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Influence of oil injection parameters on the performance of diesel powered screw air compressor for water well application

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Abstract

In this paper, a study has been carried out to find the influence of oil injection parameters on the performance of diesel powered screw air compressor which is used in water well application. Oil injection parameters considered in this study are oil injection orifice size, engine speed and oil injection pressure. Performance of the screw compressor is evaluated by measuring the fuel consumption, discharge oil temperature and free air delivery. An experimental design is created using Central Composite Design (CCD). The lower and upper bound of input parameters were fixed based on the application requirement and theoretical estimation. The experiments were performed as per the experimental design and output responses were recorded. The significance of the input parameters on output responses was studied using Analysis of Variance (ANOVA). Response Surface Methodology (RSM) is employed to study the optimum range of parameters to obtain the best performance of the compressor in drilling and idling cycles. The best performance is achieved by setting engine speed value of 1490 rpm, injection orifice diameter of 9.5 mm and an oil injection pressure of 135 psi(g) in the drilling cycle. For idling cycle, an engine speed of 1260 rpm, oil injection orifice diameter of 8.5mm and an oil injection pressure of 150 psi(g) result in the best performance of compressor in idling cycle. The optimized parameters are validated by conducting confirmatory tests. The water well screw compressor operated with optimum parameters results in considerable savings in the fuel consumption. A lubrication circuit is designed incorporating the optimum nozzle size obtained in this study.

Keywords: Oil injection parameters; Screw compressor; Central Composite Design; Optimization

1.0 Introduction

The diesel powered screw air compressor is an oil-injected screw compressor which is used in portable applications such as water well drilling, blast hole drilling in mining, Jackhammers in construction and mining etc., where the electrical power is not available. These compressors are driven by a diesel engine and the engine capacity depends on the airflow and pressure requirement. These compressors usually deliver pressure from 100 to 400 psi (g) and airflow rate at a range of 175 cfm to 1500 cfm. The amount of air produced by these compressors varies between the types of hammers / air-tools used. These compressors supply compressed air to jackhammers, air-tools which are used for drilling applications and it is often used in dusty environments, therefore high-quality air filters are used for engine and air-end.

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