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Comparing Power Consumption in Aeration Systems

Electrical power consumption in a motor is usually expressed in watts. A “watt” is the power produced by a current of one amp across a potential difference of one volt. Expressed mathematically: W = VA, where w = watts, v = volts, and a = amps.

If a motor operating on 220 volts requires 5 amps of current, then the power consumption is W = VA, or Watts = 220 X 5 = 1100 watts. Power is often expressed in kilowatts (kW), i.e. as thousands of watts. So, 1100 watts would be expressed as 1.1 kW.

If the same motor as above can be connected to a 440 volt power supply, then the same power consumption (wattage) would require only one-half of the current. W = VA or 1100w = 440v X 2.5 amps. We see that one advantage of operating at a higher voltage is not that the power consumption is less for the same application, but that the amperage is less. This fact means that the electrical wire (gauge) to the motor can be much smaller, thus saving in wire costs which can be considerable.

Utility companies charge by the kilowatt-hour. One kilowatt-hour is one kilowatt of power being consumed for one hour, or it can be two kilowatts of power being consumed in 0.5 hours (30 minutes), etc. If a motor requires 1.1 kilowatts of power to operate, and it consumes this wattage for 24 hours, then it would consume 1.1 kW X 24 hours = 26.4 kilowatt-hours of power. If the utility company charges 10 cents per kilowatt-hour ($0.10/kwh), then the charge for this usage would be $0.10/kwh X 26.4 kwh = $2.64/day.

To compare the power costs of two different horsepower motors requires that the kilowatt-hour consumption of each motor be compared over a given time frame, say 24 hours. In the case of water aerators the comparison of power costs becomes somewhat involved due to the issue of efficiencies of the aerators. For example, aerators are compared on their gross air transfer efficiency, expressed in liters/second (l/s), and on their oxygen transfer efficiency, expressed as pounds of oxygen per horsepower-hour (lbsO_2/hphr).

The point is that it is possible, say, for a two-horsepower aerator to outperform an aerator using a much larger motor. This smaller motor not only would consume less power, but the aerator also could perform at a much higher level of efficiency. Higher efficiencies equate to more thorough processing of waste and contaminants, a shorter contact time needed between the black water and the dissolved oxygen, a longer retention time of dissolved oxygen in the water, and a greater ease in meeting regulatory compliance, to name a few.

Comparing the power consumption of two motors directly requires that the voltage and the operating amperage be determined for each motor. To determine the power consumption in watts of a 10 horsepower motor requires that the current be measured during the operation of the motor in a typical application. If the motor is pulling four amps and is connected to a 220-volt system, then it is consuming 220v X 4.0 a = 880 watts or .88 kW. At 10 cents ($0.10) per kilowatt-hour, this motor would consume $0.10/kwh X .88 kw X 24 hrs = $2.11 in a 24-hour period. The power consumption of the second motor would be calculated accordingly, and then a comparison can be made.

VaraCorp's Turbine Technology aerators represent the latest advancement in aeration systems for black water. Not only do these aerators operate with much smaller motors, but they also provide some of the highest air transfer rates and transfer efficiencies of any system. Their simplicity and durability ensure long operating life with much less maintenance than typical aerators.

End of Report