ABSTRACT

With the growth of automation in industry, it has become necessary to monitor the condition of machines and machinery systems to avoid sudden failures which may be catastrophic. There are various condition monitoring techniques available like wear debris analysis, thermography, vibration analysis, motor current signature analysis (MCSA) etc. for fault detection of machines. Among these MCSA is a new and emerging technique for fault detection of a submersible pump. Because of accessibility problem for mounting of transducers and collecting oil samples, the conventional techniques of wear & debris analysis and vibration monitoring are not convenient for condition monitoring of submersible pumps. Another advantage of MCSA method is that it is non-intrusive and monitoring can be done from a remote location.

The present research work attempts to diagnose the impeller condition of a submersible pump using motor current signature analysis (MCSA). In order to diagnose the defects of impeller in submersible pump, a pump-motor model has been developed and validated. This model is for a single phase induction motor based on an RLC circuit. The load torque on the pump due to defects can be applied to the motor model to simulate the current drawn by the motor. Then the current is analyzed by various signal processing techniques like amplitude and frequency demodulation for feature extraction and fault detection in the pump. This model is simulated by applying real working conditions of a submersible pump due to torque variations caused by broken impellers.

Experiments have been conducted on the submersible pump with different impeller conditions such as normal impeller and defective impellers (in which some vanes have been artificially removed). These were carried out for varying speed and load conditions of the pump. Electrical current drawn by the pump for all the test cases is measured and acquired with help of Hall effect sensor and then analyzed both in the time and frequency domain, to detect the fault conditions in the submersible pump. Simultaneously, the vibration signal of the pump has been captured using an underwater accelerometer. This vibration signal has been used to establish a correlation with the motor current signal. Finally, this model based research work establishes a diagnosis technique for the submersible pump while it is in operation.