth of water. The plastic box sits at the gravel bottom in a corner. It is very suitable for small aquarium in which metabolic loading is less. A flow of water is continually maintained in and out of the filter unit. The flow is driven by a powerhead. The aquarium water is drawn in through a slit in an outer chamber and then passed through a sponge / foam, held against a sieve, and finally driven out of the unit to be returned to the aquarium. The box filter silently works to carry out mechanical and biological filtration. It will need to be supplemented with chemical filtration, if necessary. The outer chamber is so designed as to trap detritus "dirt" in a partitioned portion from where it can not escape. Filter, however, needs periodical cleaning. The powerhead also needs maintenance; the impeller attached to the pump shaft needs periodical cleaning.

It is generally used for freshwater aquarium only.

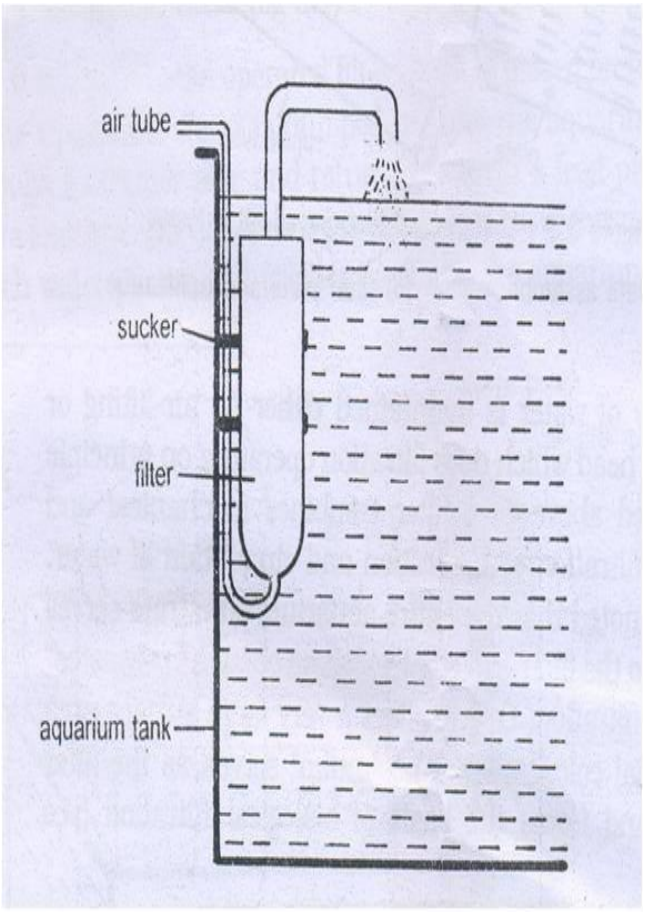
Submersible power filter

(a) position in the aquarium, (b) filter box assembly, (c) filter cartridge assembly

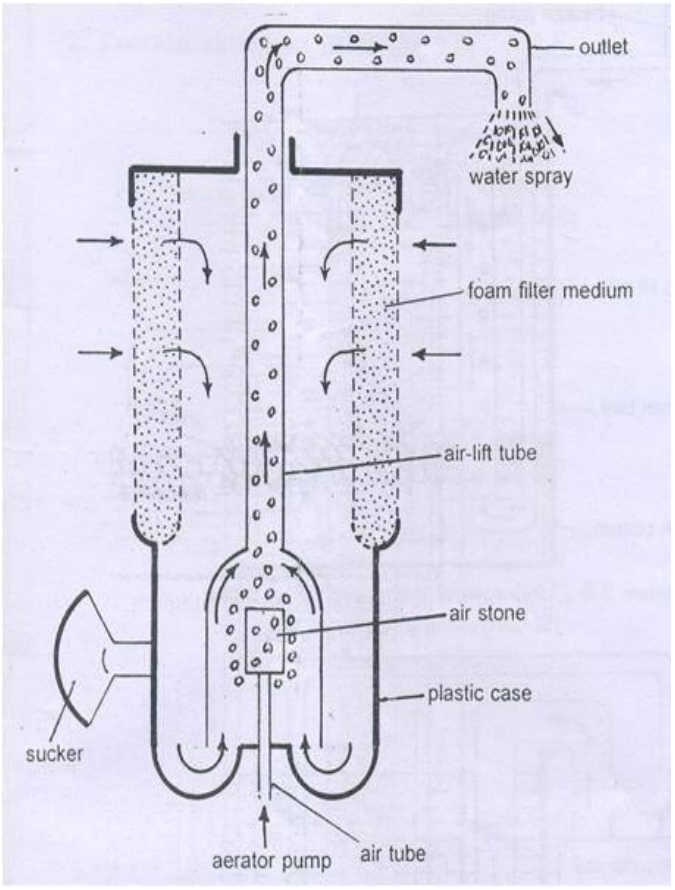


4.2.7 Submersible air-lifting filter (inside filter / corner filter)

The submersible filter is rather compact. It is attached to the aquarium wall on the inside in a corner by means of a sucker. It works on the principle of bubble-air-lifting of filtered water, which is produced at the air stone fed by an aerator pump. A foam filter is used. Obviously, the filter combines filtration with aeration. Aeration takes place during the bubble-airlifting as well as the outlet where water is returned to the aquarium in the form of a spray.
Inside filter (a) position in the aquarium
Inside filter (b) filter assembly



Position in aquarium



Filter assembly

4.2.8 Under gravel Filter (Biological Filters)

It is so called because it operates under the gravel at the bottom of the aquarium. It consists of a slit-plate in plastic having a size same as that of the aquarium bottom, which is placed between the substrate (3 inch thick gravel) and the aquarium bottom. One or two uplift pipe(s) are fixed on the plate at corners. The top of the uplift pipe ends some distance below the water surface and it carries holes or slits.

A flow of water is maintained either by air-lifting or by a powerhead which does filtration operating. The filter combines mechanical and biological filtration with aeration and circulation of water. It may be noted that the entire aquarium substrate serves as "inlet" to the filter-system, leaving no chance for "wastes" to escape filtration. Gravel offers a very large surface area for bacterial colonization.. It is used for freshwater aquarium only.

Undergravel Filter Types

Conventional flow type

Aquarium water is driven down through the gravel into the shaft-plate from where it is air-lifted using an aerator and returned to the aquarium alongwith the air-bubbles. Air-bubbling and consequent turbulence produced in water help in improving the dissolved oxygen level of water.

Reverse flow type

Aquarium water is driven down the uplift pipe, using a powerhead, and then up through the gravel into the aquarium.

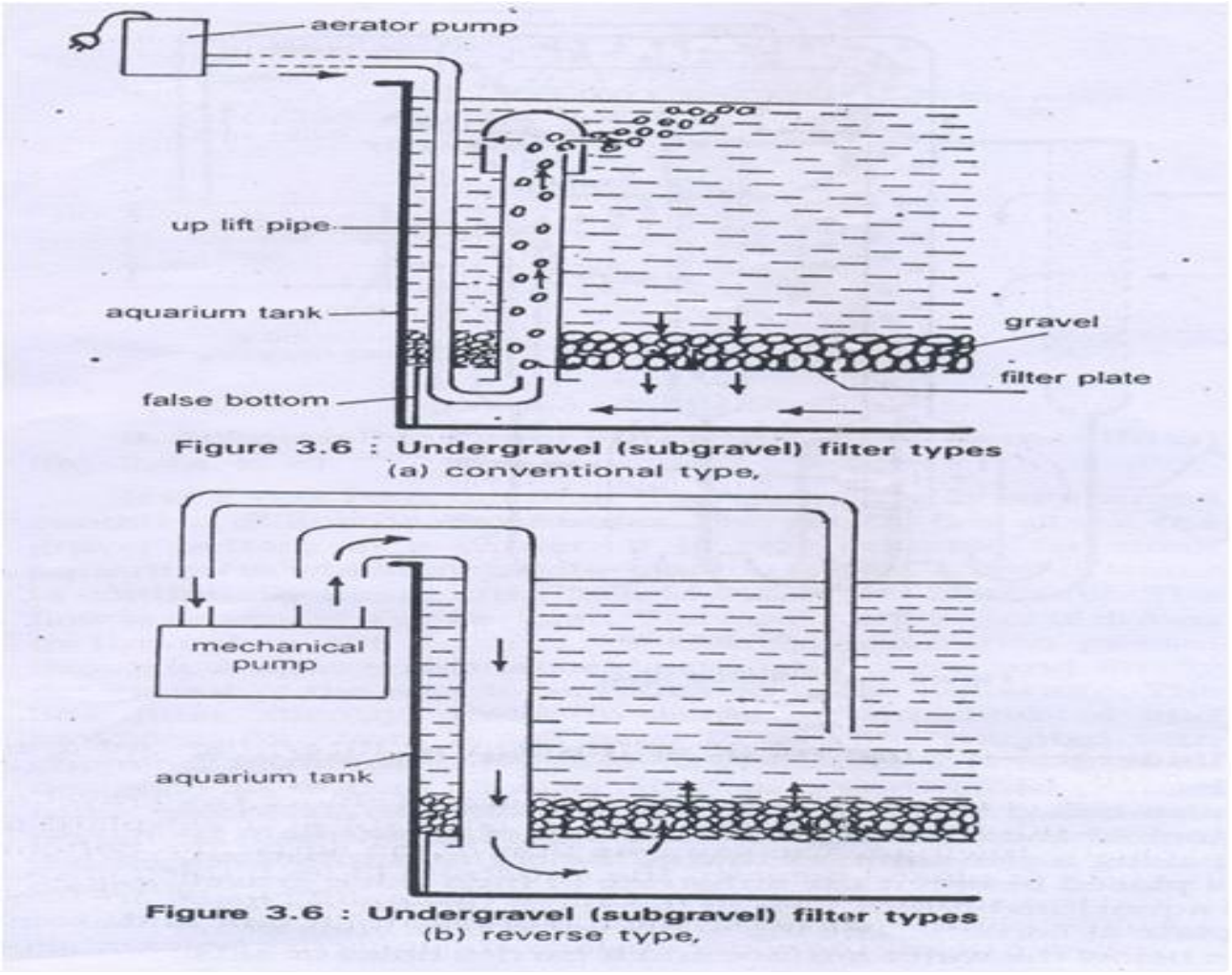


Figure 3.6 : Undergravel (subgravel) filter types
(a) conventional type,

Figure 3.6 : Undergravel (subgravel) filter types
(b) reverse type,

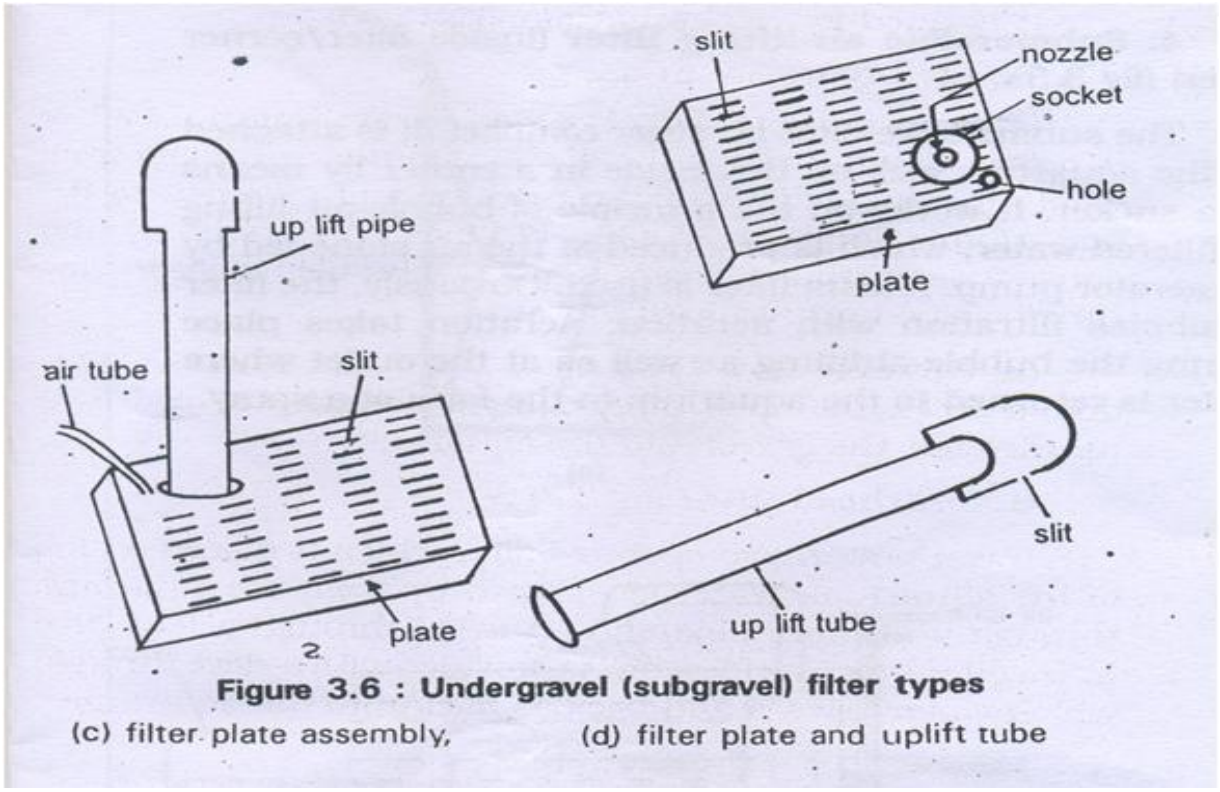


Figure 3.6 : Undergravel (subgravel) filter types

(c) filter plate assembly, (d) filter plate and uplift tube

4.2.9 Overhead Filter

It is a powerhead operated filter which is placed on top of the aquarium. Water is pumped up form the aquarium through a strainer pipe and returned through a feed pipe into a filter box. The filter box is provided with a sieve through which water passes and trickles back into the aquarium.

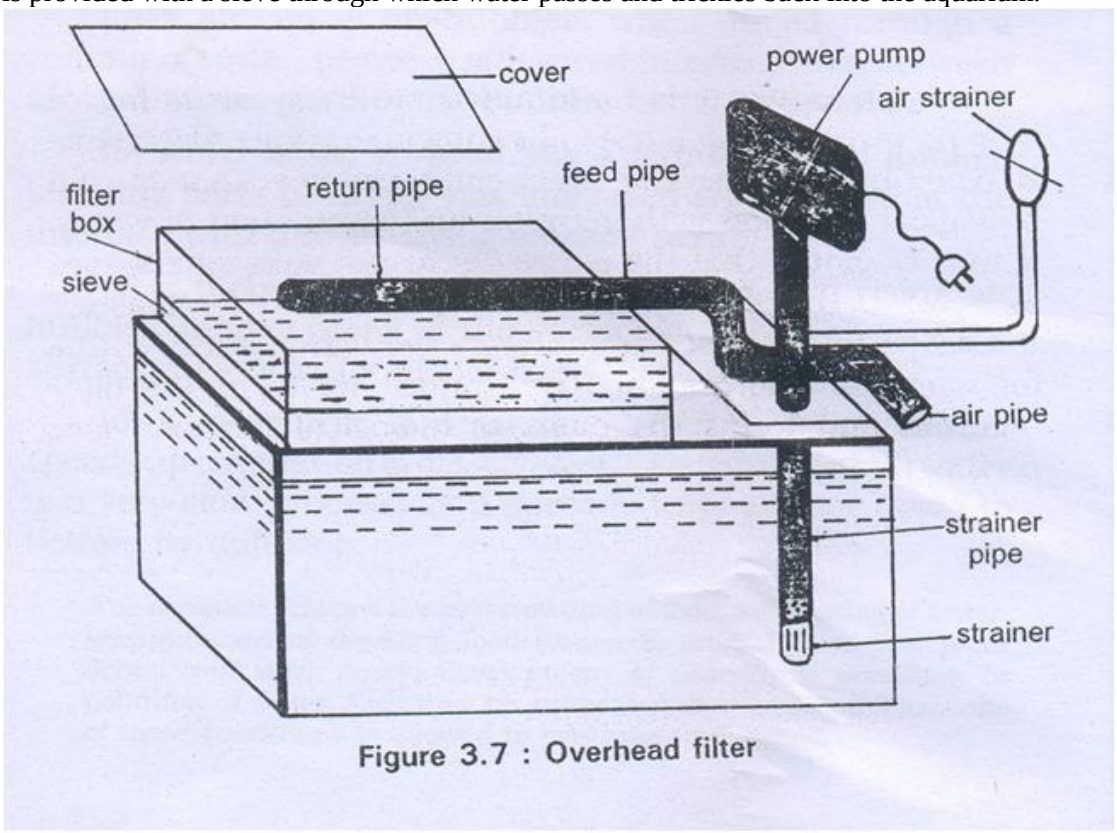
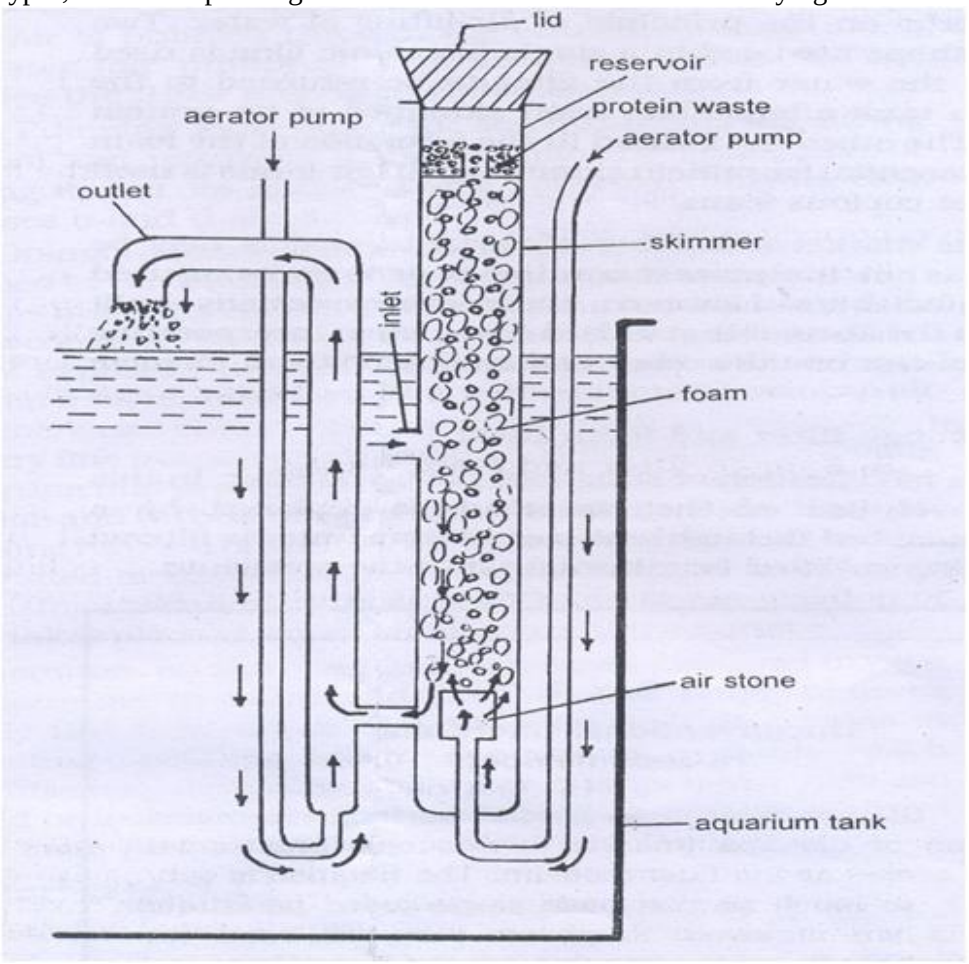


Figure 3.7 : Overhead filter

4.2.10 Protein Skimmer Filter

It is essentially designed for marine water filtration and it will not work for fresh water filtration. Its

working is quite complicated. It involves the principle of "air stripping". Protein and other organic waste are allowed to adhere to air bubbles to form a foam at the top of the filter unit, called reservoir from where it is removed daily.
It works on the principle of air-lifting of water. Two aerator-pumps are used in a single filter unit. One is used to air-lift the water from the filter to be returned to the aquarium tank after it has been skimmed of its protein content. The other one is used in the formation of the foam which is essential for protein skimming. An air-stone is used to produce copious foam.
In the market a number of variants/models may be available as new and more innovative designs are being used by manufacturers. However, these are essentially built mainly on the above five standard types, often incorporating features of one into the other and modifying them in some way.



PROTEIN SKIMMER

4.2.11 Sponge Filter and Foam Filter

It is a modification of subgravel biological filter. In this case, gravel bed of the aquarium is replaced by a sponge/foam bed through which aquarium water is filtered before being air-lifted for returning it to the aquarium.

4.2.12 Unconventional filters and Hi-tech devices

Diatom filter

A special cartridge contains skeleton of diatoms (marine microscopic organisms) which serves as the filter medium. The filtration is very perfect, so much so that even single-celled parasites/bacteria are removed. A power pump is used for maintaining a flow of water through the filter. However, the filter medium gets easily clogged, needing frequent cleaning.

UV – Sterilizer

The water of the aquarium is allowed to pass through a chamber where it is exposed to UV-radiation. Most of the microorganisms are destroyed. However, as the time of exposure is short, bacteria are not killed including the pathogenic forms. Thus, the risk for bacterial diseases remains.

Ozonizer

The device uses the principle that ozone has an antiseptic action and kills bacteria and other organisms. Ozone also has an added action of speeding up of nitrite breakdown. The risk, however, is great because any excess of ozone liberation may destroy useful bacteria also.