Exploring Water Power by Countrylife Archives

The Federal Power Commission has estimated the potential of the nations undeveloped water resources at 470 billion kilowatt hours annually, the equivalent of burning burning 100 million tone of oil costing about $10 billion tons. Although these numbers are for the more major waterways, and are therefore unimportant to the individual homeowner, they do reperesent the poetential that exist. A potential that can be tapped even in small streams and rivers. Just keep in mind that any water power design requires consideration of the wildlife around you. Fishes still need to be able to swim upstream to spawn.

Long ago, a mill-pond would store water overnight to be used by the watermill during the day. This crude form of flow control is obviously impractical today due to it's requirement of flood land. With the advent of electricity producing turbines, flow control was now required to exactly match the power generated to to the power being consumed. The precise flow regulator oftne cost more than the turbine it was controlling flow for.

Neither of these problems exist for owners of small domestic water power plants today. There are many ways to replace the old mill pond. Batteries can store unused energy. A gemini synchronous inverter can interface the utility company's power lines, using their lines as a battery or an energy reservoir. A load diversion govenor can divert the power output from a promary to a scondary load. An alternator govenor regulates the power output to match the load. And improvements have been made to the physical water control, with the availability of simple mechanical waterflow diverter govenors.

The intial step in establishing a water power system is to measure the available power. This requires measuring the the flow and the head of your water source, noting seasonal extremes and averages.

Measuring the flow can be done in a number of ways. The most obvious, but not the easiest is to divert the whole water flow into a container of a known size, and measure how long it takes the flow to fill the container. Another method is to measure the speed of flow of the stream by observing a float on the surface and measuring the flow's crossection. The float should be observed over a straight, smooth section of the waterway on a day without much wind. The crossection measured and then scaled to account for "drag" on the river bottom (a scaling factor of 0.8 for a smooth bottom and 0.6 for a rocky bottom is a good approximation).

The head is the height water falls from the headwater to the tailwater. Piping directing the water reduces the available pressure, or the head. PVC piping has very low friction, and even long sections of pipe will generally cause less than 8% loss of the head. Steel pipes in good condition will have about twice that loss.

Once the flow and head have been measured, it is then simple to calculate your available power. Power = Flow x Head x Efficiency / C Here, the effiency accounts for all non-idealities. There are losses in the head due to friction in the piping (described above). The wheels will covert the mechanical energies with less than 100% efficiencies; 65-80% effiencies are typical, dependant upon the exact type of you turbine.

Belts and gear boxes all conribute losses of 3-10%. And your alternator will only convert the mechanical energy to electrical energy at about 80% effciency. C is a constant equal to 708 cfm ft / kW or 11.8 cu ft ft / sec kW or 102 l m / sec kW.

There are many different types of water wheels, each with it's own benefits and draw backs. You must both evaluate your resources and your needs to choose the proper wheel. Below, there are descriptions of a number of different types.

Overshot Wheel: This is the classic water wheel that naturally comes to mind. They require large heads (generally 6 feet or more) in order for the wheel to clear the tailwater, which is necessary for operation. But they are efficient,usually between 60-65%, and very simple to construct and repair. They have two main drawbacks. They are very bulky, and their slow rpm requires a lot of gearing to step up to what is required by the alternator.

Undershot Wheel: Similar looking to the overshot wheel, the water flows under this wheel. Similar to the overshot wheel, it is simple to construct and repair but it still requires gearing before the alternator. It's unique design allows it to work for heads down to one foot, but it's efficiency is a maximum of 25%.

Pelton Impulse Wheel: This wheel utilizes a large head and is up to 90% efficient. The water is taken from a high head and accelerated through a pipe to a narrow nozzle. This jet is then projected onto a wheel of buckets. The wheel itself can be of a compact design, and gearing is not required before the alternator.

Francis Turbine: The water is directed to the blades of the runner by guide vanes, which can also be used to regulate flow. The runner blades are then turned by the flaling water. This design works efficiently for heads of four feet and up. Efficiencies of up to 80% are possible.

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