Experimental Research about the Effect of Carbon Black on Noise in Oscillatory Parallel Plate Squeeze Oil Film

CATEGORY OR KEYWORDS
Fluid lubrication, cavitation, noise, carbon black

AUTHORS AND INSTITUTIONS
Xu Liu [a], Xiaoyang Chen [a*], Rongyu Kang [a], Xuejin Shen [a], Ben Ni [b]
* Corresponding Author email: xychen@shu.edu.cn
[a] School of Mechatronic Engineering and Automation, Shanghai University 200072, China
[b] Ford Motor Company, Dearborn MI 48126, USA

INTRODUCTION
For the phenomenon that the carbon black could reduce the irregular typewriter noise in the engine main bearing, which was based on Ford Motor Company's patents, a comprehensive experimental study about the effect of carbon black with different particle sizes, concentrations and settling times on noise in the oscillatory parallel plate squeeze oil film test machine has been carried out.

ABSTRACT
It was found that the irregular typewriter noise of engine main bearing will be effectively reduced after adding the carbon black in lubricant oil [1]. The oscillatory parallel plate squeeze oil film test apparatus which could collect different kinds of signals including sound pressure, displacement, vibration acceleration, force, and pictures of cavitation simultaneously during the test running was used to experimental study the relationship between carbon black, cavitation and noise [2]. To solve irregular noise which is related to cavitation, carbon black was added to the lubricating oil in experiments. It was shown that the presence of carbon black can significantly reduce the generation of noise from the experiments. And this suppression effect becomes stronger as the concentration increases. Different mesh numbers of carbon black were used to study the effect of carbon black's particle size on noise. The results show that the carbon black with small particle size has better noise reduction effect. After being left for a long time, the suppression effect of carbon black was weakened. However, the small particle size carbon black still has a better noise reduction effect than big particle size carbon black after leaving same setting time. Experimental results also showed that whether the carbon black was dried had little effect on noise reduction. By image processing form pictures taken from high speed camera, the area of cavitation can be obtained. By combining the data obtained by the displacement sensor and cavitation area, the volume change of the cavitation volume in the period of noise generation could be obtained in different experimental situations. The results showed that maximum area and volume of cavitation gradually decrease as the carbon black concentration increases, which shows that the carbon black has a certain inhibitory effect on the development of cavitation and thus reduces the noise generation.

ACKNOWLEDGMENTS
Thinks to the support from Ford Motor Company (under Ford University Project 2014-2175R). The authors also gratefully acknowledge D.C. Sun, retired professor of State University of New York, for his encouragement and suggestions.

REFERENCES
[1] Morgan, P.B., Uy, D., DeRaad, S. M., et al., 2011, " Elemental Carbon Lubricant Additive to Suppress Cavitation," *U.S. Patent Application,* No. 12/814, 375.
[2] Liu, X., Chen, X. Y., Wang, P., Shen, X. J. and Ni, B., 2018, "Principle Experiments Research of Noise in Engine Main Bearing,", *Tribology Online,* **13**(3), pp. 131-139.