Design and evaluation of a new experimental technique to measure and rank the impact resistance of materials to be used in unsynchronized transmissions

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In order to reach the goal of zero greenhouse gas emission and avoid catastrophic climate changes our society has to make extensive changes. Not least the transport sector, which accounts for about 25% of the total greenhouse gas emissions. One effective way to reduce the amount of greenhouse gases emitted during transports is to convert to electrical vehicles. The transition to electric passenger cars is already ongoing, but for heavier vehicles the transition is more demanding and still in need of research and technical development to succeed.

One of the challenges is to increase the mileage of all vehicles, which is especially important in long range haulage. One contribution towards this, is to reduce the mass of the vehicles. One conceivable component for such weight reduction is the synchronizer mechanism in the transmission, which potentially can be simplified or removed. The disadvantage of this is that it would introduce high impact contacts when gears are shifted. Presently used transmission materials are typically not developed to withstand such impacts and would display severe plastic deformation and wear already after a few hundred or thousand cycles. Hence, a synchronizer-free design would not be possible without using more impact resistant materials.

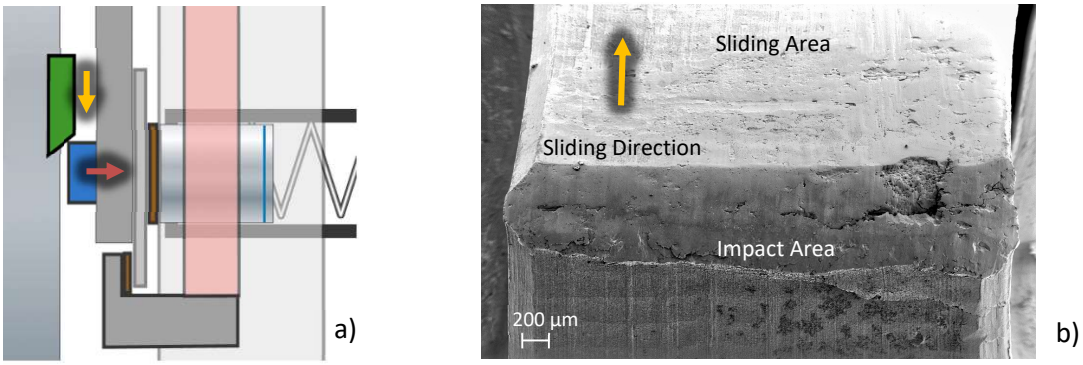

Figure 1 a) Illustration of the rig setup used to simulate the hard impact in unsynchronized transmissions. Each impact forces a stationary sample to climb and slide over the top surface of a moving sample. b) Appearance of the impact surface of a stationary sample after 10 000 impacts.

The present paper introduces the new rig, using small, simplified test bodies, designed to mimic the problematic impact and generate the wear and damage mechanisms dominating in full scale tests. The friction and impact forces are continuously measured. The technique is evaluated in a first investigation that compares the impact resistance and wear losses of five candidate steels. The damage mechanisms are analyzed using the SEM, both on the impact surfaces and in cross-sections.

Keywords: impact wear, transmissions

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