

Effectiveness of Carbon Nanotubes (CNT) as Lubricant Additive in Mixed Lubrication Conditions

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ABSTRACT

The tribo pairs operate in mixed lubrication due to the severity of the operating conditions. The asperities of the surfaces interact with each other resulting in wear. The lubricant film becomes insufficient to separate the two interacting surfaces. The anti-wear additive forms a protective layer on the interacting surfaces and prevents the wear under these conditions. The use of carbon nano tubes is gaining acceptance as anti-wear additive due to its extraordinary tribological and thermal properties. This paper is an extension of the previous work [1] of the author that reported the use of carbon nano-tubes as anti-wear additives. In the present work statistical variation in the experimental results of the wear tests is presented. Each experiment is repeated three times to determine the statistical variance. The results of the experimental investigation are reported.

Key words: Anti-wear additives, Solid Lubricant Additives, Carbon Nano-tubes, Wear, Mixed Lubrication.

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INTRODUCTION

This paper is an extension of the previous work [1] of the author that reported the use of carbon nano-tubes as anti-wear additives. In the present work statistical variation in the experimental results of the wear tests has been studied. The experiments have been conducted on block and disk test setup and each experiment has been repeated three times to determine the statistical variance. The quantity of CNT as solid lubricant additive used in the present study is 0.01%, 0.05% and 0.1% by weight of lubricant. The load (70N) and speed (25rpm) combination resulting in mixed lubrication regime has been used. The experimental results are reported.

EXPERIMENTAL RESULTS AND DISCUSSION

The Fig. 1 shows the result of the wear tests conducted on block and disk test setup at the operating conditions mentioned in the previous section.

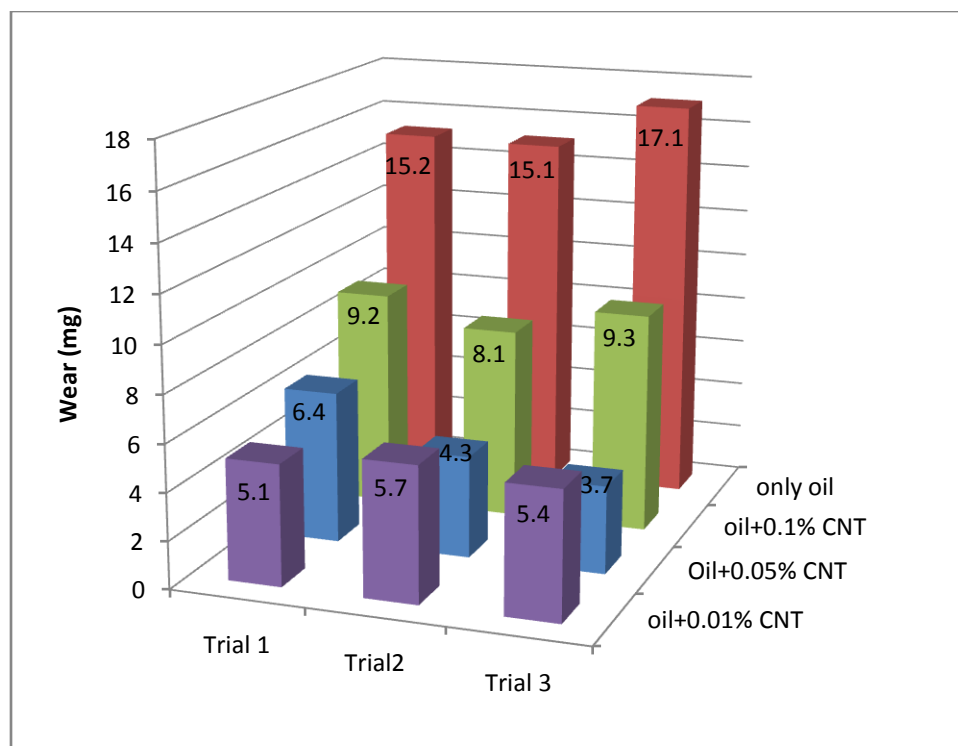


Figure 1 Experimental results

As reported in the previous work [1], a significant decrease in the wear is observed with the use of CNT as lubricant additive. The table 1 gives the details of the experimental results.

Table 1 Experimental results of the wear test

S.No.	Test No.	Wear (mg)	Standard Deviation	Average	Variance
1	Only Oil Trial 1	15.2	1.13	15.80	1.27
2	Trial 2	15.1			
3	Trial 3	17.1			
4	Oil+0.1%CNT Trial 1	9.2	0.67	8.87	0.4
5	Trial 2	8.1			
6	Trial 3	9.3			
7	Oil+0.05%CNT Trial 1	6.4	1.42	4.8	2.01
8	Trial 2	4.3			
9	Trial 3	3.7			
10	Oil+0.01%CNT Trial 1	5.1	0.30	5.40	0.09
11	Trial 2	8.7			
12	Trial 3	5.4			

It is observed that from these results that maximum statistical variance of 2.01 occurs when the CNT quantity is 0.05% and minimum statistical variance of 0.04 occurs when the CNT quantity is 0.1%. The minimum wear was obtained with 0.05% of CNT. The table 1 also indicate that in wear tests it is difficult to obtain consistently repeatable results.

CONCLUSION

Based on the observations of the experimental studies, following conclusions are drawn:

- The carbon nano-tubes considerably reduce the wear of the blocks operating in mixed lubrication conditions.
- The minimum wear is observed for 0.05% quantity of carbon nano-tubes.
- The results of the wear tests are subjected to statistical variations.

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