

3.5 TYPES OF PUMPS USED IN CONSTRUCTION

Water pumps are commonly used on construction sites to remove excess water accumulated due to heavy rain or high-water table. They primarily serve two purposes: keep water out of foundations, tunnels, and other excavations pits; and provide a supply of water for jetting and sluicing, pumping water for cofferdams, etc.

The choice of water pumps for construction sites is dependent on the complexity of the project, the amount and rate at which the liquid is removed, the type of liquid, the loss due to friction, the height of suction lift, and the size of the pump.

Factors Affecting Selection of Water Pumps for Construction Site

1. Power of the pump
2. Material of the pump
3. Motor type or fuel type of the pump
4. Head required by the application

Types of Pumps for Construction Sites

The different types of pumps used for construction are:

1. Centrifugal pumps
2. Displacement pumps
3. Submersible pumps
4. Air-lift pumps

1. Centrifugal Pumps: A centrifugal pump consists of a rotating impeller that moves water into the pump and discharges it. The rotating impeller creates a vortex as a result of which air is taken from the external environment and the developing atmospheric pressure causes the water to rise through the pump.

All the liquids can be pumped using a centrifugal pump irrespective of their viscosity.

These pumps work efficiently even with thin liquids. In certain situations, the casing of a centrifugal pump is filled with vapors or gases that inhibit pumping. Such situations demand the priming process. Priming is the process of filling the casing of the pump with liquid before starting the pump. There are self-priming centrifugal pumps that have water in reserve within the impeller chamber. Centrifugal pumps can be electric, hydraulic, gas-powered or manual type. These are often used in tunnel and foundation construction pits to handle oil, sludge and sewage.

Properties of Centrifugal Pumps

1. Centrifugal pumps are employed to pump water in facilities where pneumatic systems are compatible, and there is no requirement for suction lift.
2. It is used to pump water from domestic wells.
3. Centrifugal pumps convey continuous pressure source for the fire protection system. It can help enhance the pressure in water intake lines.
4. These can act as a sump pump in either vertical or horizontal configurations.
5. Centrifugal pumps require recirculating liquid to prevent the issues due to overheating. This is mainly caused due to low flows.
6. Proper operation of centrifugal pump requires priming.

2. Displacement Pumps: Displacement pumps can be classified into:

1. Reciprocating pumps

2. Diaphragm pumps

Reciprocating Pumps: Reciprocating pumps work based on the movement of the piston in a cylinder. Large reciprocating pumps possess 2-3 cylinders. When the piston moves in one direction, the water is drawn into the cylinder. When the piston moves to the rear end, the water is pushed out.

Reciprocating pumps gain high efficiency and are reliable. They can pump the liquid at varying heads with uniform discharge. These are best suitable for low-flow conditions.

Diaphragm Pumps: Diaphragm pumps work by drawing water into the cylinder during the raising and lowering of a diaphragm. When the diaphragm moves out, water is sucked into the cylinder. As it moves down, it is discharged to the delivery pipe. Diaphragm pumps can deliver liquids that contains 10 to 15% solids and can work with water with varying flow characteristics.

3. Submersible Pumps: Submersible pumps or sump pumps or electric submersible pumps (ESP) lowers the groundwater and remove water from a deep sump. The pump unit consists of a sealed motor close-coupled to the pump body. The whole unit is submerged in the fluid to be pumped.

The sump pump consists of a centrifugal unit and a motor mounted in a single cylindrical unit as shown in Figure-3. There is a space between the pump and casing that facilitates the movement of water up to the rising main. Submersible pumps are used for heavy- duty pumping in construction which mainly involves lifting of gritty water.

4. Airlift Pumps: Airlift pump consists of a vertical pipe that is submerged in a well in such a way that a major portion of the pipe lies below the water level. Compressed air is blown to the lower point through an air inlet. The air at the bottom carries the water up the pipe and finally to the delivery area. Airlift pumps

are mainly used for moving silt from the base of a cofferdam.

What are the factors affecting selection of pumps for construction site?

Factors that govern the selection of water pumps are:

1. Power of the pump
2. Material of the pump
3. Motor type or fuel type of the pump.
4. Head required by the application

What are the uses of diaphragm pumps in construction sites?

Diaphragm pumps can be used to deliver liquids that contains 10 to 15% solids and can work with water with varying flow characteristics.

What are the uses of submersible pump in construction sites?

Submersible pumps are used for heavy-duty pumping in construction which mainly involves lifting of gritty water.

3.6 EQUIPMENT FOR DE-WATERING DEMPLATION AND GROUTING

DEWATERING: Dewatering is a term to describe the removal of groundwater or surface water from for example a construction site. In construction the water is pumped from wells or sumps to temporarily lower the groundwater levels, to allow excavation in dry and stable conditions below natural groundwater level.

Construction dewatering techniques: There is a wide variety of methods used to control groundwater during an excavation. Selecting the right dewatering method is a critical step in almost any construction project. The presence of undesired water in a construction site can lead to safety risks, increased

costs and delays to your project. Therefore, when preparing to excavate the surface or to perform dry site construction work, it is critical to use the right technique to control, manage and remove water. This becomes even more important as the geology and hydrology will vary from location to location.

Main dewatering techniques: Construction dewatering methods refer to techniques such as wellpoints, deep wells, bypass and flood control. In wellpoint and deep wells submersible pumps are installed in a drilled well shaft, while in bypass and flood control pumps are placed in the area that needs to be dewatered.

What are dewatering equipment in construction?

Dewatering equipment are used to perform dewatering, which is defined as the process of separating water from another material like saturated soil or sludge. The separation of water is performed by using a force generated by vacuum or centrifugal motion.

Types of Dewatering Equipment

The common types of dewatering equipment are:

5. Centrifuges
6. Drying beds
7. Vacuum filters
8. Filter presses
9. Sludge lagoons
10. Gravity and low-pressure devices

1. Centrifuges: Centrifuges remove solids from liquids through the process of sedimentation and centrifugal force. As shown in Figure-1, the solids or sludge

are fed through the stationary feed tube.

The sludge moves with an acceleration through the ports in the conveyor shaft, which is then distributed to the periphery of the bowl. The bowl spins at high speed which simultaneously separates water from the solids. The separated solids are compacted against the bowl wall, as shown in the figure. The solids are then conveyed to the centrifuges drying stage and the liquid separated is discharged continuously over the weir arrangements around the sides of the bowl.

2. Vacuum Filters: A vacuum filter is an equipment that creates a vacuum to draw water from the solids. As shown in Figure-2, the filter consists of a drum submerged on a cake or sludge. A filtering medium is placed over the drum. The whole arrangement of valves and pipes is such that the vacuum is applied to the inner side of the filter medium when the drum rotates.

The rotation of the drum draws water from the sludge. When the drum carries the sludge to the atmosphere, the cake layer formed is chipped by a knife blade. The use of vacuum filters avoids the need for heat treatment or digestion before disposal or incineration process.

3. Filter Presses: This equipment uses a filter medium to separate solids from the liquids. A filter press captures the solids in the pores between two or more porous plates. The solids captured are then pushed into the cavities by forcing water over them either through plate pressure or by build-up solid pressure.

4. Drying Beds: It consists of a perforated or open joint drainage pipe placed within a layer of gravel base, which is again covered with a layer of sand. The sludge collected is placed over this sand layer and allowed to dry. The water from the sludge is removed by evaporation and by gravity movement to the underlying gravel base. This water is taken out through the drainage pipe placed in the gravel

base. With time, the sludge dries, and cracks develop on the surface. These cracks allow the evaporation of lower layers of the sludge.

The design parameters of a drying bed include:

- i. Depth of sludge
- ii. Moisture content of sludge
- iii. Availability of sand bed area

5. Sludge Lagoons: Sludge lagoons are excavated areas that are used to deposit and dry the sludge for several months to years. The depth of a sludge lagoon can vary from 2-6 feet.

6. Gravity and Low-Pressure Devices: These devices make use of a set of drying beds and low-pressure pressing devices. The low-pressure belt presses and the gravity bed allows increased solid-water separation. The equipment offers simplicity, low cost, less noise, low energy, and maintenance costs. This is a good choice for smaller treatment and operation plants.

GROUTING: The method of using grout to repair cracks in concrete, fill gaps in tiles, seal joints and stabilize the soil, etc. is called grouting. Cementitious grouting is a process in which a fluid cementitious grout is pumped under pressure to fill forms, voids, and cracks. It can be used in several settings including bridges, marine applications, dams, and rock anchors.

The grouted mass has an increased strength, stiffness, and reduced permeability. Grouting is used to provide additional strength to a building's foundation and structure. It is also used to repair cracks in concrete, fill gaps in tiles, seal joints, and stabilize soils.

What is grouting equipment? It is used to repair machine foundations, base plates, load-bearing, and pillar joints in prefabricated structures. Grouting is used

to fill gaps, cracks in concrete structures. Used for repairing footpaths and the ground under foundations.

Types of Grouting

- 1) Cement Grouting.
- 2) Chemical Grouting.
- 3) Structural Grouting.
- 4) Bentonite Grouting.
- 5) Bituminous Grouting.
- 6) Resin Grouting.

What is grouting equipment?

It is used to repair machine foundations, base plates, load-bearing, and pillar joints in prefabricated structures. Grouting is used to fill gaps, cracks in concrete structures. Used for repairing footpaths and the ground under foundations.

The materials used for grouting depends upon different factors such as the type of soil or rock and the area to be grouted.

Types of Grouting using equipments

- Permeation Grouting.
- Compaction Grouting.
- Jet Grouting.
- Rock / Fissure Grouting.
- Compensation Grouting.

Permeation Grouting: It is a type of grouting in which grout is injected into the soil to fill the pores and joints without disturbing the soil's structure and volume. Thus, it permeates coarse and granular soils creating a cemented mass. Various types of binders are used in this grouting technique, the choice mainly depends upon the permeability of soil. It is also known as cement grouting or pressure grouting.

Compaction Grouting: This type of grouting involves injecting a thick consistency soil-cement grout under pressure into the soil mass, consolidating and thereby stabilizing surrounding soils. The grout mix is designed in a way so that it does not permeate the soil voids or mix with the soil. Instead, it displaces the soil into which it is injected.

Jet Grouting: In this type of grouting, high-velocity fluid jet is used to physically disrupt the ground. The soil is eroded and grout is mixed with the soil during the process and thereby improving it. It is costly than permeation grouting. There are three system of jet grouting: Single, double and triple jet system.

Rock / Fissure Grouting: Rock grouting is fully or partly filling of fissures, fractures, or joints in a rock mass by grout injection without creating new or opening existing fractures. The grout is injected under pressure through a gap drilled into the rock mass for treatment. This type of grouting is normally done in fissured rock to reduce the flow of water along the joints.

Compensation Grouting

In compensation or fracture grouting, cement slurry grout is injected into the soil in excessive pressure to form root-like or skinny lenses within the soil mass. The root-like lenses compact the nearby soil and help to lift the overlying soil and structures. It considerably increases the density of soil mass and its macroscopic strength.

Application Of Grouting

- Stopping water flows in mines, tunnels, parkades, dams, and underground structures
- Soil stabilization.
- Underpinning structures, mining applications.
- Bearing capacity improvements.
- Reducing and correcting settlement.
- Ground improvements.
- To Provide excavation support.
- Filling the void between the lining and the rock face in tunnelling.
- Unusual and difficult geotechnical and structural problem.

2) EQUIPMENT FOR DEMOLITION

Demolition is tearing down of building and other man-made structures but it is different from deconstruction. The task of demolition usually involves falling down a lot of dust, metal and concrete, however, every demolition project is unique in its own way.

Therefore, the demolition task requires careful consideration about the way the task has to be carried out and the machinery that should be used. Depending on the size, location and surrounding environment of a demolition project, the construction machinery is chosen.

Generally, demolition projects can be broadly classified into two categories i.e., low level demolitions which involve demolition of houses and other small buildings and high-level demolitions which involves pushing down of multi-storey buildings, big dams and other bigger tasks. Different types of construction machines are used to carry out the two types of projects.

Excavators: These are the most commonly used construction equipment for demolition tasks. Typically, excavators are steady, powerful and extremely work-efficient machines. Excavators consist of a boom, dipper or stick, bucket and cab on a rotating platform known as the house.

This house sits on the top of an undercarriage with tracks or wheels. Excavators are usually employed together with loaders and bulldozers. From demolition of small buildings to multi-storey towers, excavators can be employed easily.

They can be used on various building structures such as steel, concrete and mixed material. Essentially, Hydraulic Excavators are employed for demolition of small buildings and Long Reach Excavators are used to demolish bigger buildings. The best part is both the Hydraulic and Long Reach Excavators have the ability to perform a number of different tasks with the use of different attachments such as grapples, pulverisers, claws, hammers, shears, buckets, thumbs etc.

If we talk about long reach excavators particularly, then having a long arm attachment and boom section, this strong equipment is usually used for the tough demolition tasks where breaking of tough walls and solid structures is required. This excavator's long arms permits the machine's operator to stay at a safe distance from the demolition site, yet perform the job successfully in minimum possible time.

Backhoe Loaders: They are generally used for small demolition purposes. They

have a front bucket that allows them to work as a wheel loader and an excavator-style digging mechanism at the back. Consisting of three segments i.e., boom, stick and bucket, backhoe loaders come with extensive range of attachments like Hydraulic Breaker which can be used for breaking tough materials such as rock or concrete while demolition tasks.

Skid Steer Loaders: Considered to be one of the most versatile, compact, rigid and powerful equipment and best choice for smaller sites, they are used to perform demolition tasks easily. The front bucket of the machine can be replaced with various types of attachments like hydraulic breaker, pallet booms, auger, mower, snow blower etc., to execute different jobs. Unlike other machines, these do not have steering mechanism for wheels which are mechanically aligned with the side body of the equipment.

Wheel Loaders: They are like tractors and are used to move a pile of material from the ground and load it onto a dump truck or into an open pit. They are also known as front loaders or bucket loaders. They consist of a front-mounted square wide bucket joined to the end of two arms used to scoop up materials from the ground without spreading it out. They are great for loading scrap and debris. Wheel loaders come in various sizes and are designed for fast movement and demolition.

Crawler loaders: Not only this equipment can move heavy dirt piles and materials but they can be very helpful in the demolition field of the construction industry too. They can be extensively used to push down the heavy structures.

Further, with the metal tracks, a crawler loader can track up onto the piles and clear out narrower areas easily.

Bulldozers: Referred to as only dozers sometimes, bulldozers are one of the most heavy-duty and powerful equipment and largely employed for shifting huge amount of dirt piles, cut roads and other demolition tasks. They are incredibly

strong equipment and easily identified by the huge blade at the front which is controlled with the use of hydraulic pistons and ripper at the back. The machine comes in variants with tyres and tracks. They are also commonly employed for demolition tasks.

Cranes: Generally, for high level demolition projects, cranes are used. A heavy-weight wrecking ball is attached on a cable that is swung by a crane onto the side of the big buildings to push it down. In fact, it is the only single machine which as a single piece is capable of providing three-dimensional movement of a weight. It is generally equipped with a hoist, wire ropes or chains and sheaves that can be used both to lift and lower materials and to move them horizontally. Cranes can be broadly classified as stationary or derrick cranes, mobile cranes, overhead or gantry cranes, traveller cranes and tower cranes.