DAMPING BEHAVIOUR OF DIFFERENT METALS UNDER FRETTING CONDITIONS

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ABSTRACT
Lightweight construction nowadays is becoming more important with the ongoing effort to increase efficiency, save resources, reduce energy consumption, and lower greenhouse gas emissions. In this study we investigated materials that are suitable to be used as damping elements which damp vibrations through a frictional contact. Such a damping element could for example be a bolted joint which might be used to replace a very heavy tuned mass damper and will therefore save weight.

Suitable material pairs for use as damping elements need to be a trade-off between maximum energy dissipation and minimum wear. To assess the suitability of different material combinations in terms of damping and wear resistance under fretting conditions, three material pairings were investigated in experiments. The tribological experiments are conducted on a fretting tester under "gross slip" conditions [1] with a ball on flat geometry. The cumulated dissipated energy is calculated from the fretting tester friction data. The wear volume is determined optically using white light interferometry. The so-called "energy wear approach" [2] is used to relate the wear volume to the cumulated dissipated energy. Three different alloys (nickel alloy, aluminium alloy, and brass alloy) are compared. The counter body was either steel (100Cr6) or a self-paring for all experiments.

Depending on the tribological pairing, the total wear is either distributed in both pairs or shifted towards one of the two materials (Fig. 1 left). In case of the steel-brass pairing wear is concentrated on the brass partner, while for a steel-inconel contact, mainly the steel is worn. For the third case, that was investigated, steel against anodised aluminium alloy, the steel wears almost as much as the steel fretted against Inconel. The aluminium counter body at the same time shows a wide range of wear at the first part of the experiment which can't be explained so far. The system wear of Inconel-Inconel and steel-Inconel is nearly the same (Fig.1 right) while the wear is distributed evenly on the two counter bodies in the case of the self-pairing.

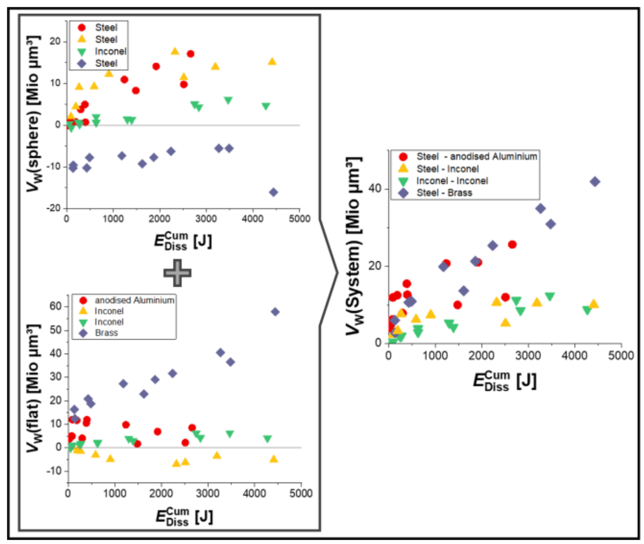

Fig.1 Wear volume V_W and dissipated energy E_{Diss} of the two counter bodies (left) and the system (right).

The different material pairs studied here, thus behave very different in term of wear when considering the complete tribo system and we therefore address the question if the "energy wear approach" can be successfully used in all cases.

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