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Steam Turbine Drives VS Electric Motors

When there is sufficient low pressure steam load in a facility, steam turbine drives are an attractive alternative to induction electric motors to drive rotating equipment such as pumps, blowers and fans.

Low pressure steam required for building heat, process work, feedwater deaeration, food preparation, absorption chillers, etc. that is supplied from a pressure reducing valve results in 100% of the steam lost to the low pressure system. Utilizing a backpressure steam turbine to drive a rotating machine and then using the exhaust steam for the low pressure system results in re-use of the majority of the heat in the steam for the low pressure needs and eliminates the cost of running an induction electric motor.

Steam turbines require only 2,545 BTUs per horsepower per hour to drive or spin the turbine. The balance of the heat is used to satisfy the low pressure steam load for the facility. Using the constants 778 foot pounds per BTU and 33,000 foot pounds per minute per horsepower this factor is calculated as follows:

33,000 x 60 minutes = 1,980,000 ft. lbs per hour/778 = 2,544.9871 BTUs per hour.

As an example, consider a relatively small 50 horsepower steam turbine with a water rate of 50 lbs/hp/hr at 150 psi (1,196 btu/lb enthalpy) will have a steam consumption of 50 hp x 50 lb/hp/hr = 2500 lbs/hr.

50 x 2,545 = 127,250 btu/hr to operate the turbine = 127,250/1,196 = 106.4 lbs/hr of steam to spin the turbine. 2,500 – 106.4 = 2,393.6 lbs/hr available as exhaust steam to use for low pressure steam applications.

Using worst/best case scenarios, at $14.00 per thousand pounds of steam and $0.05 /kwh for an electric cost, the following table illustrates the cost savings associate with running 50 hp steam turbine VS a 50 hp electric motor:

106.4 x 24 = 2,553.6 lbs/day consumed by the turbine. 2,553.6/1,000 = 2.5336 x $14.00/thousand lbs = $35.75 per day to spin the turbine.

50 hp motor X .746 kw/hp = 37.3 x 24 = 895.2/.95 kwhrs x $0.05/kwh = $47.11 to run a comparable electric motor.

47.11 - $35.75 = $11.36 per day savings = $4,146.4/yr savings

Steam costs lower than the example and/or electric costs higher than the example result in a greater savings and faster return-on-investment (ROI) when utilizing steam turbine drives. Larger horsepower applications also result greater savings at a comparable ratio to the 50 hp example.

The key to this cost savings feasibility is to have sufficient low pressure stem demand to accept 100% of the 2,393.6 lb/hr of exhaust steam available from this steam turbine drive. Low pressure steam users to consider are: deaereating feedwater heater, fuel oil heating systems, building heating systems, large domestic hot water heaters supplied by steam, absorption chillers, etc.

Common applications for steam turbines are boiler feedwater, cooling water and condensing water pumps in addition to forced draft fans and blower applications.

In addition to being cheaper to run than electric motors, steam turbines provide other advantages such as high starting torque, not subject to trips during power interruptions or power failures and run significantly quieter than induction electric motors.