

TRIBOLOGICAL PERFORMANCE OF DLC UNDER MINIMISED LUBRICATION

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KEYWORDS

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ABSTRACT

One of the main advantages of DLCs is that, under certain conditions, it can provide low friction and wear resistance even in the absence of liquid lubricants [1–3]. Kovacı *et al.* showed the superior tribological performance of DLC in humid air in comparison to steel [3]. Following one of the principles of green tribology – to minimise the amount of lubricant required in a system – this work presents an assessment of the capacity of DLCs to perform under starved lubrication and dry conditions.

Pure DLC coatings – a-C by dcMS and a-C:H by μ W-PECVD – and uncoated steel were tested in a reciprocating configuration at 60 °C in dry conditions, as well as lubricated with decreasing amounts of pure base oil to assess the tribological behaviour of the DLCs and evaluate the minimum amount of lubricant necessary to protect the surface from wear, whilst also providing low friction.

Table 1 Wear results under starved lubrication conditions.

Lubricant qnt. [$\mu\text{L}/\text{cm}^2$]	Specific wear rate [$\times 10^{-17} \text{ m}^3/(\text{N.m})$]					
	DRY, 60 °C	DRY, T_{amb}	1.20	0.60	0.30	0.12
dcMS a-C	17	4.4	3.8	1.4	2.8	1.0
μ W-PECVD a-C:H	44	19	1.3	0.39	1.5	0.93
uncoated	742	504	14	35	48	142

Steel seized under all test conditions, with wear rates significantly higher than the DLCs. When tested at 60 °C with no lubricant, the DLCs were partially worn through. They were then tested with no lubricant, but at ambient temperature and humidity. In this case, the DLCs maintained low friction and wear. The calculated induced temperature rise for the DLC/steel contact was 53 °C, that is, at higher starting temperature the flash temperature surpasses the boiling point of water, hence no humidity is left in the contact. Adsorbed water vapour passivates the dangling carbon bonds on the surface, thus keeps low energy surfaces [4]. With even the minimum amount of

lubricant, DLCs provided excellent friction and wear performance.

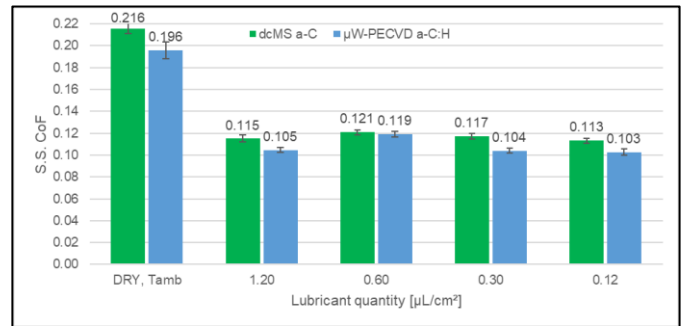


Fig.1 EOT CoF of DLCs under starved lubrication conditions.

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