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Application of Artificial Intelligence in the Overheating Control of Industrial Hydraulic System

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Abstract—*The Industrial hydraulic systems provide & support a highly synchronized and significant work flows and hence cannot afford loss of production at any instance. In any Hydraulic system, some line will be at above or below the oil temperature reservoir. In the long system-run condition, this will directly or indirectly affect the heat-dissipation unit (in the form of Hydraulic cooler unit) thereby altering heat, speed and pressure factors of the system and contribute to high hydraulic temperature at or after the hydraulic cooler to its return line to the reservoir. To increase the individual part life and in order to achieve maximum work efficiency, an artificial intelligence approach has been developed in the form of an external water-cooling system to reduce the extra heat of the hydraulic system. The study of different physical parameters, in this context, is presented graphically.*

INTRODUCTION

Consider a hydraulic system with an oil cooler, supporting massively complex and synchronized industrial apparatus. The proper working &affectivity of hydraulic system has to be ensured first and foremost to corroborate the whole production system, thereby upholding the economic concerns attached. To ensure the uninterrupted operation of such prolonged and crucial industrial systems, an approach is proposed that will not only automatically reduce the system overheating condition but also will confirm and convey the alert of over-temperature, thereby implying a fault inside the system.

GOVERNING LOGIC

The temperature balance in a hydraulic system occurs when the cooler can cool down the energy input that the system does not consume the system's lost energy i.e.,(Ploss = Pcool = Pin – Pused).

Consider the hydraulic system with an oil cooler with 12 or 24 V DC motor maximum cooling capacity is 30 kW at ETD 40°C. There are instances when the equipment has to run in tough continuous conditions without proper heat dissipation of the system, thereby causing a hike in the system temperature. Moreover, the heated surrounding temperature also affects the equipment temperature primarily targeting the hydraulic system through insufficient cooling affectivity of the Hydraulic cooler. In order to overcome the above-mentioned complications, an external water-cooling system, supported by Artificial Intelligence is proposed for the hydraulic cooler for temperature optimization, in case of high temperature operations. Temperature optimization means that temperature balance occurs at the system's ideal working temperature, which the oil's viscosity and the air content comply with recommended values. A guided water supply is to be introduced from the water tank, mounted through hoses & bolted attachments, to the top side of the hydraulic cooler facing the hydraulic vanes. The water should be distributed homogeneously in order to comply with the uniform distribution to the hydraulic vanes. The initiation and closing of the proposed system is to be guided through a control relays (NO-NC type) with limits set at 80°C (initiation temperature for the system overheat alert) and 78°C (closing temperature for the system overheat alert) with the temperature level guided by programmed control module& monitored by the temperature sensor present at the hydraulic tank side, responsible for the display of hydraulic temperature of the system and raising of alarms in case the limit temperature is exceeded. The proposed model of system will therefore be able to response independently according to the changes in ambient temperature, without human intervention through a series of control relays, thereby ensuring increased safety & reliability of the system.

The ladder logic approach is considered in the cases of relay circuit design & electrical networking of the hydraulic system with the help of control relays guided through programmed control module looped with the activation switch of guided water supply system resulting into automatic initialization and de-initialization of system as per thermal needs.

PROCESS CONSEQUENCES

The effects on various parameters such as heat dissipation, thermal efficiency with respect to time in the hydraulic system of the component are discussed speculatively. The model will not let the system or surrounding temperature condition to interrupt into the operation process. Along with process continuation, the proposed system will also be able to intimate the end user regarding temperature rise for further investigation.

Heat Dissipation

With the application of the proposed model the heat dissipation factor for the system will be increased considerably as it will not let the surrounding temperature condition to interrupt into the machine operation process.

Thermal Efficiency

The thermal efficiency of the whole hydraulic system will be elevated as the system will not only ensure the proper health and condition of the hydraulic oil but also would prevent the loss of function-ability and condition-ability of associated hydraulic parts (direction control valves, spools, seals and rings etc.) due to over temperature.

CONCLUSION

The suggested model is efficient in multiple ways when it comes to the prevention of loss due to down time of machineries caused by overheating of hydraulic system. The proposed system will be able to respond independently without human intervention along with process continuation. Moreover, the system will also be able to intimate the end user regarding temperature rise for further investigation. The offered model will further satisfy the associated issues such as extension of life of hydraulic system, extension of useful life of Hydraulic oil, increased operating time & decreased breakdowns.

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