

DETERMINATION OF THE INITIAL CONCENTRATION OF AEROSOLS AND CHEMICAL AGENTS AT THE PORTABLE AIR PURIFIER TEST SITE

Tomasz Jankowski¹, E. Dobrzyńska¹, A. Woźnica¹

¹ Central Institute for Labour Protection – National Research Institute, Department of Chemical, Biological and Aerosol Hazards, Poland
e-mail: tojan@ciop.pl

Keywords: aerosols, chemical agents, air purifiers, ventilation, chamber

INTRODUCTION

According to the World Health Organization (WHO), 99% of the world's population lives in places where air pollution concentrations exceed the organization's recommended levels. According to WHO data, poor air quality contributes to the deaths of over 6.5 million people worldwide each year. In 2019, air pollution was the fourth leading cause of premature death among humans.

Therefore, indoor air quality is a crucial issue. Research shows that most people spend up to 90% of their time indoors. Indoor air quality depends not only on the composition of the outdoor air that enters buildings, but also on the activities people undertake inside, such as smoking, cooking, and conducting technological processes.

EXPERIMENTAL SET

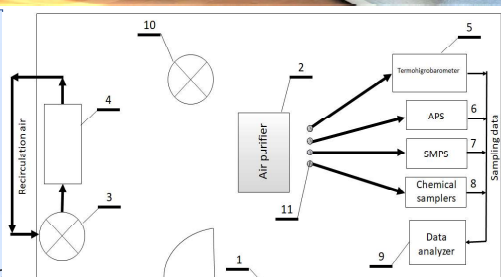
CIOP-PIB undertook to build a test station of air purifiers (2) based on the ANSI/AHAM AC-1-2020 and AHAM AC-3-2009 (R2021) method. The following were used for aerosol measurements in a laboratory chamber with a ventilation and filtration system ensuring continuous air recirculation: APS Model 3321 (TSI Inc.) and SMPS Model 3938 (TSI Inc.), consisting of a CPC Model 3776 and a DMA Model 3082. In tests for the presence of chemical substances in the air in the laboratory chamber, GC/MS and HPLC/UV analytical techniques were used. The recirculating air was taken from the inside of the chamber (1). The air flow rate was 3500 m³/h. The measurements were carried out for 5 hours.



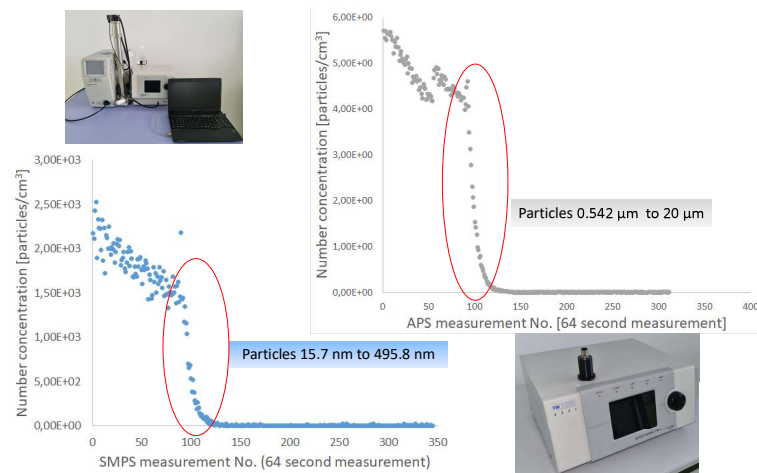
The recirculation air flow module together with the air parameter regulation module in the chamber consists of a duct fan (3) and a multi-stage air filtration system (pre-filter and HEPA filter) (4).
A fan mixing the air during the tests (10) was used in the chamber.
The air parameters in the test chamber are recorded using a LAB-EL thermohygrometer with an LB 701 panel and an LB 725 probe (5).
The concentration of test aerosols is measured using:

- APS spectrometer (TSI Inc.) to measure the aerodynamic diameter of particles in the range from 500 nm to 20 μm (6)
- SMPS particle size analysis system (TSI Inc.) to determine the number, mass concentration and size distribution in the range from 15 to 500 nm (7)
- Chemical samplers (TSI) for the determination of chemicals in air (8).

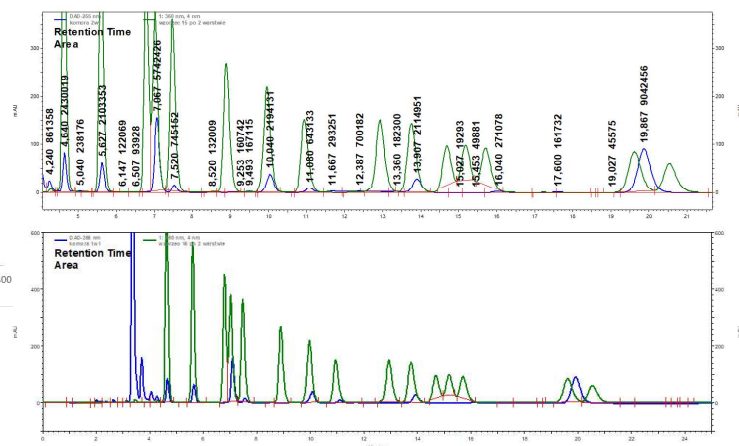
Air samples (11) are collected by the sampling probe system in an isokinetic manner



RESULTS



Example of a chromatogram of the composition of a mixture of chemical compounds.



CONCLUSIONS

- ❑ In the laboratory chamber, the number concentration of particles in the size range from 15.7 nm to 495.8 nm ranged from 2.11·10³ to 1.04·10³ particles/cm³. Starting the recirculating ventilation and air filtration system in continuous operation mode for 30 seconds caused the number concentration of particles to drop to an average value of 2.67·10² particles/cm³. In the range of particles with dimensions from 0.542 μm to 20 μm, the number concentration ranged from 5.71 to 3.61 particles/cm³. Then, after switching on the recirculating ventilation and air filtration system, it dropped to an average value of 1.11·10⁻² particles/cm³.
- ❑ From the group of carbonyl compounds, the following were identified: formaldehyde, acetaldehyde, acetone, butanal, benzaldehyde, propionaldehyde, valeraldehyde. From the group of volatile organic compounds, the following were identified: limonene, pinenes (α-pinene), xylenes, ethylbenzene, hexanol, isopropanol, siloxanes.

ACKNOWLEDGEMENTS

This work was completed on the basis of results of research carried out within the scope of the 6th stage of the National Programme "Governmental Programme for Improvement of Safety and Working Conditions", funded by state services of the Ministry of Family, Labour and Social Policy. Task no.: 1.ZS.03. The CIOP-PIB is the Programme's main co-ordinator.

REFERENCES

ANSI/AHAM AC-1-2020. Method for Measuring Performance of Portable Household Electric Room Air Cleaner.
AHAM AC-3-2009 (R2021) Method for Measuring the Performance of Portable Household Electric Room Air Cleaners Following Accelerated Particulate Loading.



XXV JUBILEUSZOWA KONFERENCJA

HIGIENA PRACY
osiągnięcia, wyzwania i perspektywy

Łódź, 1-3 października 2025

STRESZCZENIA

PLAKATY