4.3 PUMPING EQUIPMENT READYMIX CONCRETE

Pump is a mechanical device for transferring fluid from lower to upper point or from low-pressure zone to high-pressure zone. Pumps simply remove liquid from a volume of liquid, whereas dewatering equipment separates water from another material such as soil or sludge. They can be used for a number of different operations, including: Keeping water out of foundations, pits, tunnels, and other excavations.

Pumping equipment can greatly differ by design, as well as by operation principle and application, there are, however, several governing parameters, which are common for all of them. These are flow rate, head, power, and efficiency coefficient.

1) Flow rate is determined by fluid volume, which can be transferred by pump within unit of time. The unit of measurement is m^3/sec.

2) Head is a value, which represents quantity of energy delivered by pump to transferred fluid mass unit. The unit of measurement is meter.

3) Power is generally subdivided into consumed and useful. Useful power is directly spent for media transferring. Consumed power stands for power, which is delivered by motor to pump. The unit of measurement is Watt.

4) Efficiency coefficient establishes relationship between consumed and useful power and characterizes effectiveness of pumping equipment operation. More advanced construction of pump provides for less power losses, and this leads to higher efficiency coefficient.

Besides main characteristics, it is possible to highlight several secondary qualities, which would determine applicability of particular pump for given specific area. This can be noise level during operation, flow path resistance to corrosion, type of hermetic sealing, service life, availability or absence of self-priming function etc.

Application of pumping equipment

Depending on specific task, the pumping equipment of different design and operating principle can be applied in the same area. Here we will discuss come of pumps' groups, which are associated by their purpose.

Metering pump – pumping equipment intended for dosing preset quantities of fluid. Positive displacement pumps are ideal for this purpose: piston, membrane etc. They allow for metering of preset quantity of transferred medium and prevent backflow of fluid. In order to execute such function these pumps might be provided with additional systems or have some design particularities. Piston pumps can be equipped with several working cavities, which are actuated from single drive and have offset operating cycle relative to each other.

Some models are additionally equipped with mechanism for adjusting the cavity working volume in order to provide more accurate dosing. For control and dosing, the pumps of this type are equipped with stepper motors or other control devices, sothe operating device would execute preset quantity of movements. Particularities of implemented type of pump are also considered for dosing purposes. For example, membrane pumps are used, when metered fluid is poisonous, chemically aggressive or explosive.

Slurry pump – pumping equipment, which is intended for withdrawal of fluids with high content of solids of various sizes. It can be bottom sediment from various reservoirs, tanks and foundation pits, river sand and slurries. Slurry pumps can be of regular submerged or semi-submerged construction. Centrifugal pumps are usually implemented for these purposes.

Meanwhile additional requirements are applied for them: resistance to abrasive wear and ability to transfer medium with high content of solids. These features are provided by usageof wear-resistant materials and selection of optimal relation between impeller rotation speed and impeller size, since if rotation speed

lowers, abrasive wear ofits elements increases and size increases accordingly.

Booster pump – functions as a component part of pumps units and intended for pressure increasing or providing additional vacuum in system. Has design of vacuum pump (can be of oil-vapor, steam-jet, mechanical etc.). It is used in water supply system for increase of head. Booster pump can be installed before main operating pump in order to provide operation of latter in mode without cavitation or to provide intake of fluids from remote vessels.

Mud pump – single-purpose type of pumping equipment, which is implemented in drilling equipment and intended for providing mud fluid circulation in drilled well. Construction of such pump can be of rotodynamic or positive displacement type. Axial, plunger and piston types of pumps are used.

Such severe operation conditions are reason for several requirements for mud pumps. They must provideconstant and uniform feed of mud fluid in order to prevent unwanted influence ofpulsations. Meanwhile they should be powerful enough to circulate fluid and be resistant to abrasive wear by circulated fluid and should provide for possibility toquickly repair and replace broken parts.

Deep-well pump – pumping equipment mostly of semi-submerged design, when below level of pumped fluid there is only operating device – impeller. These pumps have long cylindrical body, which simplifies installation into operating position. Deep-well pumps are able to create high head, enough not only for fluid lifting, but for its feeding trough pipeline as well.

As the name implies, the deep-well pump is applied for fluid lifting out of variouswells and pits. They can be used for water supply from artesian beds and for pumping water out of flooded basements and trenches. Submerged pumps can bealso used in mining, chemical, construction and other industries.

Foam pump – pumping equipment, which is intended for transferring of emulsions and pulps with various coefficient of phases. Vertical foam pump is

construction combined in one device and consists of engine, dedicated reservoir and centrifugal pump. Distinguishing feature of foam pumps is conical reservoir with tangential emulsion intake. Rotating impeller creates vortex cavity of transferred medium in this intake, where gas part is separated and liquid part falls onto working impeller and discharged into nozzle.

Main feature of this type of pumps prescribes its area of application. Foam pumpsare used in any facilities, where it is necessary to transfer various types of emulsions. Such pumps are used in waste treatment facilities, where it is necessary to remove floating layer in floatation facilities and in enrichment plants, oil-producing and oil-refining facilities. Foam pumps are also used for construction, since they are able to pump construction mixes.

Fire pump – basically it is console centrifugal pump, which is outfitted for firefighting purposes. Since centrifugal pump does not have self-priming ability, it can be connected to vacuum pump for priming if water is drawn from water body. If firefighting fluid is drawn from tank, which is located above level of suction nozzle, then priming is not necessary.

Fire pump can be additionally equipped with pressure gage and system for head dynamic change in order to prevent damage to pump or firefighting hose in case latter was quenched or clogged. If foam mixture is used for firefighting, then fire pump will be equippedwith foam mixer for foaming, where pumped water is mixed according to preset proportion with foam-producing agent, which is delivered from separate vessel.

Other pumping equipment:

Canned motor pumps

Pumping stations and

units

Pumps for formation pressure maintenance

Pumping equipment with magnetic couplingPneumatic pumps

Rotary-vane pumps

READY-MIX CONCRETE EQUIPMENT

The concrete equipment of a Ready Mixed Concrete plant generally are:

1. Material feed system
2. Sand making machine
3. Storage system i.e., hopper and cement silo
4. Weigh hatching system and reversible type mixer
5. Transit mixer
6. Pumping system

Cement Input and Delivery: This consists of a cement silo. It receives cement by vertical screw movement. From silo, cement can be delivered by a slant screw movement. On its way it passes through a weigh hatching bin connected to a scale which ensures correct weight

Aggregate Storage: Depending upon the requirements, four compartments can be provided to store the aggregate. Three of these compartments can store coarse aggregate of different grading after they have passed the vibrating screens. If good natural sand is available then the same can be used, otherwise a sand mill is incorporated to produce artificial or crushed stone sand conforming to IS: 383-1970. The aggregates pass through weighing bins before reaching the mixer.

The Batch Plant: The batch plants are available in three categories namely manual, semi-automatic and automatic. In semi-automatic plant, the charging and discharging of batches are activated manually but are automatically terminated. In a fully automatic plant, a single starter switch activates the batching sequence,

the weight and volumes of which have been already programmed into the system. Sometimes the plants have both manual as well as fully automatic system. At Nave Sheva near Bombay the plant used was of this type and had a capacity of 80 cm/hour.

The central console was air conditioned and computers were located in it. The design mix program data is punched in thecard and inserted in the computer. In the auto mode, the exact quantities as per the design for aggregates, cement, water and admixtures are delivered to the mixer. The mixing time is around 40 seconds. The water together with admixturesis atomized and sprayed ‘on to the mix to ensure thorough mixing. The concreteis then discharged by bottom slide gates of plan directly to the waiting transit mixers. The batch plant could have capacity to mix 0.75 cum onward at a time in the pan.

Transit Mixer: The transit mixers are available in several sizes in international and Indian markets varying from 2 to 6 cum capacity. A minimum of 2 nos. are required for a batch plant. The transit mixer rotates at a speed of about 13 revolutions per minute and keeps the green concrete in an agitated state. During travel, the transit mixer has the facility to mix water of measured quantity.

The efficiency of the batch plant depends on the tale at which the quantity manufactured from the plant is drawn. If insufficient number of transit mixers are employed, then the hatch plant is forced to remain idle for part of the time, thus making the system uneconomical. In order to avoid it, the required number of transit mixers should be procured.

ASTMC 94 allows a maximum of 1.5 hour orbefore the drum had 300 revolutions, whichever is earlier, form the introduction of water to placement of concrete into formwork The mixing in transit mixer usually results in stiffening of the mix resulting in reduction of slump by about 2cms. ASTMC-94 allows the addition of water at job site to restore the slump initially then that required at job site, so that when it reaches the site, the slump is the required one.

Placement of Ready Mixed Concrete (RMC): The RMC arrives at the site.by transit mixers. Now it has to be placed without segregation and before it has achieved an initial set into its final position in the formwork. This placement can be done in different ways according to site conditions.

For example, if the site conditions allow, the concrete could be discharged directly from the transit mixerto the formwork. Another method is use of belt conveyors which are used when large quantities of concrete are involved. However, this system consumes considerable time in erection, maintenance and dismantling.

Another method involves use of buckets and hoppers which discharge concrete at its lowest practical slump by sliding gates. A crane is used together with it to place concreteat distances and heights which cannot be reached by transit mixer. However, concrete pump is a very popular mode of transporting concrete horizontally and vertically.

These are available in both stationery and mobile models with capacities of 20 cumin to 60 cm/hr. Therefore, an efficient ready mixed concretefacility must include one concrete pump.