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Comparative study on the mass density relative distribution In aerodispersed systems of limited volume and liquids

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УНИВЕРСИТЕТ ЗА НАЦИОНАЛНО
И СВЕТОВНО СТОПАНСТВО

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Aerosols with limited volume (AsLV)

Aerosols with limited volume have some specific properties, notably rapid phase sedimentation and decrease of the upper borderline height, constant density decrease, particle coagulation, fluctuations in density distribution and temperature.

The similarities between the properties of AsLV (AsLV have the ability to take the shape of the container; they have hydrostatic properties when flowing) and those of liquids were studied by Petrova. Some properties of AsLV link them closer to gases – they have similar values of viscosity and density. Some authors introduce for this state of the aerosols the concept of quasiliquid state.

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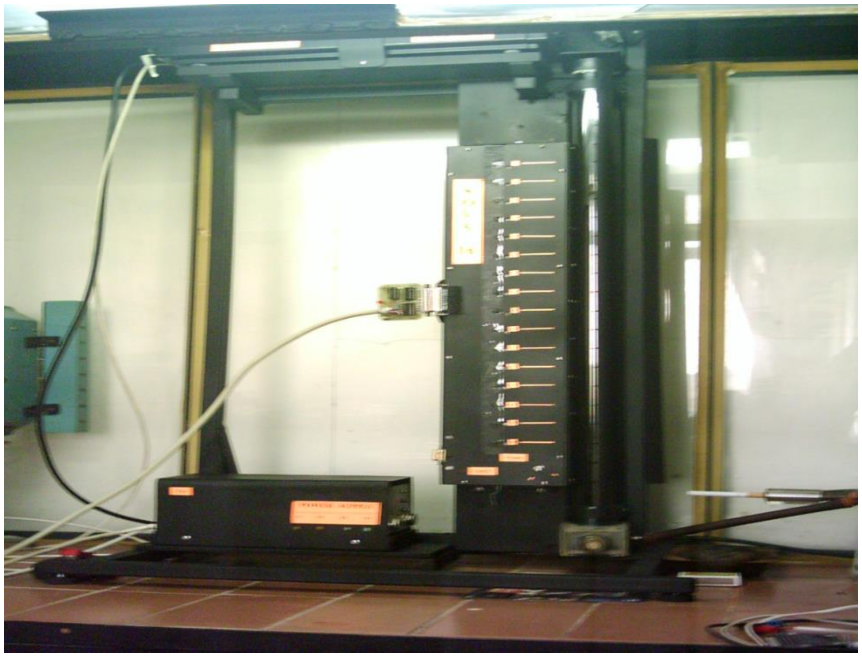
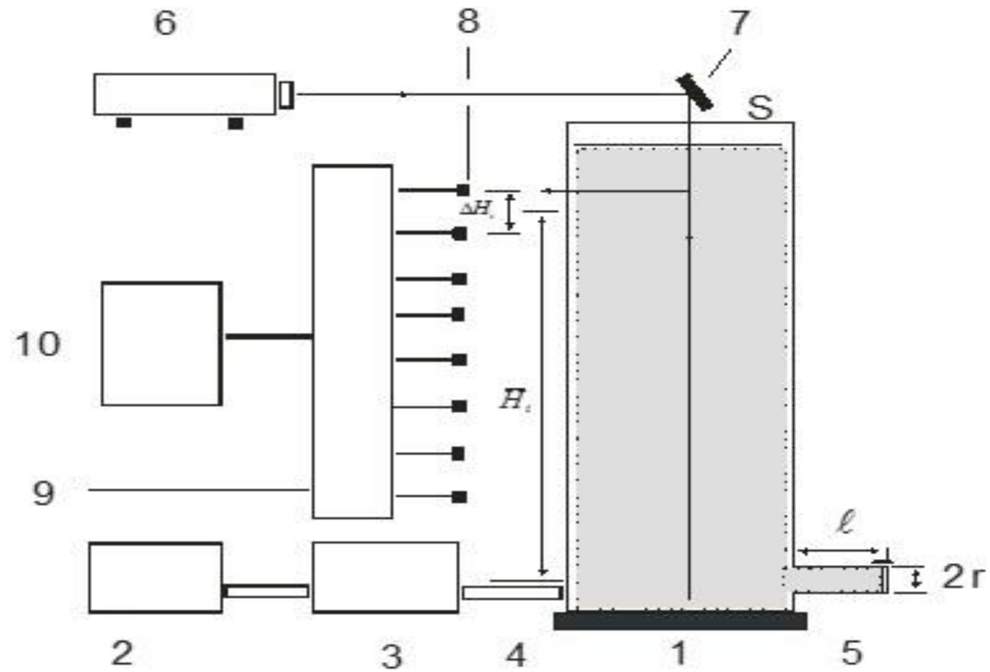
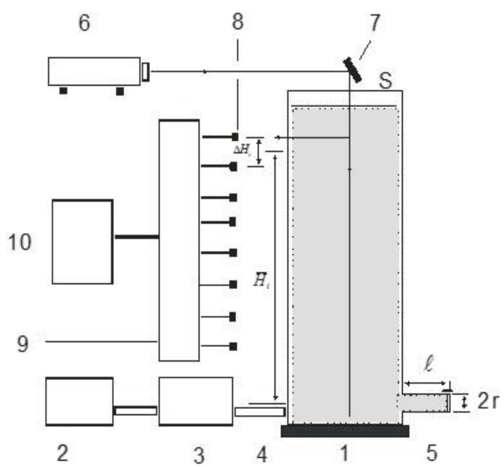
Scheme of the experimental equipment





Where 1 is an aerosol chamber, 2 container for initial aerosol formation, 3 peristaltic pump, 4 entry to the chamber, 5 calibrated exit tube, 6 laser, 7 mirror, 8 photoelectric sensors, 9 electronic block, 10 PC.

Experimental data

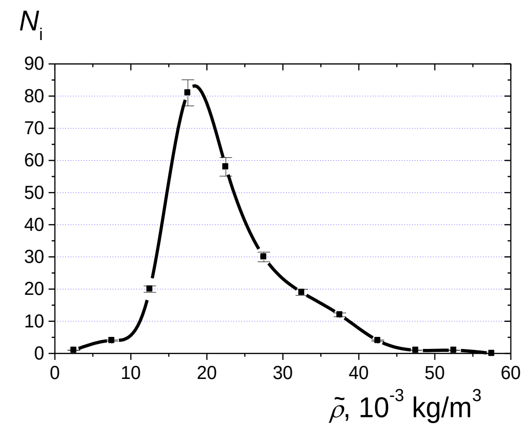


The aerosol is formed in a chamber for initial aerosol formation 2. Using peristaltic pump 3 the aerosol is transfered to aerosol chamber 1 (of section S) through entry 4. The calibrated exit pipe 5 of lenght land diameter 2ris closed (not shown). When opened, the aerosol starts to flow out and the upper borderline “aerosol-air” reduces. The laser beam (laser 6, mirror 7) passes through the cylinder‘s longitudinal axis 1. Photoelectric sensors 8 register only the light scattered by the aerosol in horizontal direction (90°). The signals are processed by electronic block 9, which consists of DC amplifiers, triggers and a logical unit. A Personal Computer records the moment of crossing the upper aerosol–air borderline through each of the photoelectric sensors. The final results are processed, recordedand visualized.

$\tilde{\rho}$.

Experimental data

We used the data for the mass density of aerosols phase of tobacco smoke (as AsLV) from 10 different brands of cigarettes in this work. The aerosol's phase particles have a very small size and vastly high concentration. Their parameters vary to some extend, depending on the conditions of their formation.

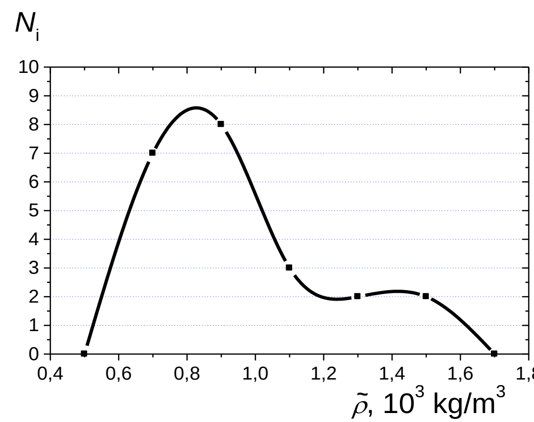


.Distribution of N_i values of the determined AsLV densities part of each subinterval having a midpoint

$\tilde{\rho}$

Experimental data

In the case of liquids. In this numerical experiment we used tabular data for the densities of some liquids cited in D. Hristozov, I Mladenov, S. Armenski, N. Andreev, M. Minev, H. Manev, Physics laboratory practicum, Nauka i izkustvo, Sofia, (1990)



N_i values distribution of the liquids densities array in each subinterval with midpoints

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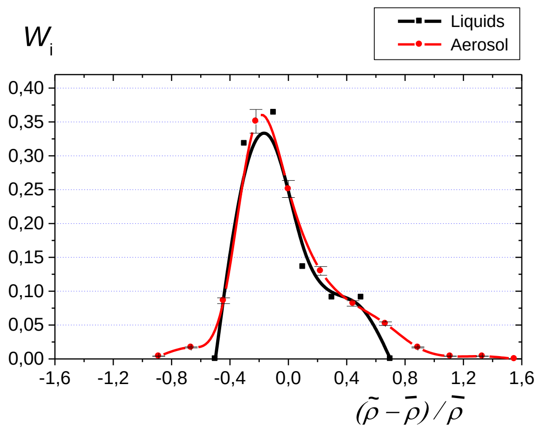
Data analysis

The values of densities of aerosols of limited volume (aerosol phase of AsLV) and liquids differ by about 5 orders of magnitude. In order to compare their density distribution first we define the average value of the density and the probability $W_i = N_i / \sum N_i$ of belonging in each subinterval to the left or to the right of the average density. After we complied the dependence of Wi on the dimensionless value $(\tilde{\rho} - \bar{\rho})/\bar{\rho}$ in one singe graph. The dependence we obtained is presented in figure



Probability distributions W_i of the mass densities of aerosol phase of AsLV and density of the liquids compared to their average values.

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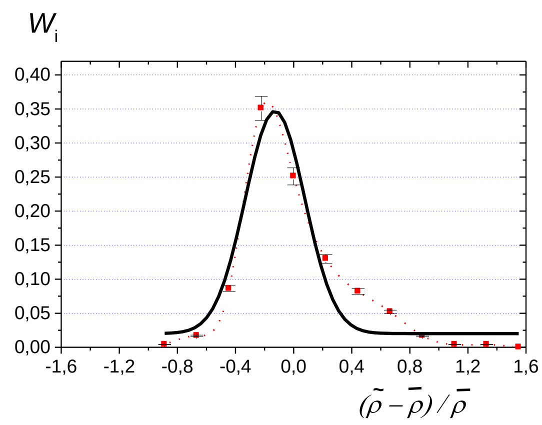
Conclusion

Based on the demonstrated above, we can conclude the probability distribution Wi of the mass density of the aerosol phase compared to the average value for AsLV (Wi) is very close to that of liquids. The distribution is similar in shape to the Gaussian distribution with predominance of the values greater than the average.



Probability distribution of the mass density of the aerosol phase of AsLV in relation to the average value W_i (squares and dashed line). Comparison with the Gaussian distribution (solid line).

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