Chapter 6

Fishing Floats and Sinkers

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6.1 Introduction

Floats and sinkers are essential accessories of fishing gear intended to keep the gear in the desired position in the water column and also to give the gear the required shape during operation. In different fishing gears they serve different functions. In trawls, these are used to keep the net mouth vertically open during the operation, by attaching floats along the head rope and sinkers along the foot rope. In gill nets, floats help in keeping the wall of netting in fishing orientation and in appropriate fishing depth while in seines and surrounding nets their function is to keep the vertical orientation of the netting during operation. In long lines, they are used to keep the fishing hooks in the appropriate fishing depth and also serve as markers, for locating the lines. In large traps such as set nets, they are used to keep barrier netting in position and in proper orientation.

6.2 Fishing floats

Floats are buoyancy elements used in all fishing gear. The properties desirable for floats are (i) high buoyancy, (ii) retention of buoyancy, (iii) capacity to withstand pressure of water at varying depths, (iv) resistance to rotting, shocks and abrasion, (vi) drying properties, (vii) long service life, (viii) ease of manufacture, (ix) low cost; and (x) easy availability.

Floats are made of natural materials such as wood, bamboo, cork, rubber, etc. or synthetic materials such as plastic, thermocole (expanded polystyrene), poly vinyl chloride (PVC) and fiberglass. Floats of natural materials are mostly used in inland water bodies. Floats of natural materials, such as wood become quickly water-logged and have to be dried for long periods, to regain their buoyancy. Often these floats will not regain their original buoyancy and the material cracks. A float is considered to be of not much use, when its buoyancy is reduced by 50 %. In wooden floats, the loss of buoyancy due to water absorption and its redemption rate contribute to the resultant efficiency of the gear to which it is attached. Floats made of high specific gravity materials such as glass, aluminium, steel and high density plastic acquire their buoyancy by enclosing air in pockets. Synthetic

plastic floats are the most popular and widely used ones in modern fishing gear.

6.2.1 General dimensions

Size of the floats is generally represented by length, outer diameter and diameter of hole (Fig. 6.1).

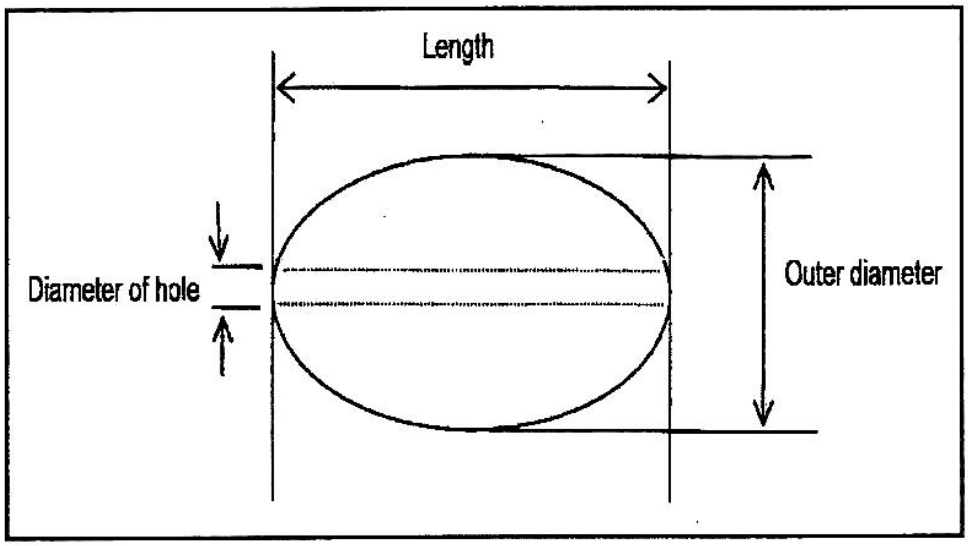

Fig. 6.1 Dimensions of float

6.2.2 Buoyancy

Buoyancy is the net upward thrust of the float when fully submerged in water. The buoyancy of floats made of different materials and shapes can be calculated by using the formula (Mukundan and Narayanan, 1975):

$F = W (1 / \rho - 1)$

where F is the buoyancy in g; W is the weight of float in g; ρ is the specific gravity of the material.

A rough estimation of the buoyancy of a cylindrical float is given below (Prado, 1990):

Buoyancy (gf) = 0.5 to 0.6 x L (cm) x $\varnothing$ $(cm)^2$

where L is the length of the float and $\varnothing$ is the outer diameter of the float.

The buoyancy of float made in spherical shape can be calculated by the following formula (Satyanarayana, 1960):

$F = KD^3$

where F is the extra buoyancy of float in g; D is the diameter of float in cm; K is the constant which vary according to the type of material used for the float.

The specific gravity of important float materials is given in Table 6.1. Buoyancy of the floats varies with the size and mass in the case of hollow floats and with the size and density in the case of sponge plastic or rubber floats.

Table 6.1 Specific gravity of common float materials

Material		Specific gravity
Cork	:	0.22 – 0.26
Sponge	:	0.10
Wood	:	0.50
Aluminum	:	2.70
Glass	:	2.60 – 3.70
Plastic	:	0.95
Rubber	:	0.29
Artificial rubber	:	0.24

6.2.3 Classification of floats

Floats are available in a variety of shapes, size and materials. Broadly floats can be classified based on shape and material (Fig. 6.2).

Based on shape

Based on the shape, floats are classified into spherical, disc shaped, cylindrical, egg/oval shaped, apple shaped and irregular shaped (Fig. 6.3 and 6.4).

Spherical: Spherical floats are usually made of two hemispheres joined in the middle. Floats with single and double knobs and also with perforations are available to pass the float line. Usually materials like glass, aluminium, HDPE and fibre glass are used for making these floats. They offer good buoyancy and are commonly used in trawl nets and purse seines.

Disc-shaped: These floats resemble a disc with a hole in the middle for attaching them to the gear and are commonly used in gill nets.

Cylindrical: These are usually made of expanded PVC or hard plastic or rubber and are mainly used in seines and gill nets.

Egg-shaped: These floats are oval in shape, resembling egg and are usually made of rubber and PVC. Perforation is provided to attach the float line.

Apple-shaped: These resemble apple in shape and perforation is provided to tie the float line. These are widely used in gears like purse seines, trawls and gill nets and are usually made of low as well as high density poly ethylene.

Irregular shaped: Often floats made of thermocole, rubber, etc., come in irregular shape.

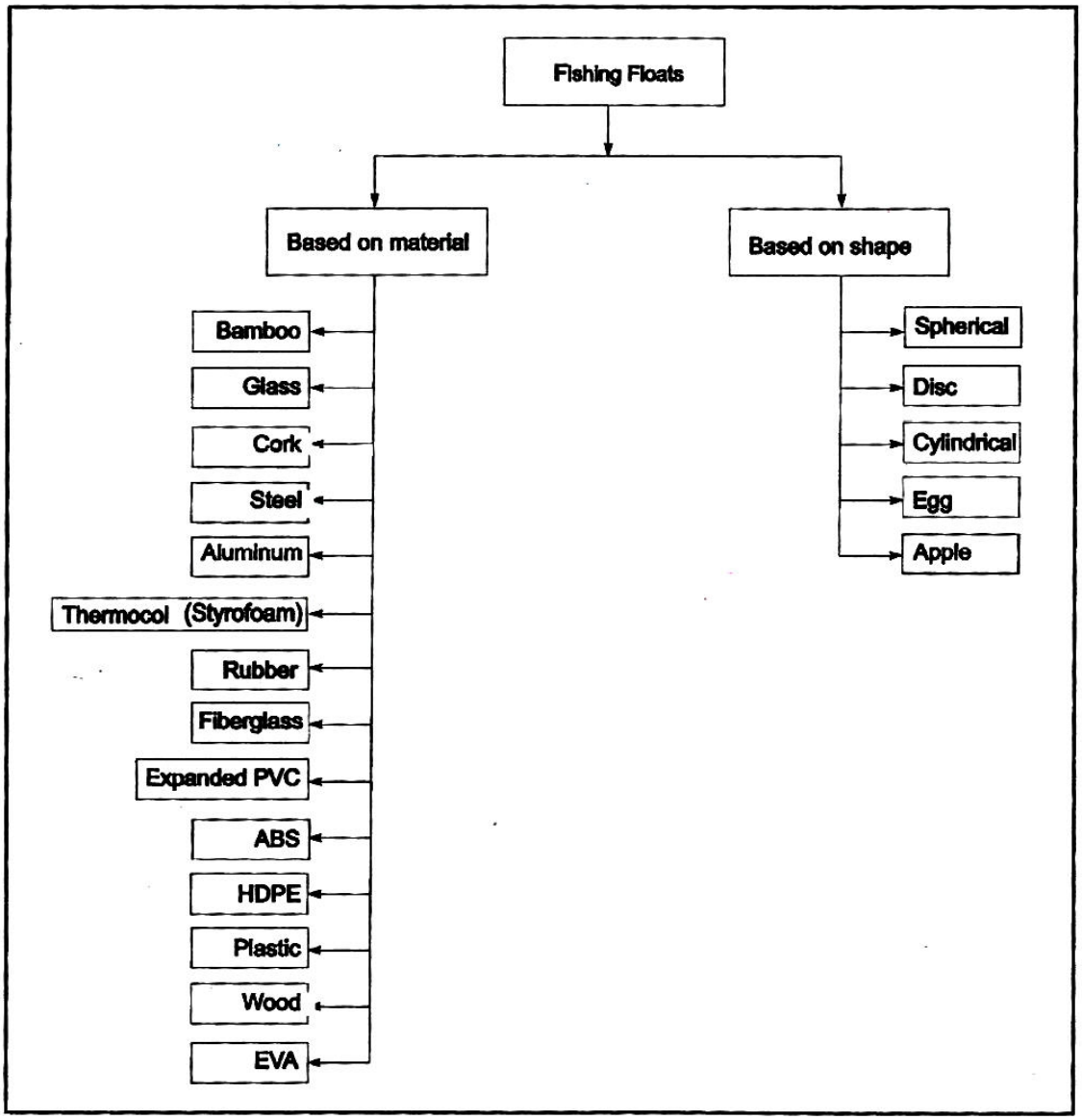

Fig 6.2 Classification of fishing floats

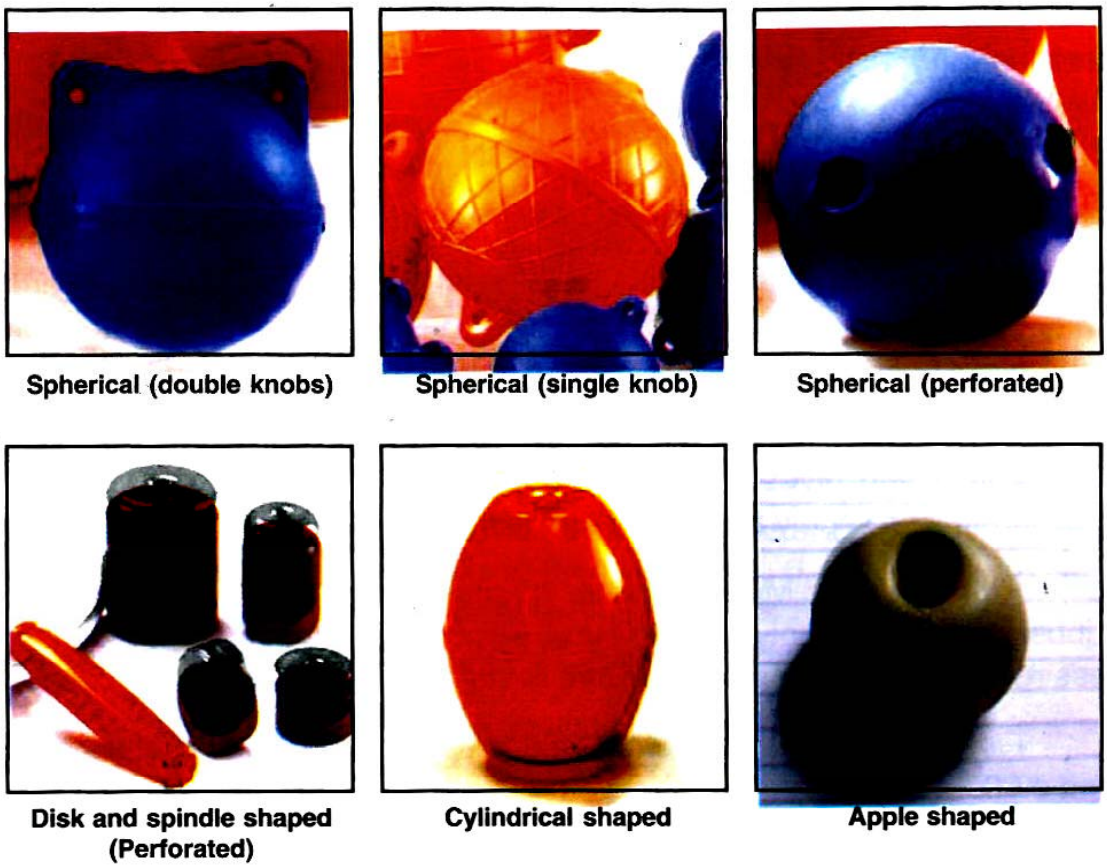

Fig. 6.3 Floats with different shapes

Based on material used

Based on material used, the following types of floats are seen:

Wooden floats: Floats made of lightwood (density 0.25-0.6 g.cm^{-3}) are used for fishing purpose. These become water logged very quickly and it take days to dry them. The common species of wood used are *Bombax malabaricum* and *Melia azedaracha* (Satyanarayanan and Kuriyan, 1962)

Bamboo floats: Bamboo stem has got hollow spaces at inter nodal region and this enables them to remain buoyant in water (density 0.5 g.cm^{-3}). This particular property of bamboo is being put into use as good fishing floats since ancient time.

Glass floats: With a density of 2.60-3.70 g.cm^{-3}, glass floats have good buoyancy and resist pressure up to 360 m depth. Even though this was the most commonly used material earlier, due to its fragile nature and requirement of a net covering to prevent breakage which increases resistance of the gear make this material unpopular now.

Cork floats: It has got good buoyancy, but cannot withstand high pressure and absorbs water quickly.

Aluminum floats: These are usually made by welding two aluminum hemispheres of 14-gauge thickness. They have high impact resistance and can be used in trawls, gill nets and seines.

Steel floats: Steel floats are made by welding two steel hemispheres. They began to replace the glass floats since they are more durable and can be operated at greater depths. Corrosion is a major disadvantage.

Thermocole (styrofoam) floats: Thermocole does not absorb water, is very light and gives very high buoyancy. But they can not withstand pressure. Used widely in gill nets and seines operated in shallow waters.

Rubber floats: Made of either natural rubber or artificial / synthetic rubber these are mainly used in purse seines. As they are heavy and have less resistance to pressure their use is very limited.

Fiberglass floats: Can withstand pressure up to 400 meters depth and a 200 mm diameter float weighing 900 g in air can give a buoyancy of 3800 g. These are now widely used in commercial fishing operations.

Expanded PVC floats: The most commonly used floats in seines and gill nets, these do not absorb water and have very high buoyancy as well as retention of buoyancy.

Hard plastic floats: Now almost all the other types of floats have been replaced by hard plastic *viz.*, high density polyethylene floats. These have very high buoyancy, retain buoyancy for longer periods and withstand pressure and high impact. Besides, these are comparatively cheap. These are available in spherical shape with single and double knobs and also with perforations for passing the float line. Disc and cylindrical types are available in perforated conditions (Fig. 6.3).

The shift towards distant and deep sea fishing changed the type and characteristics of fishing gear materials and accessories. There is an increasing demand for gear and accessories able to withstand harsh conditions and the high pressures at deep seas. Hence the current scenario with regard to floats is totally different from what was documented earlier as the floats made of wood, glass and aluminium have been replaced almost completely by floats made by new polymer based materials like expanded Polyvinyl chloride (PVC), Acrylonitrile-Butadiene-Styrene (ABS), High density polyethylene (HDPE), Ethylene vinyl chloride (EVA), Styrofoam, etc.,

Fig. 6.4 A variety of synthetic plastic floats

(Thomas et al., 2008). A variety of floats made of different materials, brands, shapes and colours are available in the market (Fig 6.4). HDPE, PVC and styrofoam floats are the most popularly used floats. The shapes of floats available in each material are given in Table 6.2.

Table 6.2: Float shapes available in different materials

Material	Shapes available
HDPE	Spherical, disc, cylindrical and egg-shaped
PVC	Disc, cylindrical and egg-shaped
ABS	Spherical, disc, cylindrical and egg-shaped
EVA	Egg-shaped
Styrofoam	Any shape

The floats are variously shaped like spherical, cylindrical/disc, egg shaped etc. The sizes of PVC cylindrical floats range from 50x10 to 150x190 mm. The PVC egg floats include sizes of 125 and 150 mm whereas, the HDPE spherical floats include sizes (diameter) of 100, 125, 150, 200, 250 and 300 mm. The sizes of HDPE cylindrical floats range from 50x10 to 150x20 mm. The size of aluminium and glass spherical float is generally 125 mm.

6.3 Fishing sinkers

Fishing sinkers are important components of fishing gears and serve different purposes in different gears. They are used to (i) sink a fishing line,

(ii) give the gear the desired shape, (iii) keep the gear in the desired position, (iv) obtain vertical gape, and (v) have firm contact with the bottom. For instance, in gillnetting sinkers together with floats give the net the desired shape. In trawls they are attached to the footrope to obtain the vertical gape and to have firm contact with the bottom in bottom trawls and other dragged gears. In purse seine they provide the vertical stretch and high sinking speed. Desirable properties of sinkers are (i) high sinking force, (ii) ease of manufacture, (iii) low cost and (iv) easy availability.

The shape and size of the sinker is very critical for successful operation of fishing gear hence they are designed in such a way that there is no entangling with the gear during operations.

6.3.1 Sinking force

Sinking force of different sinkers can be worked out as per Mukundan and Narayanan (1975).

$$S = W(1 - 1/\rho)$$

where S is the sinking force in g; W is the weight of the material in g; and ρ is the specific gravity of the material.

6.3.2 Sinker materials

Materials used for sinkers are stone, clay, ceramic, cement, glass, lead, iron, tungsten, bismuth, tin, stainless steel and plastic. Specific gravity of common sinker materials is given in Table 6.3.

Table 6.3: Specific gravity of different sinker materials

Material	Specific gravity
Lead	11.3
Iron	7.8
Tungsten	19.62
Stone (Granite)	2.6
Brick	1.9
Porcelain	1.7
Clay	2.2
Cement	2.24 – 2.4
Glass	2.6

Locally available materials are generally used to make sinkers in various regions. However, the easy availability of lead sinkers in different sizes and shapes has made lead a widely used material replacing the commonly available materials like stone, clay and brick (Edappazham et al., 2006). Baranov (1970) suggested lead as the best material for sinkers for fishing purpose due to its high specific weight and easiness to shape by machining and casting.

6.3.3 Classification of sinkers

Based on material used, mode of manufacture and shape, sinkers are variously classified (Fig. 6.5). Based on the type of material used they are classified as stone, clay, ceramic, porcelain, cement, glass, lead, iron, tungsten, bismuth, tin, stainless steel and plastic sinkers. Baked clay sinkers come in different shapes but are mostly in either spherical, cone or ring-like in shape. These are commonly used in gill nets. Broken tiles and bricks are also used as sinkers. Porcelain/ceramic/clay sinkers are gaining relevance these days due to the issues related to the contamination of water bodies by the increased use of lead sinkers. Sealing of the lead with an inert material like plastic prevent leaching. Sinkers made up of cement are mostly disc shaped. These are extensively used in gill nets. Apart from this, large cement sinkers are used for mooring purpose. Iron is widely used for fishing sinkers while corrosion is its main disadvantage. Glass sinkers are usually made up of recycled glass pieces in spherical shape. The main drawback in using glass sinkers is the chances of breakage while handling the gear.

Lead is the most common material used in making sinkers. It was noted that the traditional fishermen are switching over to lead sinkers along the coast owing to its ready availability and ease of use (Edappazham et al., 2006) These are available in numerous shapes and sizes suiting different needs. New, non-toxic sinker alternatives made out of bismuth, tin, stainless steel, tungsten, ceramic, recycled glass, natural granite, plastic etc. are available in countries like U.S.A., U.K., Canada and China (USEPA, 1994). Tungsten sinkers are superior to lead but are expensive than lead sinkers and molding is more difficult. However, with tungsten, a sinker of about one-third of the size of lead sinker will have the same weight (Anon, 1994). Bismuth is slightly less dense than lead and is brittle. Bismuth has low melting point and expands as it cools, in contrast to lead, and therefore must be poured only into high-quality milled moulds while making sinkers. Tin is less dense than lead, is soft, and can be easily formed, reworked and reused for various fishing tasks. Plastic sinkers are made up of high molecular weight polymers like Polypropylene, Polyvinyl chloride (PVC) or Acrylonitrile-Butadiene-Styrene (ABS). They are cheap and can be coloured to attract fish to the gear.

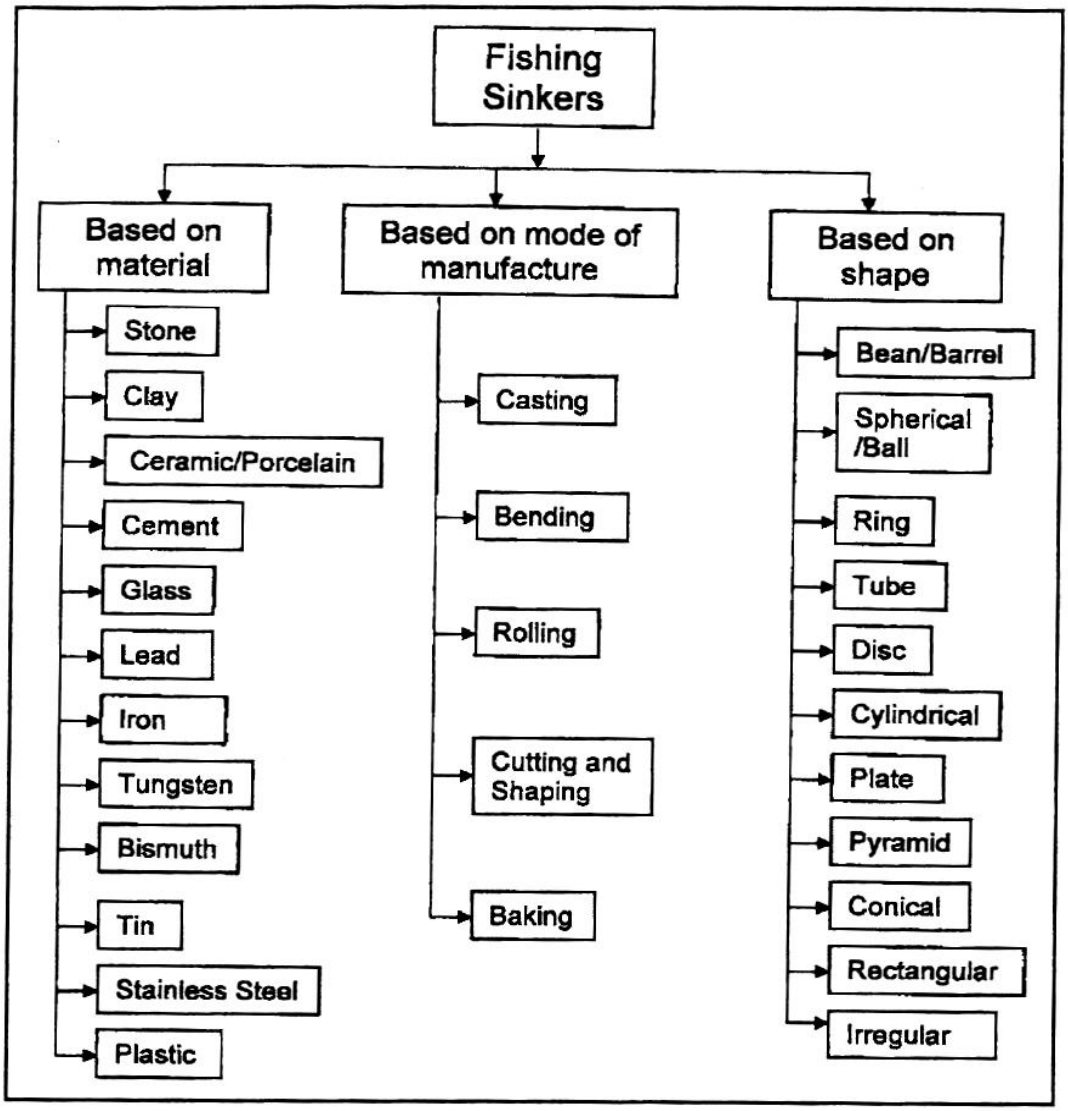

Fig. 6.5 Classification of fishing sinkers

Based on mode of manufacture, sinkers are classified as cast, bent, rolled, cut and baked. Most of the lead sinkers and plastic sinkers are made by casting. In the case of sinkers made by bending, a metallic piece is bent like a ring or tube and fixed to the gear. In rolled type of sinkers a rod or strip of metal is rolled into a kind of coil or ring and is then attached to the gear. Materials such as stone and brick are cut or machined into the desired size. Sinkers made by baking clay had been very common in historic times and have got a promising future as an environment friendly material.

Based on shape, the sinkers are classified as bean/barrel shaped, spherical/ball, ring, tube, disc, cylindrical, plate, pyramid, conical, rectangular and irregular shaped (Fig. 6.6). The shape and size of the sinker is very critical for successful operation of fishing gear and hence they are designed in such a way that the entangling of the sinker with the gear during operation is minimized.

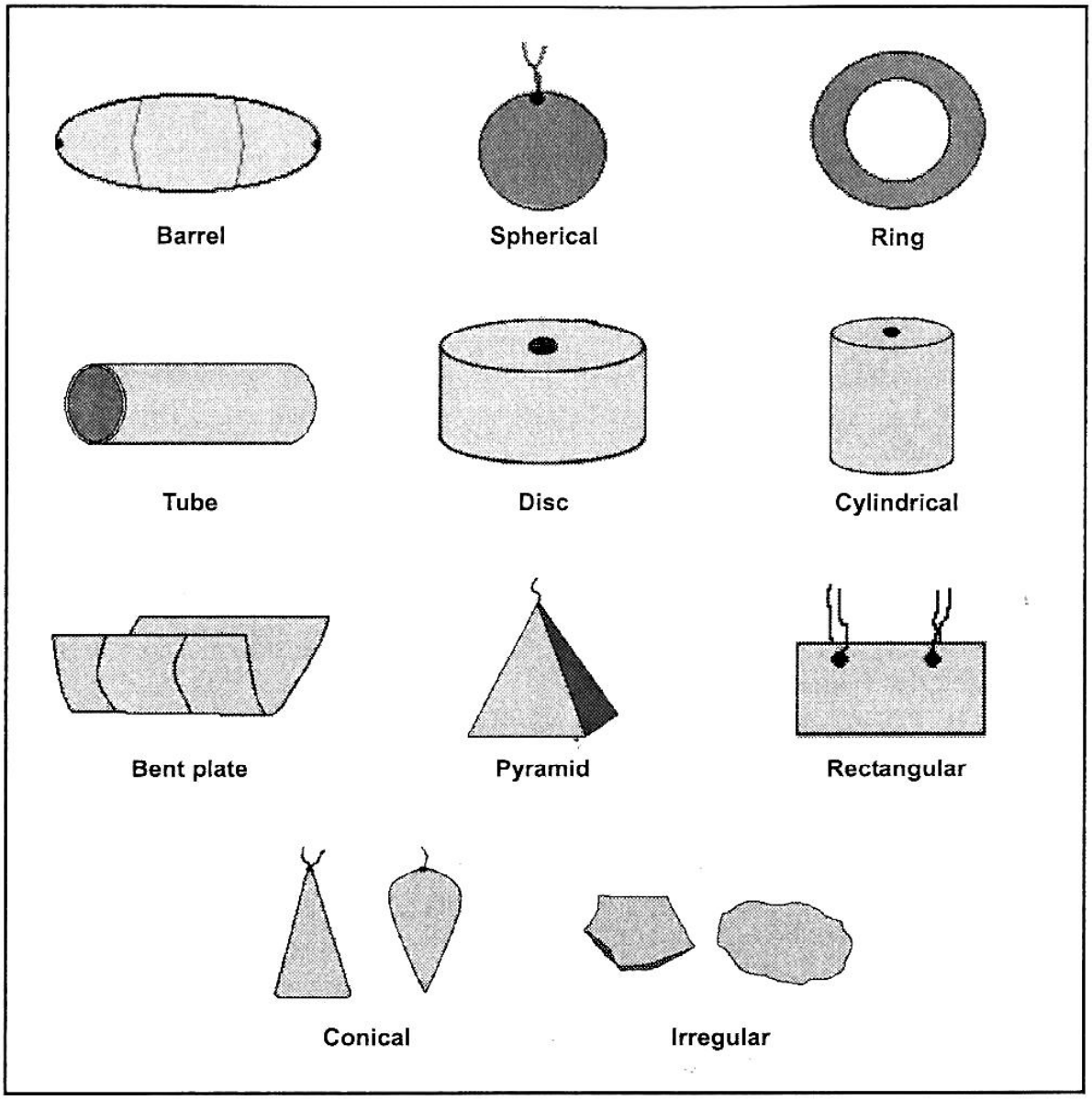

Fig. 6.6 Common shapes of sinkers

There is a trend to use lead sinkers replacing all other materials due to its ease of use, less bulkiness, corrosion resistance etc. The use of lead sinkers adds more lead to our environment. Exposure to lead can have a broad range of health problems depending on the amount of lead present and the length of exposure. Besides, reports on death of sea birds engulfing lead sinkers have urged environmentalists demanding ban on use of lead sinkers. In India, studies concerning these issues are generally lacking. It is advisable to impose some restriction on use of leaded sinkers and jigs especially in fresh water bodies. Currently there are many non-toxic sinker alternatives in the market made out of bismuth, tin, stainless steel, tungsten, ceramic, recycled glass and natural granite.

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