# Hydraulics Section III: Pumps

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# Citation

Trotta, P.D., and J.O. Ramsey. 2005. Hydraulics III: Pumps - PowerPoint Presentation. *in* (M.A. Gross and N.E. Deal, eds.) University Curriculum Development for Decentralized Wastewater Management. National Decentralized Water Resources Capacity Development Project. University of Arkansas, Fayetteville, AR.

# Section Objectives:

- Know the different types and classes of Pumps and the best applications of each
- Understand how to optimize the Pump Design Issues to maximize pump effectiveness
- Use Affinity Law calculations
- Understand main characteristics of pumps used in onsite

# Classification of Pumps

Among the many types of pumps available are:

Special-Effect Pumps

Gas Lift

Electromagnetic

Gear

Jet (Eductor)

Rotary

Hydraulic Ram

Force

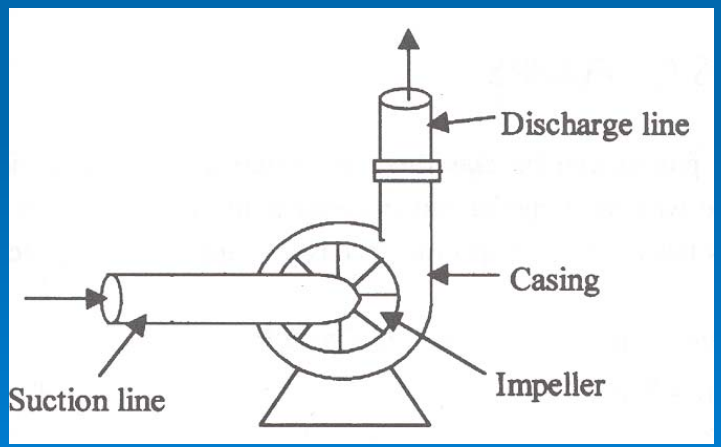
Grinder

Positive Displacement Pumps

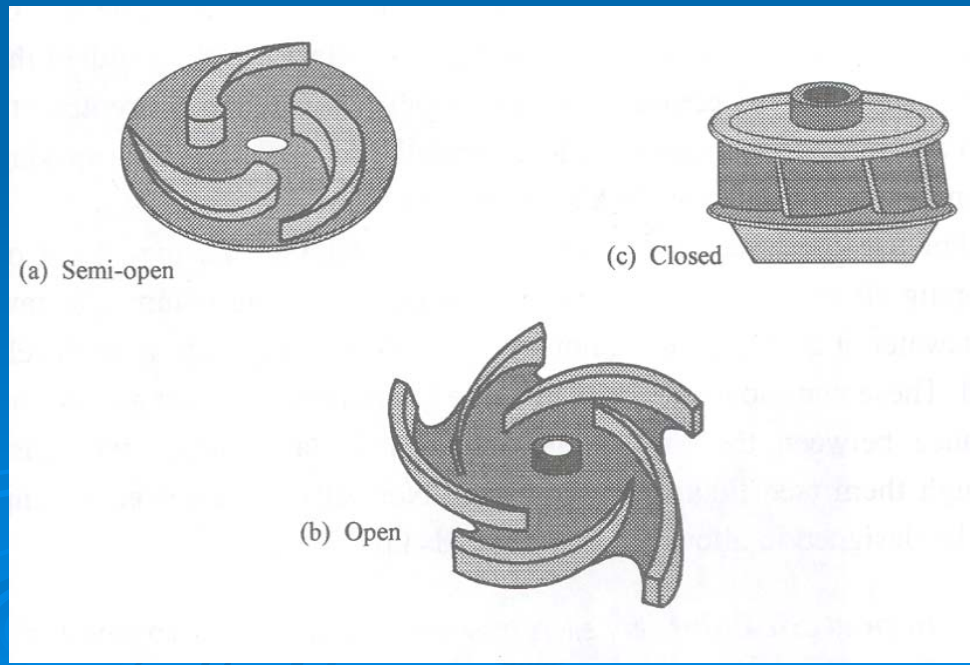
# Centrifugal Pumps

- Centrifugal pumps are the most widely used pump
- Centrifugal pumps depend on centrifugal forces
- The advantages of the centrifugal pump are its simple construction and operation, space requirements and rotary action.

Centrifugal Pump



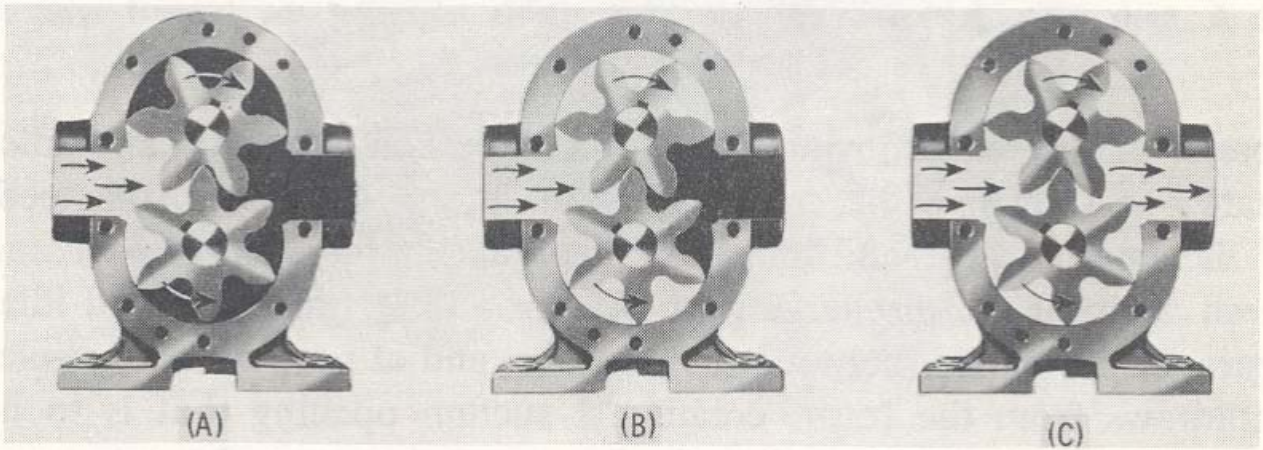

Impeller Designs



# Rotary Pumps

The rotary pump continuously scoops water from the pump chamber. There are three classifications of a rotary pump, gear-type, vane-type and screw-type.

Rotary Pump Section

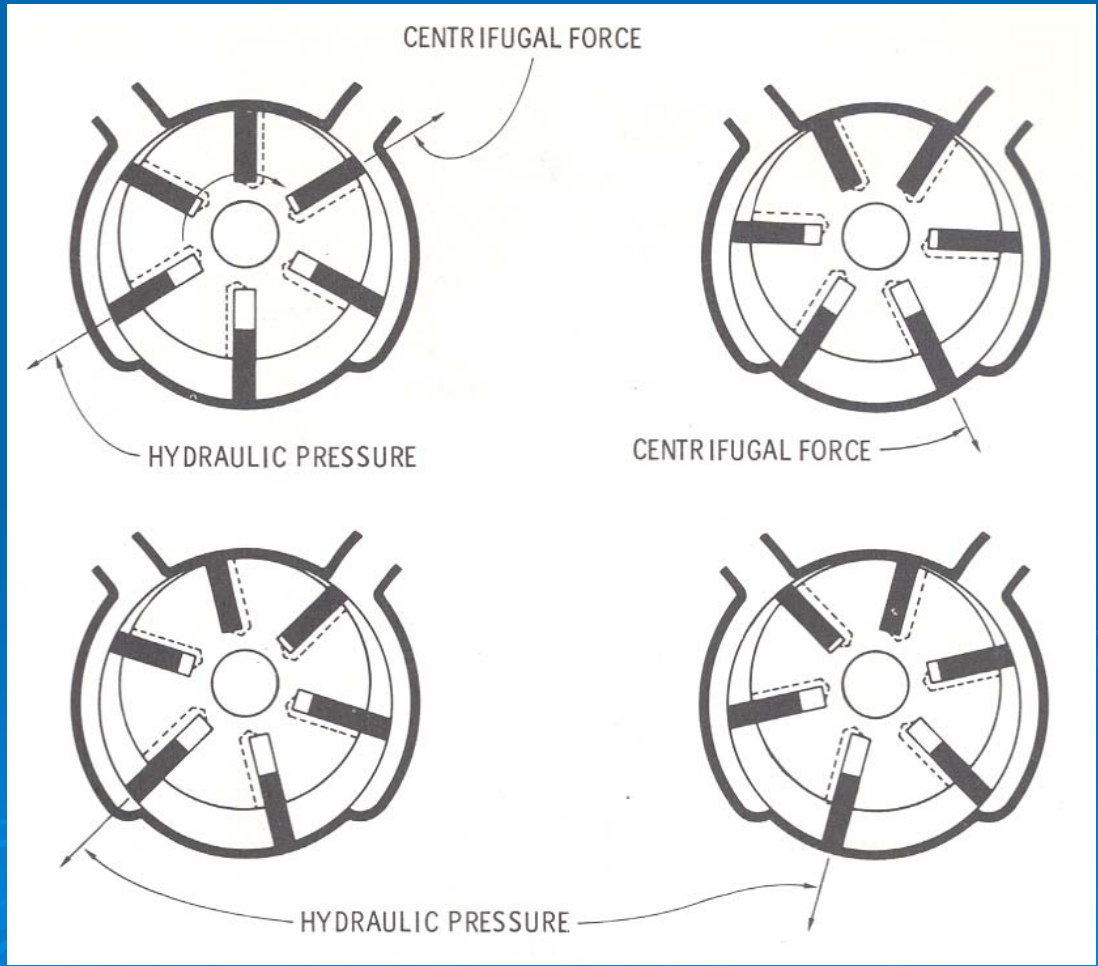



Courtesy Roper Pump Company

**Fig. 2. Movement of a liquid through a gear-type hydraulic pumps: (A) Liquid entering the pump; (B) Liquid being carried between the teeth of the gears; and (C) Liquid being forced into the discharge line.**

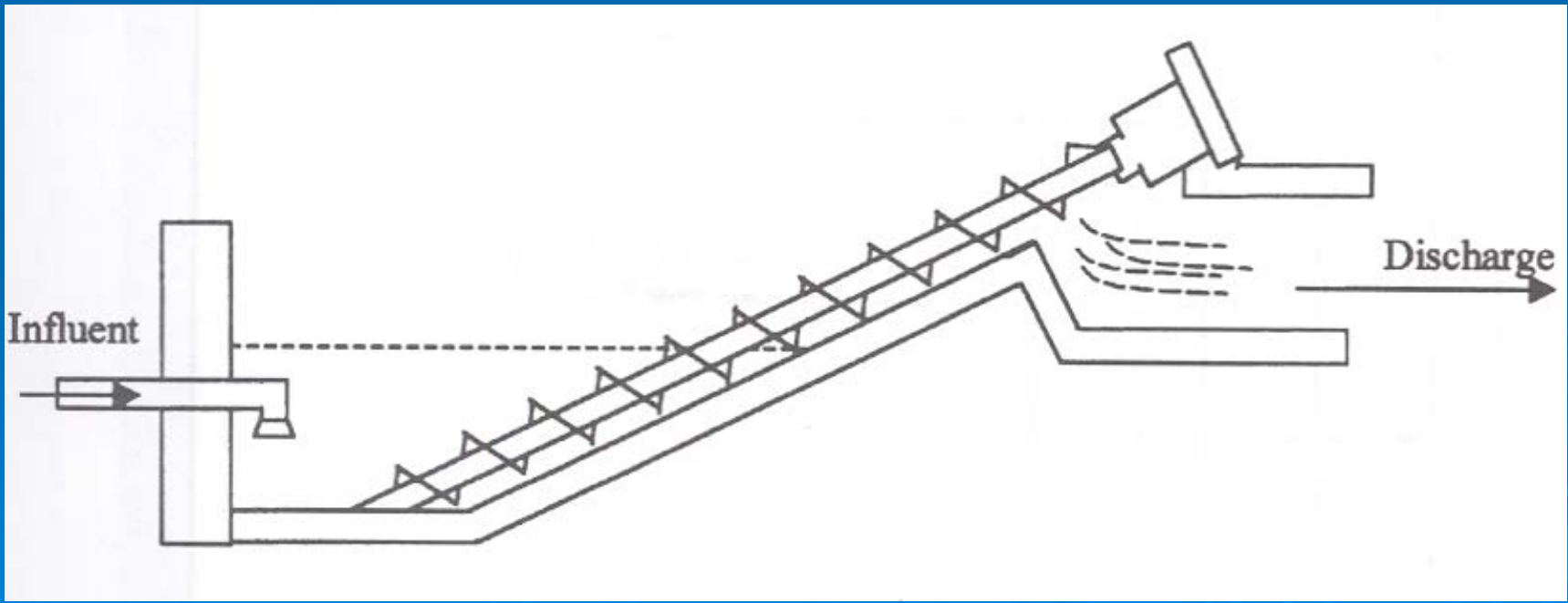
# Rotary Vane Type Pump

Operation is based on increasing the size of the cavity to form a vacuum and then forcing the fluid out under pressure by reducing the size of the cavity.



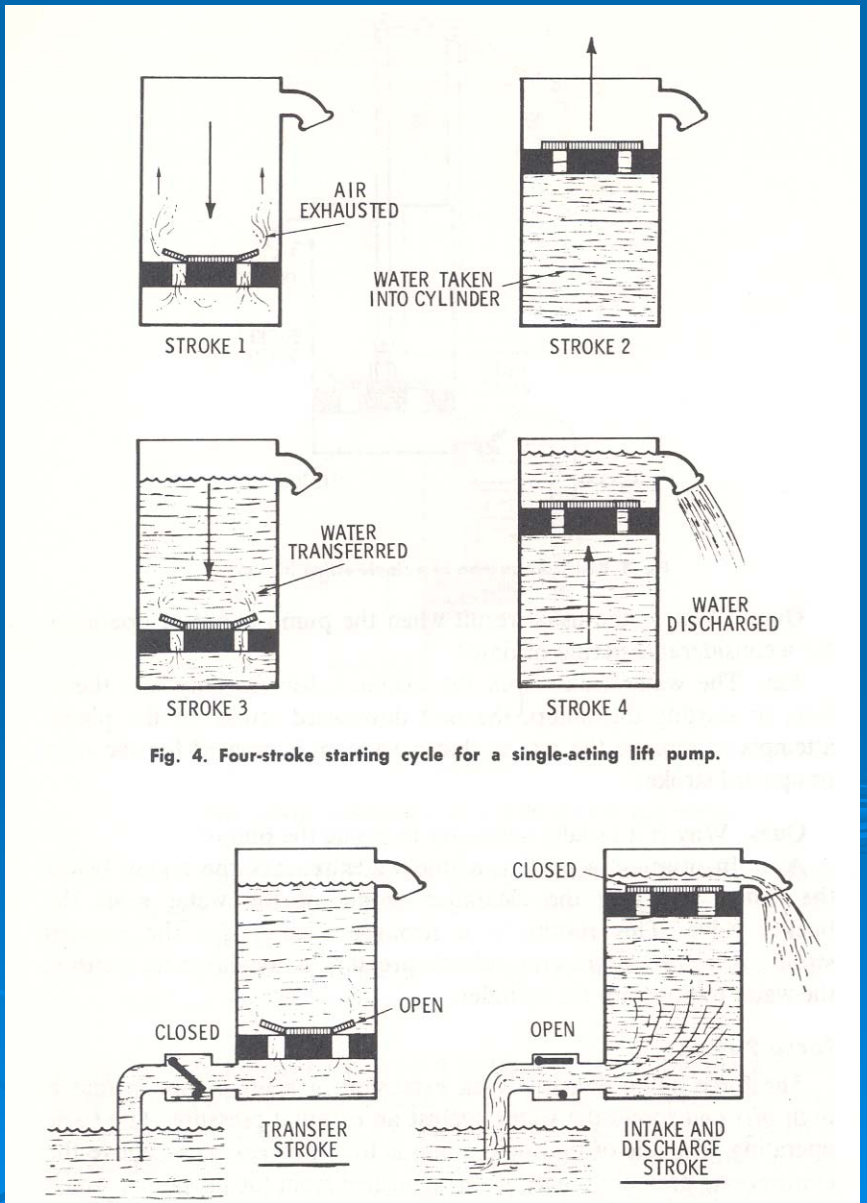
# Screw-Type Pump

- Liquid is carried between screw threads on rotors and is displaced as the screws rotate and mesh.



# Reciprocating Pump

- A piston or plunger differentiates the reciprocating pump from a centrifugal pump.
- Two types: the lift pump and the force pump.



# Lift Pump

The force pump actually lifts and forces the water against an external pressure.

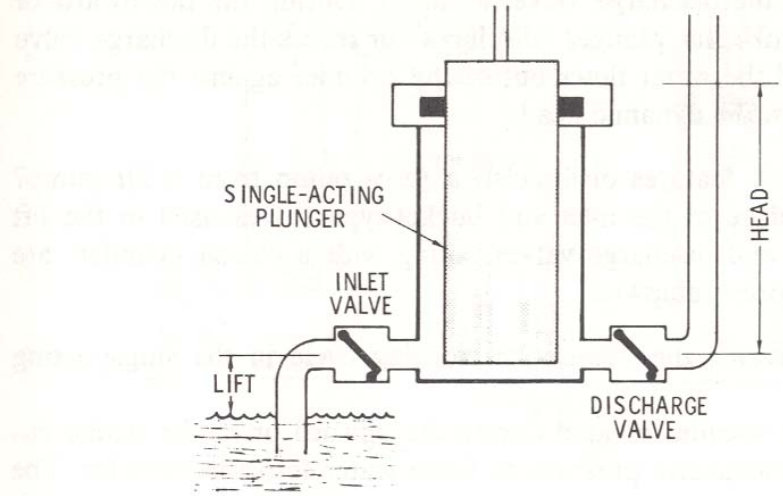
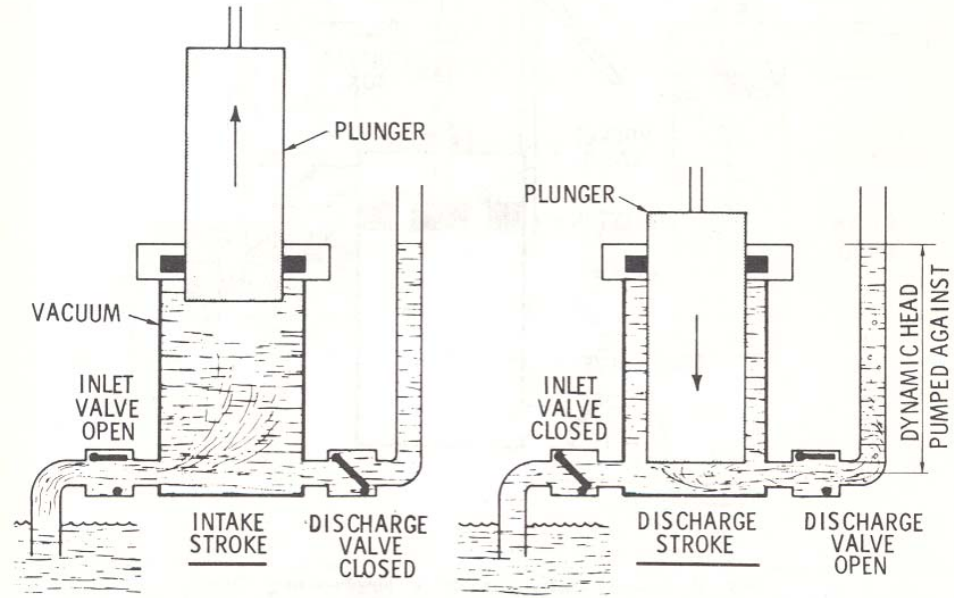



**Fig. 6. Basic construction of a single-acting plunger-type force pump.**



# Pump Design Issues

## Efficiency:

The difference between the brake and hydraulic power is the friction power or friction horsepower and is accounted for by the pump efficiency.

## Steep versus Shallow Performance Characteristics

A steep pump curve will provide a stable flow over various pressures.

Shallow pump curves will provide a steady pressure with varying flows.

# Pump Design Issues

## Horsepower

When pushing water the pump performs work. The two basic terms for horsepower are Hydraulic Horsepower and brake horsepower. When pushing water two basic terms for horsepower are hydraulic horsepower (whp) and brake horsepower (bhp).

## Affinity Laws

Pump performance may be changed either by changing the impeller, motor or both. To change the pump performance characteristics certain basic laws are valid for all centrifugal pumps. These laws are called the affinity laws.

# Pump Design Issues

## Multiple Pumps

Series pump operation is achieved by having one pump discharge into the suction of the next.

Parallel operation is achieved by having two pumps discharge into a common pipe.

## Characteristics of Pumps used in Onsite

a. Ability to pass solids
b. Relatively flat head versus discharge curve
c. Two Phase versus Three Phase Power
d. Impervious to Sewage Characteristics
e. Easily Maintained and/or Replaced
f. High Head for systems using orifices