One-third of car fuel consumption is due to friction loss

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No less than one third of a car's fuel consumption is spent in overcoming friction, and this friction loss has a direct impact on both fuel consumption and emissions. However, new technology can reduce friction by anything from 10% to 80% in various components of a car, according to a joint study by VTT Technical Research Centre of Finland and Argonne National Laboratory (ANL) in USA. It should thus be possible to reduce car's fuel consumption and emissions by 18% within the next 5 to 10 years and up to 61% within 15 to 25 years.

There are 612 million cars in the world today. The average car clocks up about 13,000 km per year, and in the meantime burns 340 litres of fuel just to overcome friction, costing the driver EUR 510 per year.

Of the energy output of fuel in a car engine, 33% is spent in exhaust, 29% in cooling and 38% in mechanical energy, of which friction losses account for 33% and air resistance for 5%. By comparison, an electric car has only half the friction loss of that of a car with a conventional internal combustion engine.

Annual friction loss in an average car worldwide amounts to 11,860 MJ: of this, 35% is spent in overcoming rolling resistance in the wheels, 35% in the engine itself, 15% in the gearbox and 15% in braking. With current technology, only 21.5% of the energy output of the fuel is used to actually move the car; the rest is wasted.

Worldwide savings with new technology

A recent VTT and ANL study shows that friction in cars can be reduced with new technologies such as new surface coatings, surface textures, lubricant additives, low-viscosity lubricants, ionic liquids and low-friction tyres inflated to pressures higher than normal.

Friction can be reduced by 10% to 50% using new surface technologies such as diamond-like carbon materials and nanocomposites. Laser texturing can be employed to etch a microtopography on the surface of the material to guide the lubricant flow and internal pressures so as to reduce friction by 25% to 50% and fuel consumption by 4%. Ionic liquids are made up of electrically charged molecules that repel one another, enabling a further 25% to 50% reduction in friction.

In 2009, a total of 208,000 million litres of fuel was burned in cars worldwide just to overcome friction; this amounts to 7.3 million TJ (terajoules) of energy. Theoretically, introducing the best current technological solutions in all of the world's cars could save EUR 348,000 million per year; the best scientifically proven solutions known today could save EUR 576,000 million per year, and the best solutions to emerge over the next 10 years could save EUR 659,000 million per year.

Realistically, though, over a period of 5 to 10 years of enhanced action and product development measures could be expected to enable savings of 117,000 million litres in fuel consumption per year, representing an 18% reduction from the present level. Furthermore, in realistic terms, carbon dioxide emissions could be expected to decrease by 290 million tonnes per year and financial savings to amount to EUR 174,000 million per year in the short term.

Drivers can influence fuel consumption

A driver can significantly influence the fuel consumption of his or her car. A reduction of 10% in driving speed, e.g. from 110 km/h to 100 km/h, translates into a 16% saving in fuel consumption. Slower speeds also allow for higher tyre pressures; an increase from 2 bar to 2.5 bar can translate into a 3% saving in fuel consumption.

VTT and ANL calculated friction loss in cars worldwide using a method that incorporated total crude oil consumption and fuel consumption of cars, the energy consumption of an average car, and the energy that an average car uses to overcome friction.

Friction losses were accounted for in the subsystems of a car – tyres, engine, gearbox, brakes – and also in its components, such as gears, bearings, gaskets and pistons. The friction losses caused at friction points and lubrication points were also considered.

The study was conducted at the Metal Products and Mechanical Engineering strategic competence cluster in the DEMAPP programme, co-ordinated by FIMECC Oy, where practical solutions for minimising friction loss are also being developed. The study was funded by the Finnish Funding Agency for Technology and Innovation (Tekes), VTT and FIMECC Oy, and the Argonne National Laboratory, Department of Energy (Chicago, USA).

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