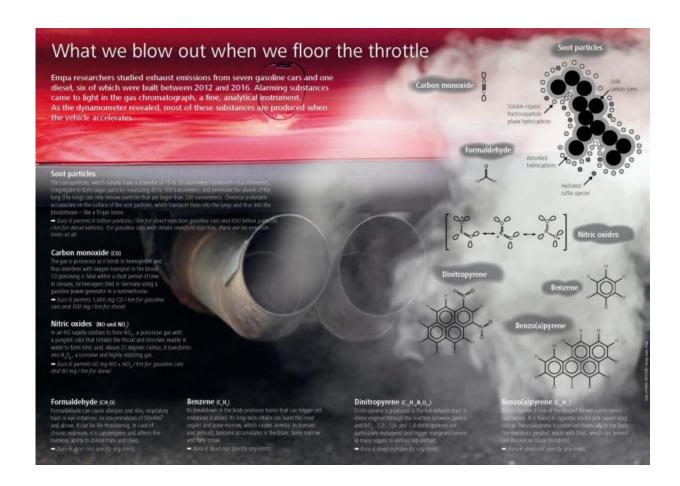


Carcinogenic soot particles from petrol engines

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Credit: Empa

A new study led by Empa scientists finds that some direct-injection gasoline engines emit just as many soot particles as unfiltered diesel cars



did in the past. Particle filters can remedy this.

Worldwide, three new cars roll off the line every second – that's 73 cars and 18 million utility vehicles per year. Most run on gasoline. In industrialized nations, the trend is moving towards so-called downsizing engines: smaller but with direct gasoline injection and turbocharging. This technology is more environmentally friendly and saves fuel, according to manufacturers. Experts estimate that by 2020, 50 million of these direct-injection gasoline engines will be running on the roads across Europe, and researchers are now studying the cocktail of exhaust emissions from these engines.

Researchers of the GasOMeP project, along with collaborators, selected seven direct-injection gasoline cars, including a Mitsubishi Carisma (2001 model, exhaust emission standard Euro 3). The other vehicles were all built between 2010 (VW Golf, Euro 4) and 2016 (Citroën C4, Euro 6b). By way of comparison, a current Peugeot 4008 (2013, Euro 5b) with a diesel engine and a particle filter was also included. All the vehicles were tested based on the WLTP cycle (Worldwide Light-Duty Vehicles Test Procedure), which will be mandatory for newly licensed models as of September 2017 (see p. 10).

The results were sobering: Every single one of the tested gasoline cars emitted 10 to 100 times more fine soot particles than the diesel Peugeot. Under the microscope, the particles from the gasoline engines were similar in size to the soot particles that had given diesel a bad name: primary particles measuring 10 to 20 nanometers in size, which congregate into particle agglomerates measuring 80 to 100 nanometers before leaving the exhaust. "Once inhaled, these particles remain in the body forever," explains Norbert Heeb. The evidence shows that they can penetrate the membrane of human alveoli in the lungs and thus get into the bloodstream.



However, the particles are not the only problem, as Heeb is well aware: "Liquid or solid chemical toxins from the combustion process, including polycyclic aromatic compounds, accumulate on the surface of the particles, which can then smuggle these substances into the bloodstream – like a Trojan horse."

Maria Munoz, a colleague of Heeb's from Empa's Advanced Analytical Technologies lab, took a closer look at the exhaust emissions from the vehicles tested in the GasOMeP project – and discovered benzo(a)pyrene, a known carcinogenic substance also found in cigarette smoke.

The World Health Organization (WHO) considers even the tiniest dose of benzo(a)pyrene harmful. The EU settled on an air limit of one nanogram per cubic meter. Levels in <u>exhaust emissions</u> were found to be as much as 1,700 times above this limit. Or to put it another way, one cubic meter of exhaust gas transforms up to 1,700 cubic meters of clean air into a mixture deemed carcinogenic according to the EU standard.

Once again, the diesel <u>vehicle</u> with particle filter fared much better. In the test, the Peugeot emitted only 45 nanograms of carcinogenic substances – six times less than the best one of the analyzed <u>gasoline cars</u>

Researchers push for action

The results of the GasOMeP project were presented during a conference held at the Empa Academy in late March. The researchers concluded that particle filters used for diesel vehicles should now also be mandatory for gasoline vehicles.

"At the moment, they don't incorporate the best available technology,"



says Heeb. "New exhaust emission technologies launched on the market usually take around 13 years to become fully effective. Only then will nine out of 10 cars from the vehicle stock be replaced. So the sooner particle filters are made mandatory for gasoline vehicles, the better it will be for everyone's health."

Provided by Swiss Federal Laboratories for Materials Science and Technology

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