

# Fish Culture Engineering

## 2- Water Transport

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All aquaculture facilities require a supply of water. It is important to have a reliable, good-quality water source and equipment to transfer water to and within the facility

The volume of water needed depends on the facility size, the species and the production system

In some cases can it be very large, up to several hundred m<sup>3</sup>/min



This is equivalent to the water supply to a quite large villages, considering that in Norway a normal value for the water supply per person is up 180 liters per day

Correct design and construction of the water inlet system  
Is an absolute requirement to avoid large unnecessary problems in the future

The science of the movement of water is called  
**hydrodynamics**

## **1- Pipe and pipe parts**

In aquaculture the common way to transport water is through pipes; open channels are also used in some cases.

**Channels** may be used for transport into the farm, for distribution inside the farm and for the outlet of water

They are normally built of concrete and are quite large; the water is transported with low velocity

Channels may also be excavated in earth, for example to supply the water to earth ponds.

Advantages of open channels are their simple construction and the ease with which the water flow can be controlled visually; disadvantages are the requirement for a constant slope over the total length and there can be no pressure in an open channel

The greater exterior size compared to pipes, and the noise inside the building when water is flowing are other disadvantages.

Plastics, mainly thermoplastics, are the most commonly used materials for pipes. Thermoplastic pipes are delivered in many different qualities with different characteristics and properties.

Thermoplastic pipes can be divided into (polyethylene; PE) and (polyvinyl chloride; PVC) depending on the way the pipes are connected

The opposite of thermoplastic is hardening plastic, such as fibreglass which is made of different materials afterwards it is impossible that are hardened; to change its shape, even by heating.

Fibreglass can be used in special critical pipes and pipe parts, but only in special cases

It is also important that materials used for pipes are non-toxic for fish

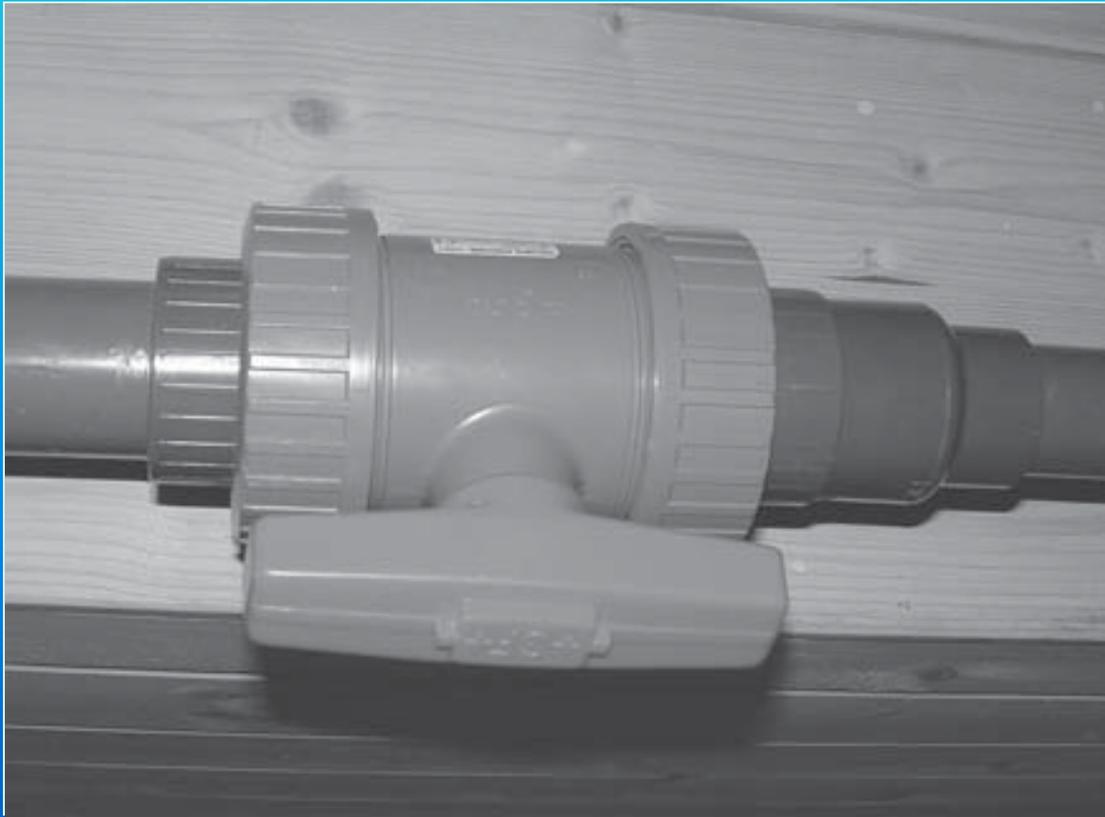
Copper, much used in piping inside houses, is an example of a commonly used material that is not recommended for fish farming because of its toxicity

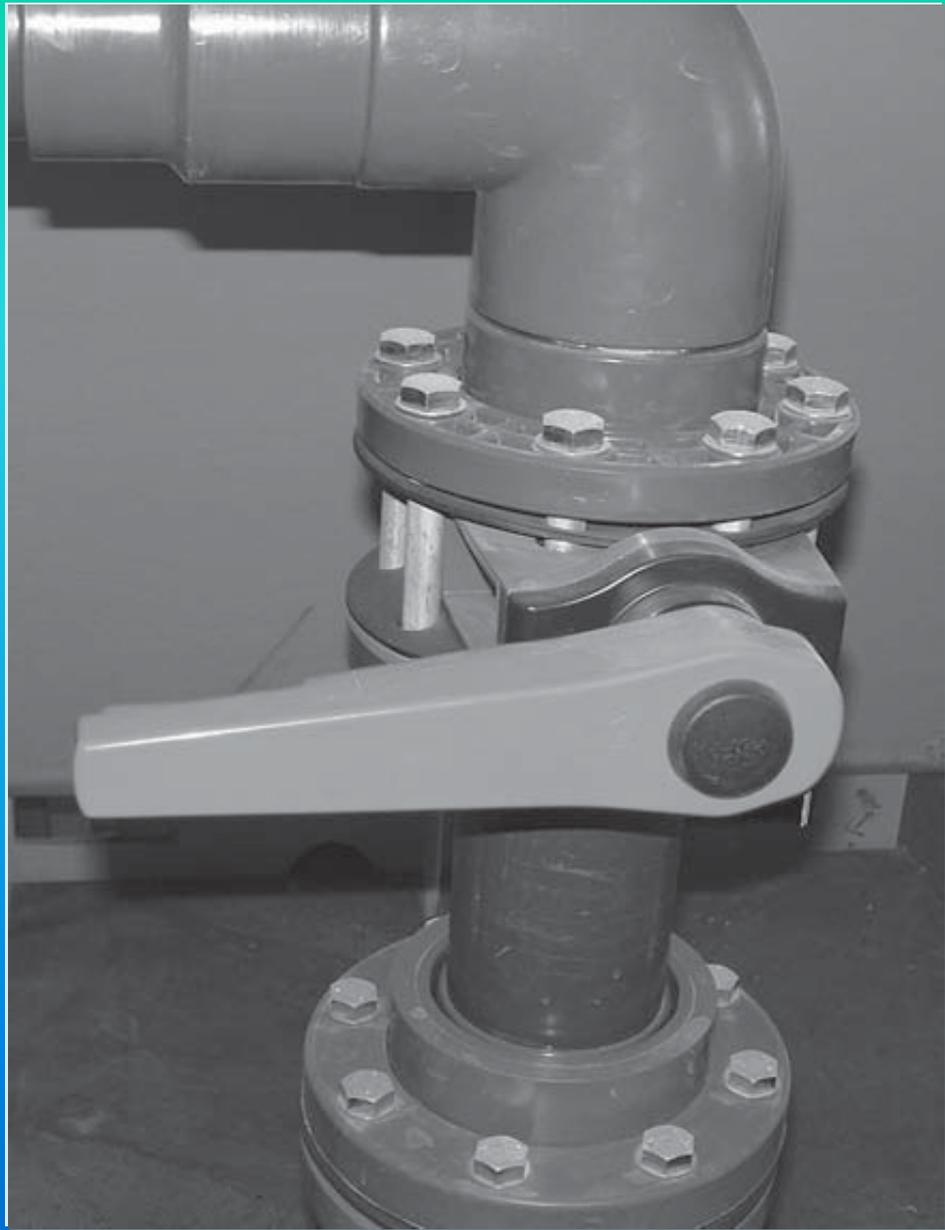
In the past steel, concrete or iron pipes were commonly used, but today these materials are seldom chosen because of their price, duration and laying costs

# Valves

Valves are used to regulate the water flow rate and the flow direction

Many types of valve are used in aquaculture





Ball valves are low cost solutions used in aquaculture.

The disadvantage is that they are not very precise when regulating the water flow.

The design is simple and consists of a ball with an opened centre. When turning it will gradually open or close

The check valve or 'non-return' valve is used to avoid the backflow of water; this means that the water can only flow in one direction in the pipe system

There are also many other types of valves, for instance electrically or pneumatically operated valves which make it possible to regulate water flow functions automatically

In new and advanced fish farms such equipment is of increasing interest, especially when saving of water is necessary

## **Pipe parts – fittings**

large variety of pipe parts can be found, especially for PE and PVC pipes

Various bends or elbows are normally used in aquaculture  
T-pipes are also used to connect different pipes.

Different conversion parts allow the connection of pipes or equipment with different diameters

Sockets, flanges or unions are used to connect pipes or pipe parts. Sometimes end-caps are used to close pipes that are out of use.

## Head loss in pipelines

All transport of water through a pipe or a channel between two points results in an energy loss (head loss).

This is caused by friction between the water molecules and the surroundings. In all pipe parts where there is a change in the water direction (bends) or narrow passage (valves) additional friction will occur; this will also increase the head loss.

Inside a pipe there is a velocity gradient, with the highest water velocity in middle of the pipe and the lowest close to the pipe walls because friction is highest against and close to the wall.

In addition to friction loss against the wall there will be friction between the water molecules because their velocities are not equal.

## Pumps

Pumps are mechanical devices that add energy to fluids by transforming mechanical energy (normally from electric motors) to potential and/or kinetic energy of the fluid.

Increase in potential energy is illustrated by the lifting of water to an elevated tank, while the increase in velocity and hence the flow rate through a pipeline by pumping increases the kinetic energy of the water

Pumps are commonly used in aquaculture systems, usually to increase the system pressure and thereby force the water to move against an energy gradient

In most aquaculture situations pumps are used to lift water from one level to another. Water will flow only when energy is available to create a flow, i.e. there is a positive energy gradient

## **Types of pump**

There are several types of pump based on different principles

The type of pump chosen depends on a number of factors, including the amount of fluid to be pumped and its characteristics, and the head.

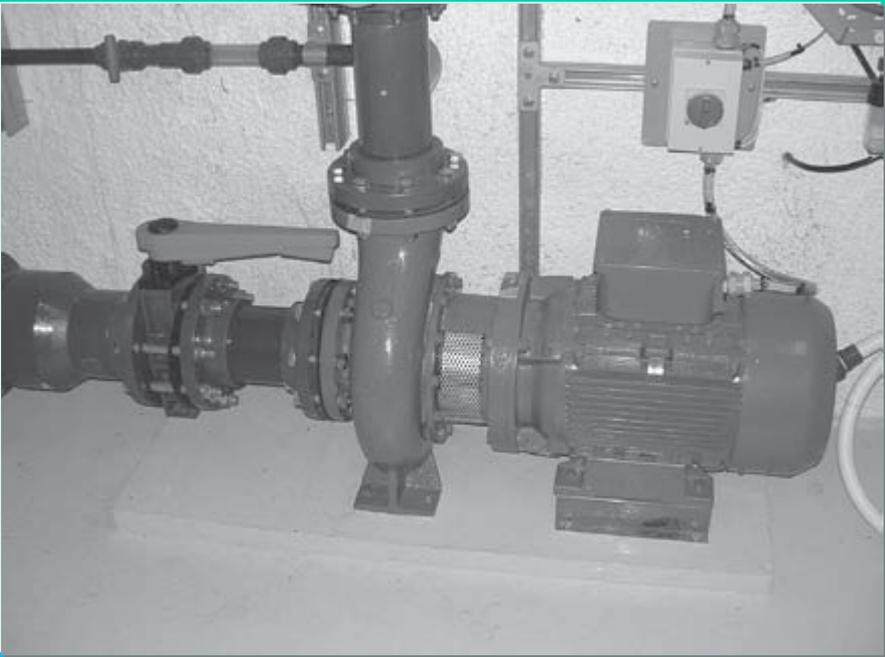
A major pump type is the displacement pump in which liquid is displaced from one area to another

An example is the piston pump: when the piston moves up and down it creates, respectively, a vacuum and pressure, and in this way the liquid is transported; back-flow valves must be included.

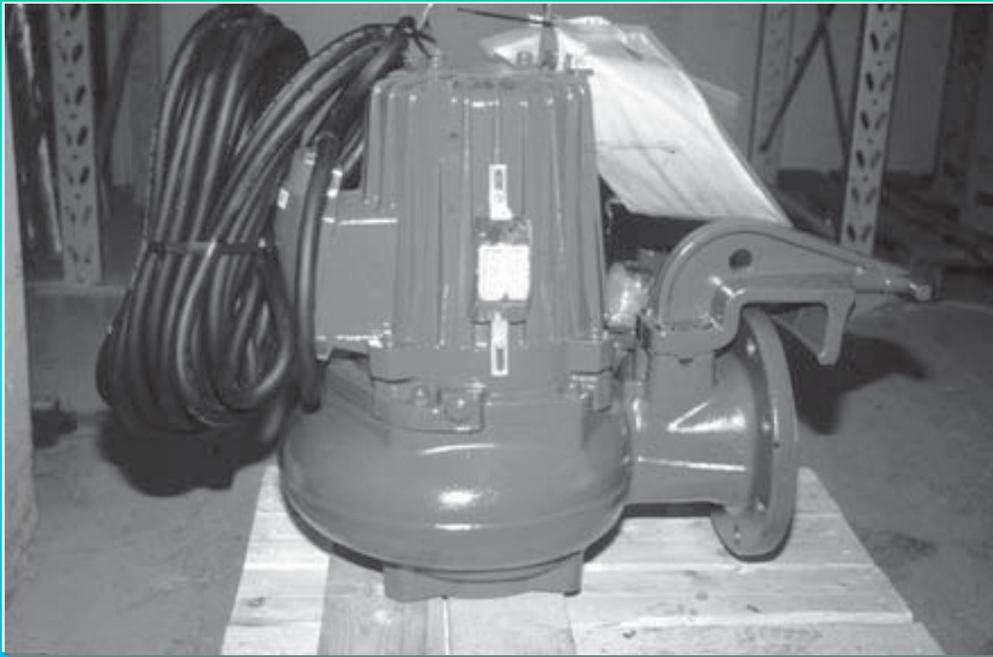
The ejector pump is based on another principle. Here a part flow under high pressure is used to draw a main stream with much higher water flow but lower pressure.

In air-lift pumps, air is supplied inside an open pipe standing partly below the surface and partly filled with water. The air bubbles will then drag the water towards the surface and in this way a water flow is created inside the pipe. This principle may be used to pump water, add air (aeration) and for fish transport.





Dry Placed Pump



Sub-merged Pump

