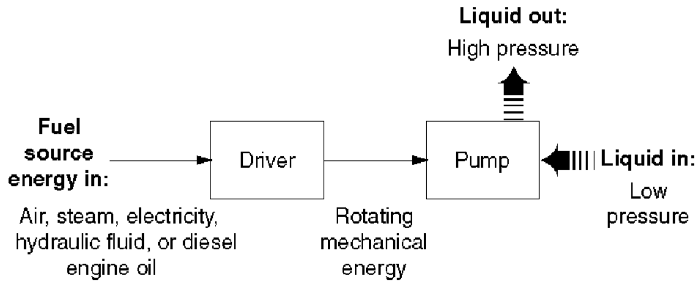
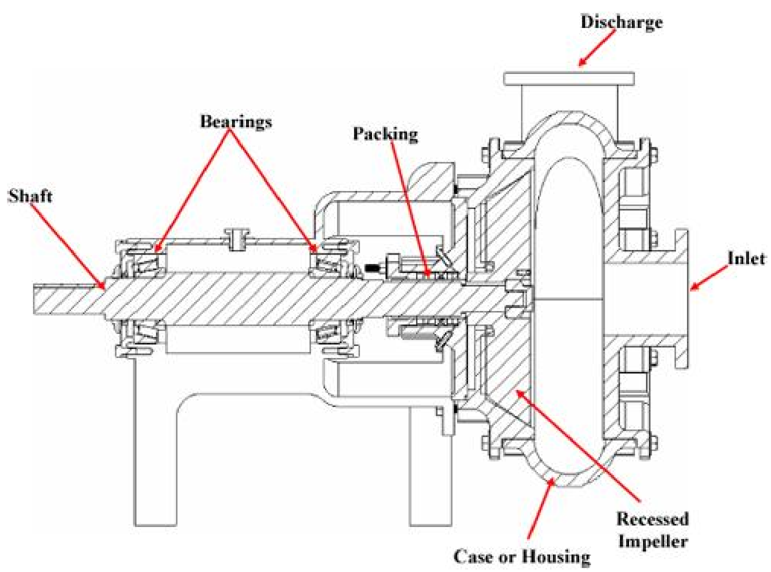
INDUSTRIAL PUMP BASICS



What is a pump?

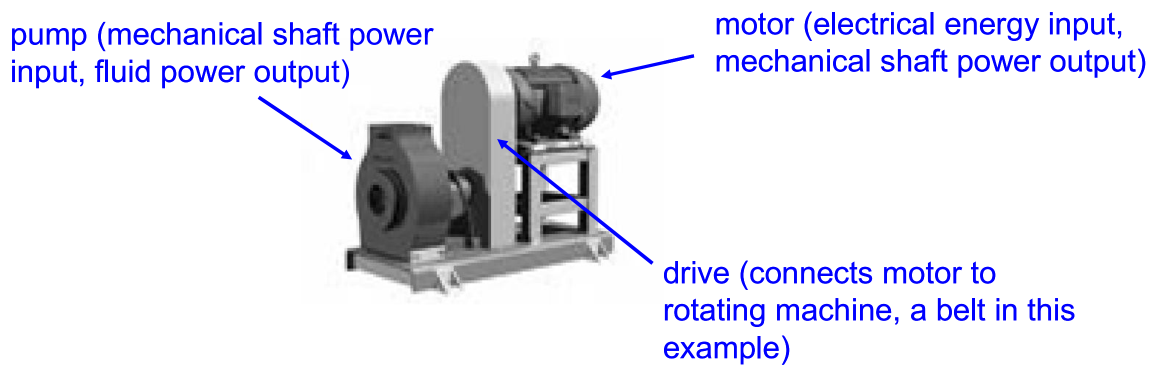
A pump is a machine that increases the pressure of a flowing liquid.

Pump construction and terminology: impeller (a.k.a. rotor or wheel), housing (casing), shaft, bearings, other mechanical parts as illustrated below.



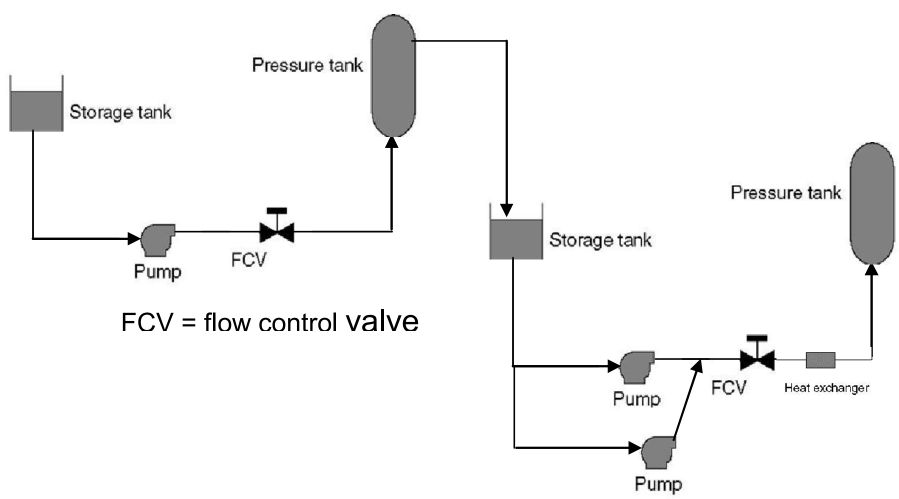
Pump assembly operation: on/off, throttle, speed control drive (direct, VFD, belt & pulley, magnetic).

A typical pump assembly:



Pumps are part of some industrial process ***systems***. What is a system? A system includes pumps and the associated equipment that all work together to do something useful such as deliver water for a cooling system, circulate refrigerant in a refrigeration system or pump sewage in a treatment system.

A sample industrial system that includes pumps:

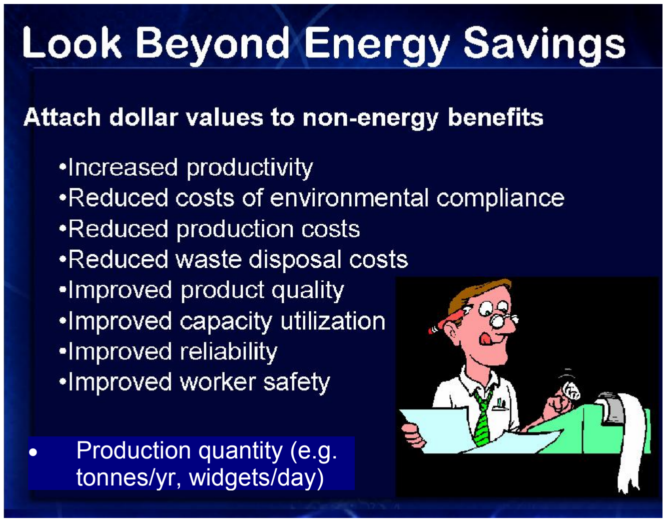


What can be done to reduce the kWhs consumed by pumps?

	Measure	**Range of kWh savings**
Improve pump or pump assembly	Better control (eliminate throttle losses, reduce speed, use it when you need it)	5-50%
	Upgrade or replace with a more efficient pump	10-30%
	Replace V-belt with an energy-efficient "sync" belt	3-5%
	More efficient motor (not usually your best bet)	2-5%
Improve system	Modify the process to reduce flow or pressure required	5-50%

What does Power Smart need to know to help our customers?

Information to ask	**Possible or sample answer**
Description of pump and what it does?	Pumps water, part of refrigeration, …
For each pump: rated motor horsepower (hp)	50 hp
For each pump: hours of operation per year	6 days / week @ 16 hours / day = 96 hours/week (~ 5000 hr/yr)
For each pump: how is it controlled?	On/off (automatic? manual?), variable speed, throttle valve (automatic? manual?)
Any problems with this pump?	High maintenance, fails frequently, difficult to control, not enough capacity, vibrates a lot, overheats
"Look beyond the energy savings"	Are there plans to expand production? Reduce production? Save maintenance costs?



Sample calculation of pump savings in kWh/year and $/year

Information you are given (e.g., from questions you asked on the phone):

1. "Nameplate" information on the motor: 25 hp, 460 volt, 26 amps.
   1.1. Note: information on nameplate is always the nominal, full load rating. Actual motor amps are usually less than nameplate, but sometimes a bit higher. Nameplate power may be horsepower (hp), or could be in kilowatts (kW).
   1.2. To convert hp to kW, multiply hp by 0.746:
   25 hp * 0.746 kW/hp = 18.7 kW
2. 19 amps measured by the customer's electrician.
3. The pump operates 52 weeks/yr, 6 days/wk, 16 hrs/day (5000 hours per year).
4. Average electricity cost is 5.5 cents/kWh ($0.055/kWh).
5. Pump is controlled with a throttle valve.

Information you assume:

1. Based on table on page 3, make a "guesstimate" that 25% can be saved by speed control.
2. Assume motor "power factor" is 0.9.

Calculation:

(a) kWh/yr consumption:

kWh/yr this pump consumes (“baseline”)

kW[1] = volts * amps * √ (3) * (power factor) / 1000

= 460 * 19 * 1.73 * 0.9 / 1000 = 13.6 kW

kWh/yr = 13.6 kW * 5000 hours/yr = 68,000 kWh/yr

(b) potential kWh/yr savings:

About how many kWh/yr can be saved each year?

kWh/yr savings = 0.25 * 68,100 kWh/yr = 17,000 kWh/yr

(c) $/yr savings:

How much money can be saved each year?

17,000 kWh/yr * $0.055/kWh = $940/yr

Additional Resources

1. Improving Pumping System Performance - A Sourcebook for Industry (2nd edition) **http://www1.eere.energy.gov/industry/bestpractices/motors.html**
2. Variable Speed Pumping: A Guide to Successful Applications (2004). **http://www1.eere.energy.gov/industry/bestpractices/motors.html**
3. Guidance for Draft Standard for Trial Use: EA-2-2008 Energy Assessment for Pumping Systems (American Society of Mechanical Engineers) **http://www.cee1.org/files/ASMEEnergyAssessmentforPumpingSystemsGuidancev0.2.pdf**
4. **www.pumpsystemsmatter.org**
5. **www.pumps.org**
6. **www.pumplearning.org**

[1] This is a useful formula to keep handy. It is good for 3-phase power systems, typical of industrial plants. Note that in our homes we have 1-phase power, and the formula is the same *except* take out the √ (3).