

First time measurements of sub-3 nm particles from a natural gas engine

Researchers from the Aerosol Physics Laboratory of Tampere University of Technology, Finland, observed particles in the size range of 1-5 nm in natural gas engine emissions. They concluded the origin of the particles to be in vicinity of the engine cylinders. More measurements are needed to figure out the composition of the emitted particles.

Jenni Alanen and her colleagues from the Aerosol Physics Laboratory of TUT studied the particle emissions of a small scale natural gas engine. The engine itself was an old gasoline engine that was modified to run with natural gas. Natural gas is considered to have smaller environmental effects than diesel and gasoline, and e.g. its carbon dioxide and particle mass emissions can be smaller than in diesel engines. The particle number concentrations though are not necessarily smaller. Heavy duty natural gas engines are used in buses, and larger scale engines in ships and power plants. "The scientific interest itself makes this research intriguing, and there is always the question about health effects of the small nano particles." Jenni says.

The emission researchers at TUT, lead by dr. Topi Rönkkö, are forerunners in investigating different aspects of engine emissions. They have published several scientific articles about the smallest particles in the vehicle emissions and the PSM is now a part of their standard equipment set. In this study they measured the particle number concentration, size distribution,

volatility and electric charge. **The particle size distribution was found to peak at extremely small sizes, about 2-5 nm.** Usually vehicle emission measurements concentrate on particles with a diameter above 23 nm, due to e.g. EU regulations on vehicle emissions, but in this case for the small scale natural gas engine less than 1% of the particles were in that size range.

The volatility measurements showed a size reduction of particles, rather than complete evaporation when the sample was heated. **The researchers concluded that the particles emitted from the natural gas engine have a non-volatile core.** The composition of the particles remains to be determined, but this can give a hint of what the particles could consist of. The origin of the particles was thought to be in the engine cylinders, or their vicinity. Among the other results, this observation can help understand more about the formation process of natural gas engine exhaust particles.

In Jenni's view the emission measurements are exciting, because they involve researchers,

laboratory staff and e.g. engine manufacturers and other industrial parties all working together: "The measurement campaigns can be a few weeks long, and it usually means traveling. The days are long and tiring, but at the same time very rewarding. Creativity and problem solving skills are often needed since surprising things or problems can come up any time and you have to figure them out on the spot - and up to now we've always managed to do that!"

Alanen et al. The formation and physical properties of the particle emissions from a natural gas engine. Fuel, vol 162, 155-161, 2015

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Photograph courtesy of Jenni Alanen



Jenni Alanen

More about the research of the Aerosol Physics Laboratory of Tampere University of Technology on their website: <http://www.tut.fi/en/about-tut/departments/physics/research/aerosol-physics/index.htm>