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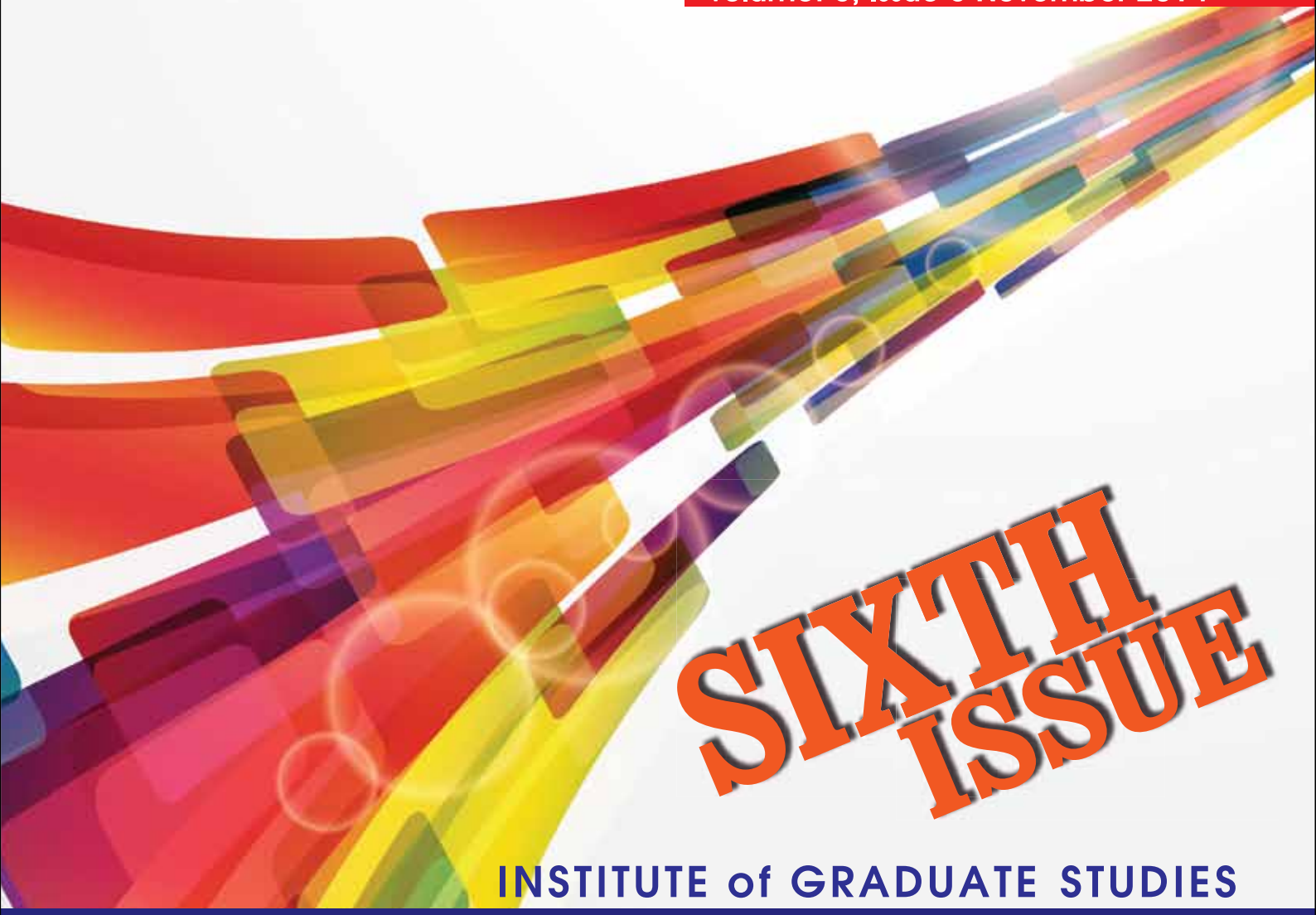

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Title :
Formulation, Performance Evaluation And Prediction Of Bio-Lubricant For Journal Bearings

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This thesis is concerning about hydrodynamic lubrication in journal bearing. The research covers three primary areas: the formulation of an alternative biodegradable bio-lubricant using renewable resources; the performance evaluation of the formulated oil through a true-scale versatile journal bearing test rig; and the modeling and prediction the behavior of bio-lubricant around the bearing circumference. The first part of the research is focused upon the formulation of an environmentally-friendly lubricant using vegetable oil with various composition of petroleum base stock. The physico-chemical and tribo-chemical properties of the formulated oil have been analyzed using multiple standards apparatuses. This study provides valuable data to conform an ISO VG 68 hydraulic industrial lubricant by blending 52.70 % (wt) soybean oil, 40.55 % (wt) mineral oil, and 6.75 (%) additive packages. The experimental results clearly demonstrated that the formulated green lubricant was far more efficient than the synthetic lubricant in terms of friction coefficient, wear rates, wear volume loss and worn surface morphologies. However, the green lubricant failed to outperform conventional lubricant with respect to degradation test and wear scar diameter performance. From this study, the use of bio-lubricants as ‘green’ alternatives for machine lubrications will be significant in the reduction of environmental pollution and depletion of natural resources. The second part is about evaluating the performance of this novel bio-lubricant under practical

application conditions and also to design a new eco-friendly lubricant-bearing combination in which the end goal was to maximize friction coefficient reduction and safeguard the environment. Two different bearings made of conventional steel and green lead-free materials were tested at various operating conditions. The formulated blend proved its viability as a promising alternate for base oil lubricants for industrial use due to its better performance, lower friction, lower operating temperature and on top of all, its bio-degradability and environment friendliness. This can contribute to reduce the global demand of petroleum-based lubricant substantially. The established lubricant-bearing duo is capable of replacing typical lubricants and bearing materials that include lead with regards to its higher availability and superb performance. The third part of this research is the first attempt to develop high-fidelity mathematical models based on Response Surface Methodology (RSM), which can be used to predict the hydrodynamic lubrication behavior of the bio-oil around the journal bearing circumference. The study employed the response surface methodology (RSM) with Box-Behnken experimental Design technique (BBD) for performing statistical predictions and appraising the influence of the three-level-three-independent variables (i.e. rotational speed, bearing load and oil-feed pressure) on the oil-film key characteristics (i.e. maximum pressure, temperature and bearing friction). Another exceptional aspect of this research was the examination of the embedded interactions among the three key parameters. This facilitated the acquirement of deeper knowledge regarding the significance of every parameter. Finally, a comparative study was conducted between the estimated data generated through RSM based models and the outcomes developed through fuzzy logic technique. The comparison showed that RSM offers an extensive variety of information on the control and response variables interrelationships, with a relatively small number of test runs. It is expected that the results of this research can be fairly helpful to the tribological community in general and the bearing designers in particular.