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# PUMP CLINIC 5

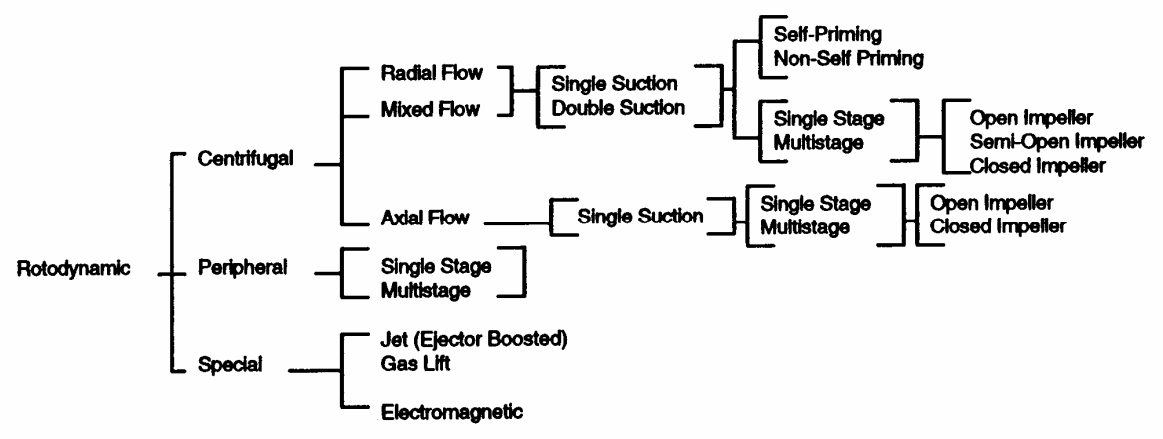
## CENTRIFUGAL OR POSITIVE DISPLACEMENT
## Which pump to choose?

Firstly, let us take a look at the two classifications in question and define both classes discussing the merits of individual types of pumps in each class.

1. Rotodynamic (which the main sub-classification is centrifugal)
2. Positive displacement

### Rotodynamic

Rotodynamic pumps are rotary machines in which energy is continuously imparted to the pumped liquid by a rotating impeller, propeller or rotor.




For this discussion we will not consider the special category as they are rarely used and only under very specific conditions.

Before going on to review centrifugal pumps which account for probably well over 95% of Rotodynamic applications, when do we use a peripheral pump (sometimes called side-channel or regenerative turbine pumps)? They are most definitely not suited to handling solids because for efficient operation, they depend on close clearances between their impellers and guide plates which also limits their viscosity-handling capabilities to under 20mm²/sec.

However, they are ideal for low capacities limited to 10 l/sec at quite high heads up to 310 metres through multi-staging, plus they have a built-in self-priming capability. Finally, many peripheral flow pumps have the ability to handle quantities of vapour mixed with liquid for substantial periods.

Back to what we would all consider true centrifugal pumps, we can, for the purpose of this discussion, consider the following classes:

1. Closed impeller
2. Open Impellers
3. Slurry pumps

In considering these classes we must look at how they handle solids and viscous liquids. Closed impeller pumps below 80mm for example, should not be used for liquids of viscosity greater than, say, 50mm²/sec because the viscous nature of the liquid creates too many internal losses to operate efficiently, and likewise 'lightly muddy' water is about the worst solids they can handle. However, the larger the centrifugal pump, the higher the viscosity it can efficiently pump, such that at over 150mm for example, it can handle up to 800mm²/sec.

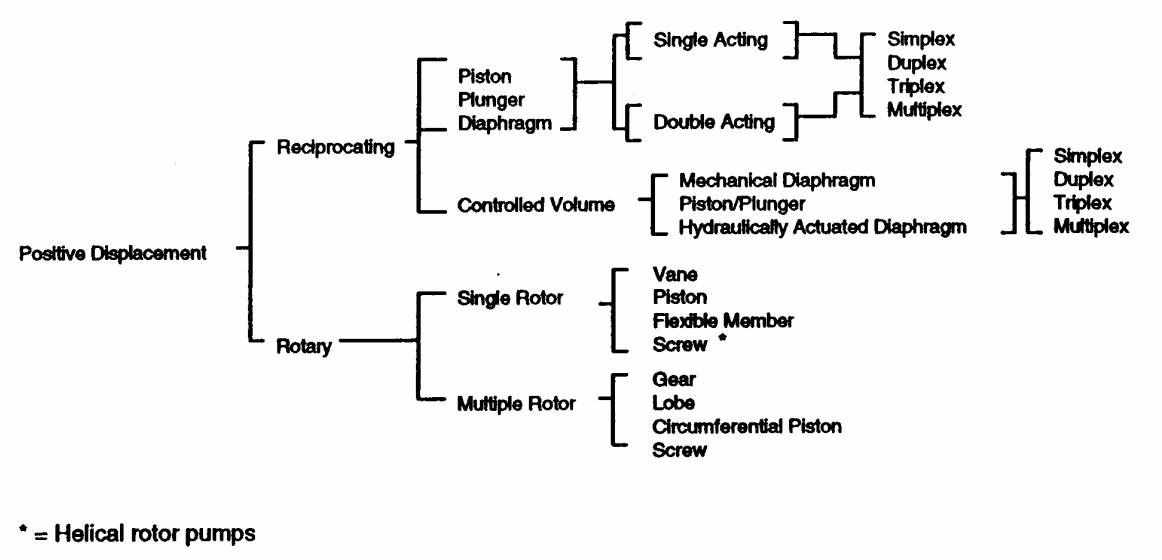
Open impellers can handle solids up to 5% provided that the individual solids can fit through the impeller passage-ways and remembering that high velocities within a centrifugal pump encourage high abrasive wear, if that is a characteristic of the solids. In these cases, a positive displacement pump with its lower internal speeds could be a more economic option as appropriate materials must be selected to accommodate the wear and this can be expensive.

For serious solid volumes, firstly these can be handled in sewage style pumps with single and two-vane impellers that have passages able to pass solids the size of the suction connection, generally beginning at 80mm.

Then we come to true slurry centrifugal pumps which can handle high volume solids, say to 50-60% generally at under 100 metres heads. These are built with large clearances with internal adjustment for wear, plus wear plates and components which are readily replaceable, including rubber-lined parts.

## Positive Displacement

Positive displacement pumps are rotary or reciprocating machines in which energy is periodically added by application of force to movable boundaries of enclosed fluid containing volumes, resulting in a direct increase in pressure.




All positive displacement pumps can handle viscous liquids generally to very high viscosities and most are capable of handling substantial solids with the exception of vane, gear, multiple-screw and some forms of lobe pumps. For clean liquids of low viscosity, again many positive-displacement pumps can handle these liquids. However, many rotary types do not do it economically because of slippage of thin liquids (low viscosities) through their clearances i.e. gear, lobe and multiple-screw pumps.

For positive displacement pumps it should be remembered that in sizes up to say 50mm discharge, the capital costs generally are similar to centrifugal pumps.

However, after that, the positive displacement pump rapidly increases in cost, such that a 150mm discharge-type pump can cost many times that of a standard centrifugal water pump.

## Conclusion

The above supports, in general, the basic conclusion that:

1. Centrifugal pumps are for low viscous clean fluids
2. Positive displacement pumps are for slurries and viscous liquids

However, there are some important instances which do not follow these basic conclusions:

a) Slurry applications, e.g. 80mm discharge and above and generally below 100m head should be centrifugal.

b) For clean liquid duties below 3 l/sec and above, 180 metres total head positive displacement pumps should be considered.

c) For viscous liquid applications with up to 800mm²/sec viscosity and capacities above 70 l/sec a centrifugal pump should be considered.

d) Generally, raw sewage applications should use centrifugal pumps

e) All applications below 0.5 l/sec should be positive displacement pumps

To conclude, every pump application should be individually considered as to the type of pump most suitable.

If in doubt, consult your pump supplier.