

Particulate emissions from jet engine



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Introduction

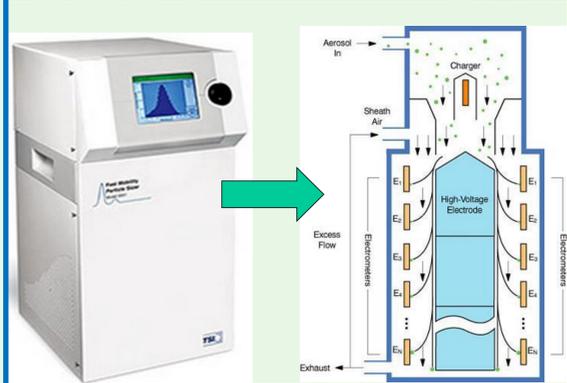
Particulate emission from aircraft engines represents a significant threat to human health and air traffic. Particles emitted at areas of the airports are nano-sized, which easily leak into the lungs thus giving rise to heart diseases, asthma or bronchitis. Current standards of emission caused reduction of emission of large diameter particles generated by aircraft engines. Despite this increasingly common issue at airports is smog, causing a reduction of visibility.

Methodology

Measurements were carried out in stationary conditions. The object of tests was a combat and training aircraft, the first jet aircraft of Polish design PZL TS-11 Iskra, equipped with SO-3 turbine engine.

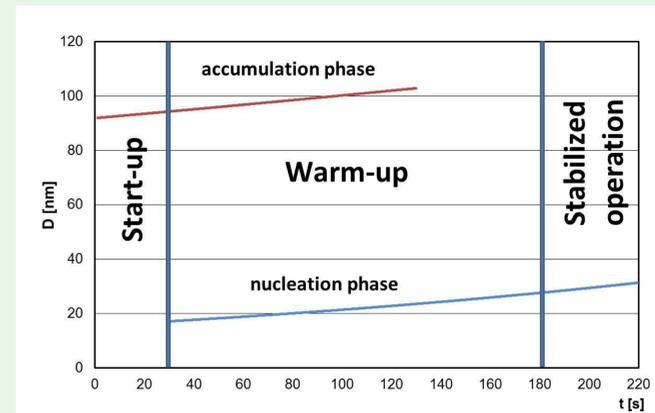
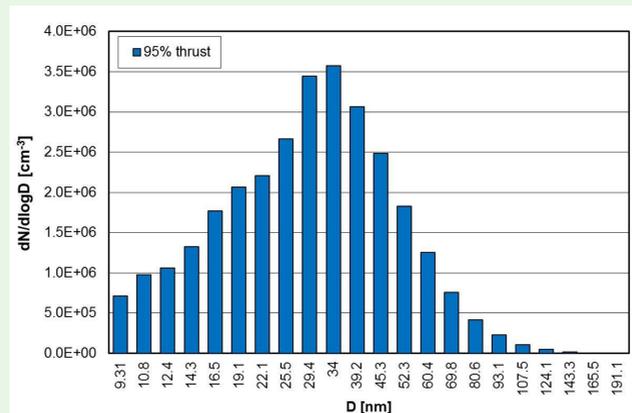
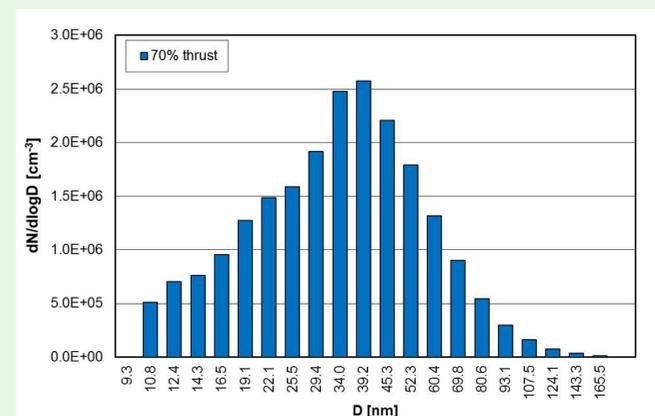
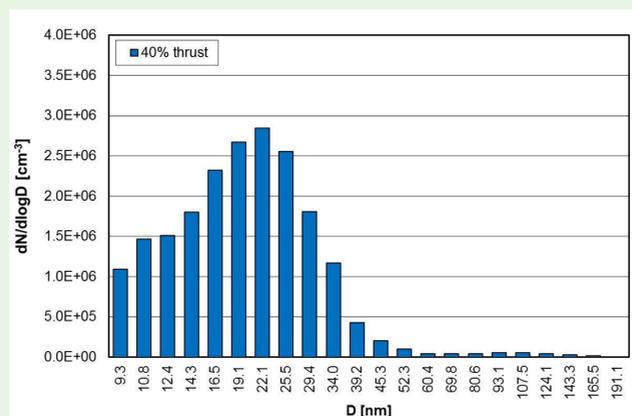
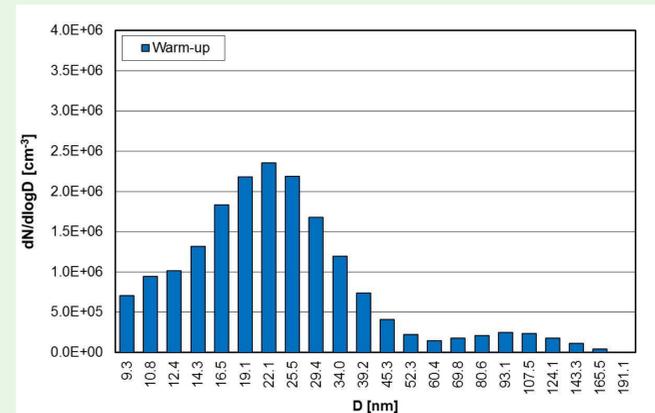
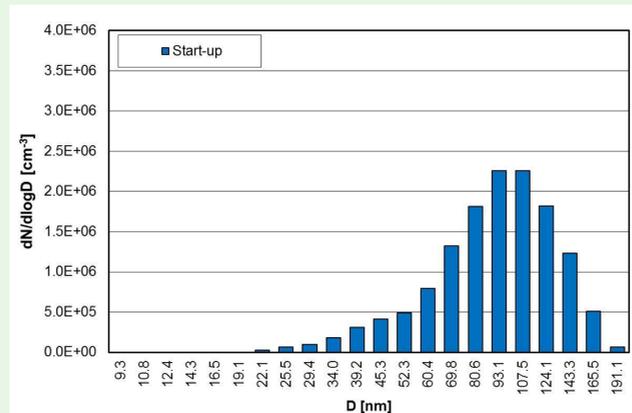


For measurements of values of diameters of particles was used the EEPS 3090 mass spectrometer (Engine Exhaust Particle Sizer™ Spectrometer) by TSI Incorporated. It enabled measurement of the discrete range of particle diameters (from 5.6 nm to 560 nm) on the basis of their varying speed.



Results

The aim of this study was to determine the distribution of sizes of particulate matter emitted by a jet engine in three phases of its operation: start-up, warm-up and stabilized operation for different values of thrust. Using the measurement apparatus was determined the distribution of diameters of particles. Measurements were carried out in stationary conditions.



Summary

On the basis of the analysis of the size distribution of the particles it was found that during the start-up phase are emitted particles with diameters of about 100 nm, which are the soot agglomerates with absorbed SOF (soluble organic fraction) substances, generated in accordance with the accumulation mechanism. During the warm-up, two characteristic diameters can be found, presence of which ensues from existence of two mechanisms of generating particles. Apart from particles resulting from the accumulation mechanism, are also generated particles in the form of the nucleation phase with diameters of about 30 nm, consisting of substances that form volatile fractions of SOF, small amount of carbon and metal compounds. Engine stabilized operation causes an increased number of particles with characteristic diameters of about 30 nm, which prevail during further engine.