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An investigation into the efficiency and embodied energy of electric motors for use in pumping

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Abstract

This research report is separated into two sections. The first section covers the embodied energy which is required to manufacture a new electric motor. It takes into account the energy required to mine, transport and process all raw materials, as well as the energy used by the factory to turn the raw materials into a motor. The second section investigates the actual efficiency of a pumping system under various operating conditions, these include changing the static head, changing the throttling of a valve, and changing the supply frequency. Two 0.37 kW induction motors are used, an energy efficient motor and a standard motor. The differences in efficiency between two motors is compared under each of the different test conditions. The analysis is also taken a step further as the efficiency of each of the subsystems is investigated in isolation, rather than simply looking at the overall efficiency of the system. This provided valuable information about how the system could be made more efficient, as well as an understanding as to where the losses in the system occur.

Finally the two sections are combined so that one is able to decide whether it is worth upgrading to a new more efficient motor or stick with the existing motor. Although there may be efficiency improvements by using the new motor, there is also an upfront embodied energy which was required to manufacture the motor. The two pieces of information will give a payback period, if the motor is operated less than the payback period then more energy is in fact used to manufacture the motor than the motor actually saves due to improved efficiency.