TRC CONTINUATION PROPOSAL 2016-2017

Prediction of Coupling Guard Temperature and Gearbox Windage Power Loss

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INTRODUCTION

Windage power loss (WPL) is defined as the power loss due to the fluid drag experienced by the gear when it is running in air or an air-oil mist [1]. From past experience, the high-speed effects become significant at pitch line velocities above 10,000 ft/min (50.8m/s). Moreover, coupling guard heating and pressure distribution within coupling guard are closely associated with windage effects. According to latest edition of API 671, the maximum coupling guard temperature should not exceed 60 °C (140°F), the investigation of windage is therefore of practical significance.

In this project, a multivariable regression based code will be developed to predict coupling guard temperature and gearbox WPL. The development of the code is based on extensive simulations in ANSYS CFX and Fluent. Parametric studies of factors influencing coupling guard temperature and gearbox WPL will be conducted. Guidelines on designing coupling guard and gearbox to mitigate windage power loss will also be provided.

PROPOSED WORK

Following work is proposed for next term of the project:

1) Refine CFD model used in case study as more physical testing results become available;
2) Validate other windage mitigation features and provide guidelines for future anti-windage structure design;
3) Include other geometry parameters in regression model and conduct test cases to further validate the regression model;
4) Identify key influencing factors of gearbox windage power loss;
5) Conduct parametric studies of factors that influence gearbox WPL and provide guidelines on reducing WPL;
6) Collaborate with TRC member companies and validate simulation results with field test results

DELIVERABLES

1) Modelling methodology and worked examples of coupling guard temperature and gearbox WPL prediction in ANSYS CFX and Fluent;
2) A multivariable regression based code for coupling guard temperature prediction, including coupling guard geometric variables;
3) Conduct parametric studies of gearbox WPL and understand the effect of influencing factors;
4) Guidelines on designing coupling guards and gearboxes to reduce heating and WPL

STATUS OF CURRENT WORK

1. Coupling Guard Temperature and Windage Power Loss: A Case Study

The case study showed that windage flanges fail to effectively reduce temperature within the coupling guard, and therefore cannot reduce the guard surface temperature. The CFD model provided accurate simulation results, as validated by test results.

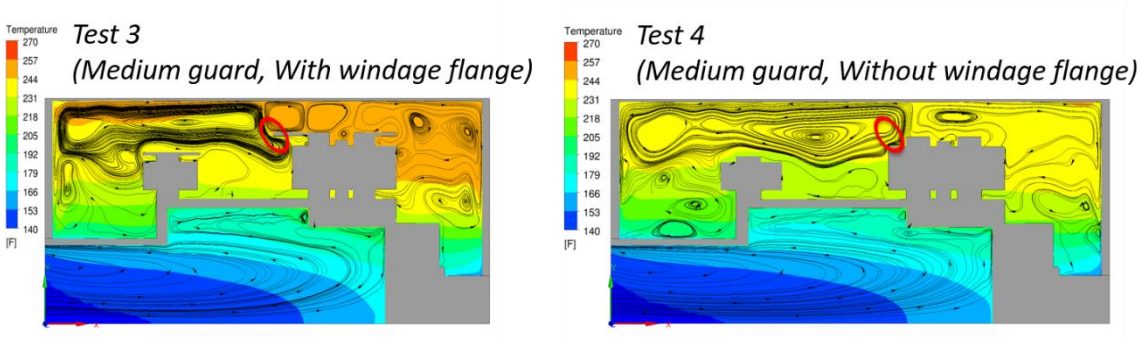

Fig 1. Comparison showing the effect of adding windage flange

2. Regression model for coupling guard temperature prediction

With the demand to efficiently predict guard temperature in design phase, a mathematical model is developed based on CFD simulation results. It is a regression based model which gives correlation between input (parameters of coupling) and output parameters (maximum guard temperature).

3. Gearbox windage power loss

The predictability of individual spur/helical gear WPL has been validated in ANSYS CFX and Fluent through several cases. Initial results of transient simulation of two meshing gears also shows that CFD model can give reasonable prediction for gearbox hydraulic (windage/churning + squeezing) power loss.

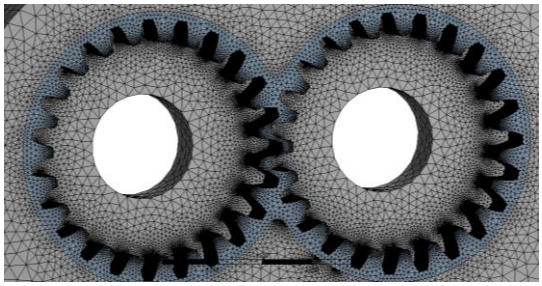

Fig 2. Detail of mesh showing gear engagement

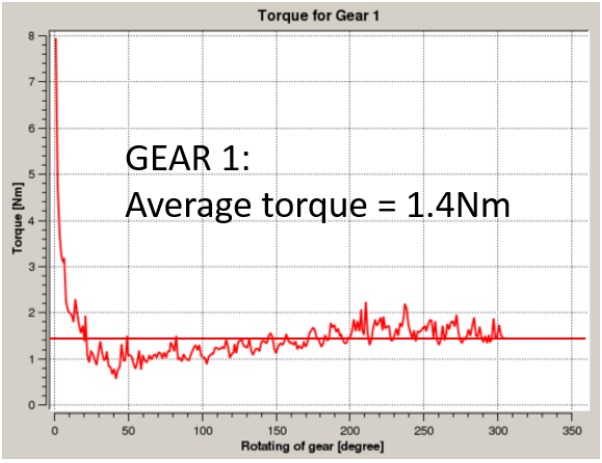

Fig 3. Evolution of torque value on gear 1

COSTS

The cost includes $2,200 monthly salary for a graduate student, $2500 for insurance and fringe benefits, $9000 for tuition and fees, and $1,000 for miscellaneous. The total cost is **$38,900**.

REFERENCE

[1] C. N. Eastwick and G. Johnson, "Gear windage: A review," *Journal of Mechanical Design*, vol. 130, Mar 2008.