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Department of Chemical, Biological and Aerosol Hazards
Aerosol. Filtration and Ventilation Laboratory

TEST REPORT

Contract to perform testing No.: 287/PZ/2025/NC

SUBJECT OF THE CONTRACT: Testing the emission of nanoparticles during the cleaning process of a Surface Mount Downlight 24W EVLN-SDL-24W(S) 6000K EV SUN

ORDERING PARTY: EVS Ltd.

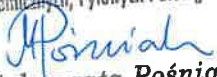
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Date of start
18.04.2025

Date of end
05.05.2025

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KIEROWNIK ZAKŁADU
Zagrożeń Chemicznych, Pyłowych i Biologicznych

dr Małgorzata Pośniak

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1. Purpose and scope of tests

The aim of the study was to determine the emission of nanoparticles into the air from the provided samples of Surface Mount Downlights 24W Model EVLN-SDL-24W(S) 6000K EV SUN.

The study was conducted in a test chamber ensuring low concentration of background particles. The concentration of released nanoparticles was measured using the SMPS particle dimensional analysis system (TSI Inc.). The view of the material sample is shown in Figure 1.1.



Figure 1.1 The view of the material sample

2. Identification of the method used

The methodology used in the described studies was developed at the Central Institute for Labor Protection – National Research Institute (CIOP-PIB). The studies were carried out in the Nanoaerosol Research Laboratory in the Tech-Safe-Bio building.

Measuring instruments and additional equipment used:

- SMPS Model 3938 particle size analysis system (TSI Inc.) consisting of a Model 3082 electrostatic classifier and a Model 3776 condensing particle counter. Ident. No. VIII-2074
- LB-701 thermohygrobarometer with LB-706B (LAB-EL) panel – for measuring temperature, atmospheric pressure and relative air humidity. Ident. No. VIII – 1963
- Test chamber (CIOP-PIB). Ident. No. VIII-2558
- Model GF40 air flow regulator (Brooks Instruments). Ident. No. VIII-2318.

The test stand consists of a test chamber, electrical installation, air flow module, air filtration module, air parameter regulation module, aerosol particle concentration measurement module and measurement data collection and archiving unit. The first element of the test stand is the chamber, which allows to meet the requirements for obtaining low concentrations of aerosol particles. The recirculation air flow module together with the air parameter regulation

module in the chamber consists of a duct fan and a multi-stage air filtration system (pre-filter and HEPA filter). Additionally, a fan mixing the air during the tests was used in the chamber. Air parameters (atmospheric pressure, temperature and relative air humidity) in the test chamber are recorded using a LAB-EL thermohygrometer. In the test stand, the measurement of the number and mass concentration and the dimensional distribution for 64 dimensional fractions of aerosol particles in the range from 15 to 500 nm is performed using the SMPS particle dimensional analysis system. The test stand is equipped with an acquisition unit that receives and archives measurement data and a program for data analysis and visualization. The view and diagram of the test stand are shown in Figure 2.1 and 2.2.



Figure 2.1. View of the test stand for testing nanoparticle emissions from lamp samples

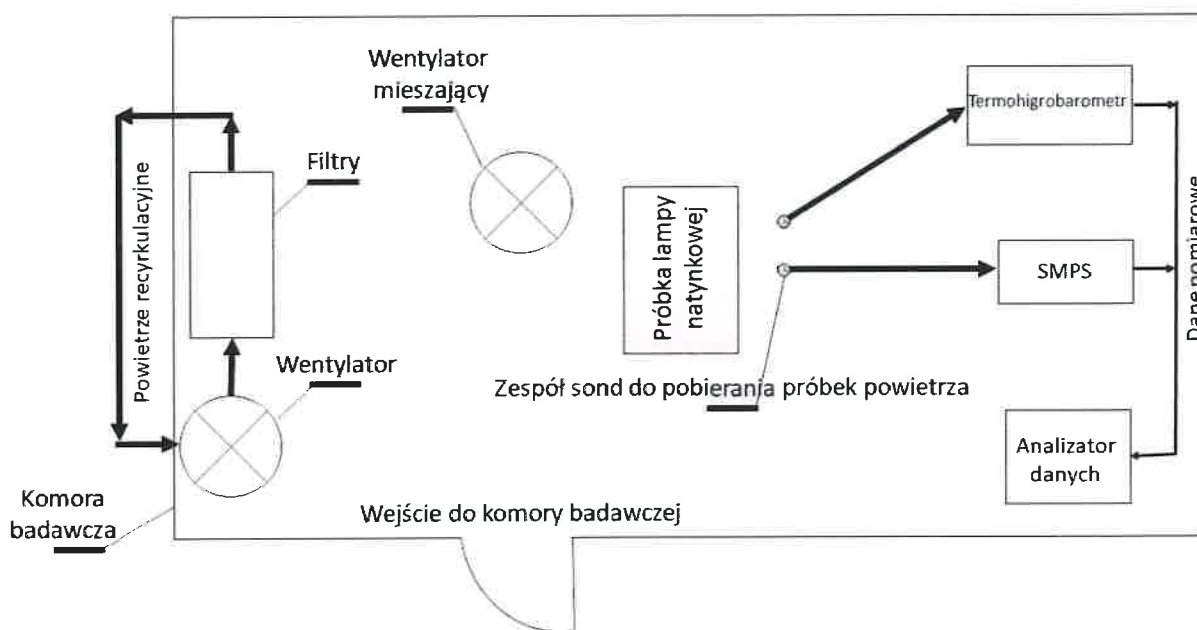


Figure 2.2. Schematic diagram of the test stand for nanoparticle emission from samples in the test chamber

The criteria for evaluating the test results were based on established reference levels that should not be exceeded. The results were referred to the recommendations contained in [1,2,3,4]. The indicated publications present an approach based on established reference levels of the number concentrations of nanoparticles in the air. Nanomaterials are divided according to their density for:

- nanoparticles with a density higher than 6 g/cm^3 , belonging to the group of biostable, granular particles (some nanoforms of metals, e.g. Au, Ag, Fe, Pb and metal oxides, such as SnO_2 , Fe_xO_y , CoO), a reference level of **20,000 particles/cm³** was set,
- nanoparticles with a density lower than 6 g/cm^3 , e.g. some metal oxides (ZrO_2 , ZnO , TiO_2 , Al_2O_3), dendrimers, nanoclays, fullerenes, nanopolymers, as well as technical carbon black, SiO_2 , etc., a reference level of **40,000 particles/cm³** was set.

References

1. CIOP-PIB Recommendations: Nanometric structures of metals and metal oxides in the work environment. Potential hazards. Safe work principles; Lidia Zapór, Warsaw 2013. Available at: https://www.ciop.pl/CIOPPortalWAR/file/76572/chempyl_Nanometryczne_struktury.pdf
2. WHO Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials; collective work. Available at: <http://apps.who.int/iris/bitstream/10665/259671/1/9789241550048-eng.pdf>
3. Broekhuizen, P., and Hendrikx, B. 2013. Nano reference values in the Netherlands. Vol. 73. Dostępne pod adresem: <https://www.gefahrstoffe.de/library/common/X075en.pdf>
4. Schumacher, C., and Pallapies, D. 2009. "Criteria for assessment of the effectiveness of protective measures." IFA DGUV. Available at: <https://www.dguv.de/ifa/fachinfos/nanopartikel-am-arbeitsplatz/beurteilung-von-schutzmassnahmen/index-2.jsp>.

3. Test results

3.1. Test results on the release of nanoparticles during the dry cleaning process of the lamp surface

The results of the studies on the release of nanoparticles from samples of Surface Mount Downlights 24W Model EVLN-SDL-24W(S) 6000K EV SUN during **the dry cleaning process** are presented in the form of tables and graphs.

During the conducted studies, the air parameters were controlled: temperature, relative air humidity and atmospheric pressure (Table 3.1).

Table 3.1. Atmospheric conditions during the measurement of nanoparticle emissions

Air parameters	Temperature [°C]	Pressure [hPa]	Relative humidity [%]
average	24.8	1002.0	35.8
min	24.4	1001.7	33.8
max	25.4	1002.3	36.9

At the background stage, the following values of the number and mass concentration of aerosols were recorded: $4.91 \cdot 10^2$ [particles/cm³] and $1.28 \cdot 10^0$ [μg/m³] for particles from 15.7 nm to 495.8 nm.

Figures 3.2 and 3.3 show the averaged particle size distribution and changes in the mean geometric diameter of particles released during the dry cleaning process of the lamp surface.

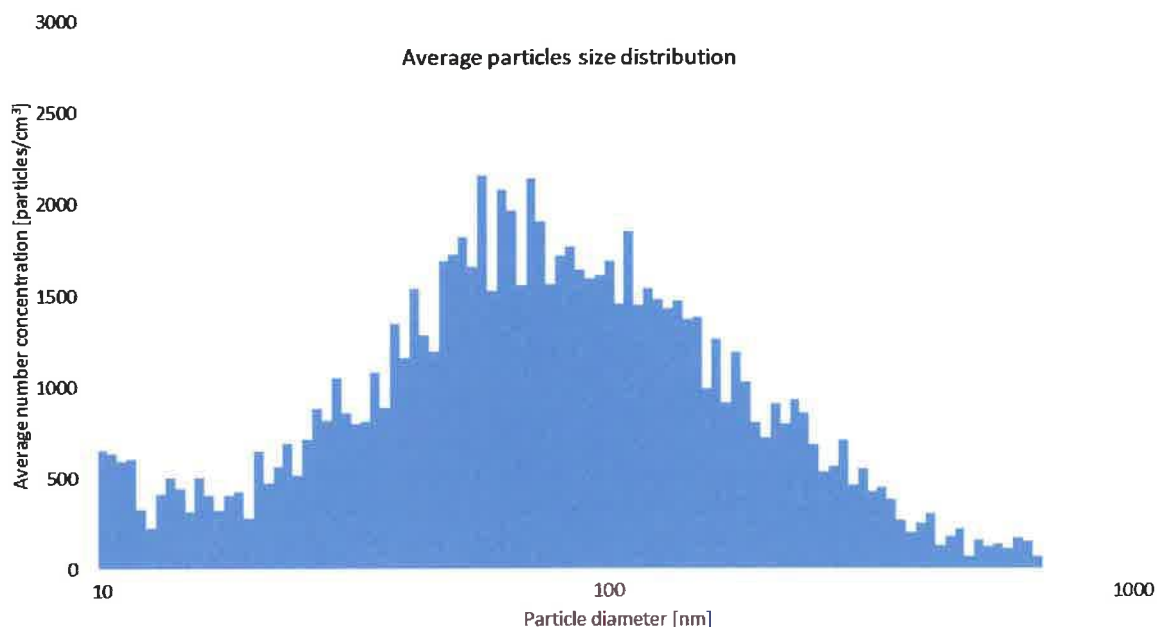


Figure 3.1 Average size distribution of aerosol particles during the dry cleaning process of the lamp surface

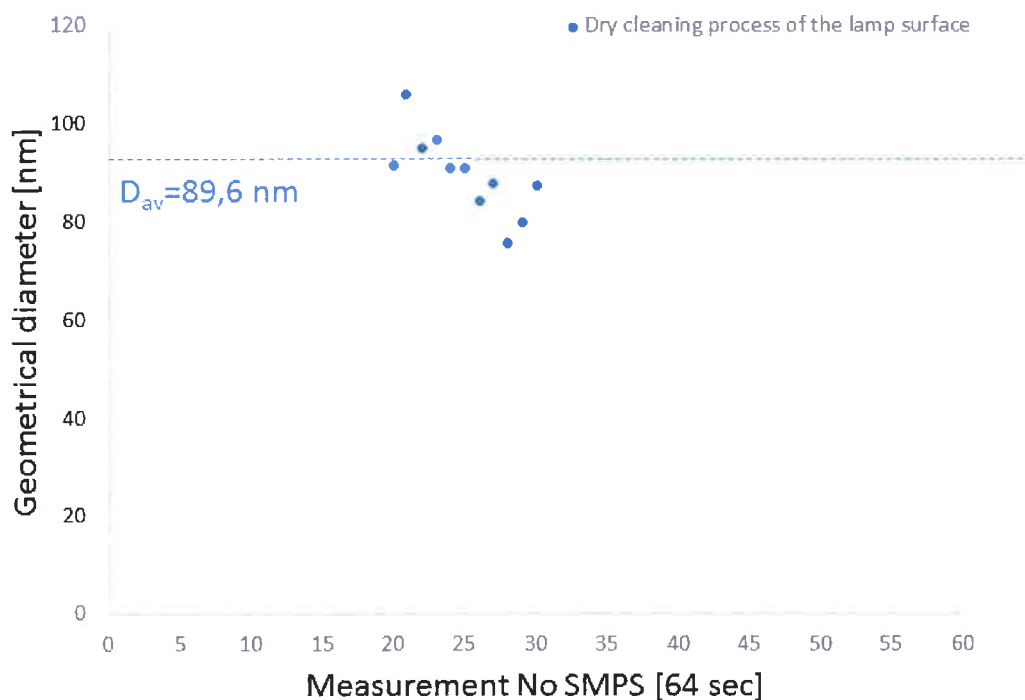


Figure 3.2 Changes in the mean geometric diameter of aerosol particles during the dry cleaning process of the lamp surface

Figures 3.3 to 3.4 show the changes in the averaged 3-sample number and mass concentration of aerosols in the particle size range from 15.7 nm to 495.8 nm released during:

- the background stage (red)
- the lamp surface dry cleaning process (blue)
- the air purification process in the test chamber (green).

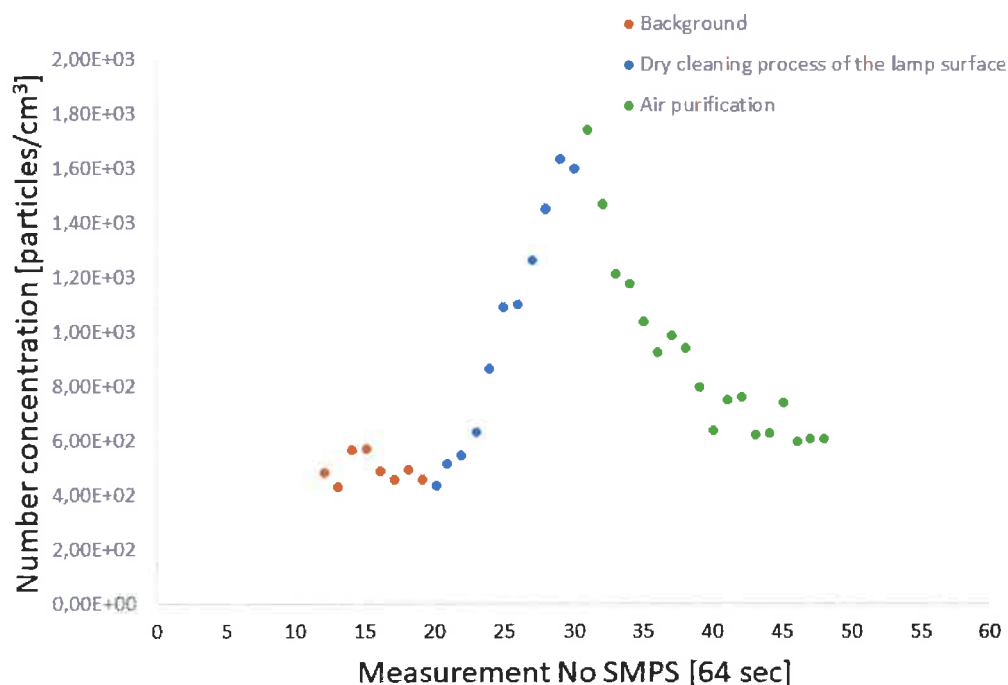


Figure 3.3 Changes in the number concentration of particles with sizes from 15.7 nm to 495.8 nm during the dry cleaning process of the lamp surface

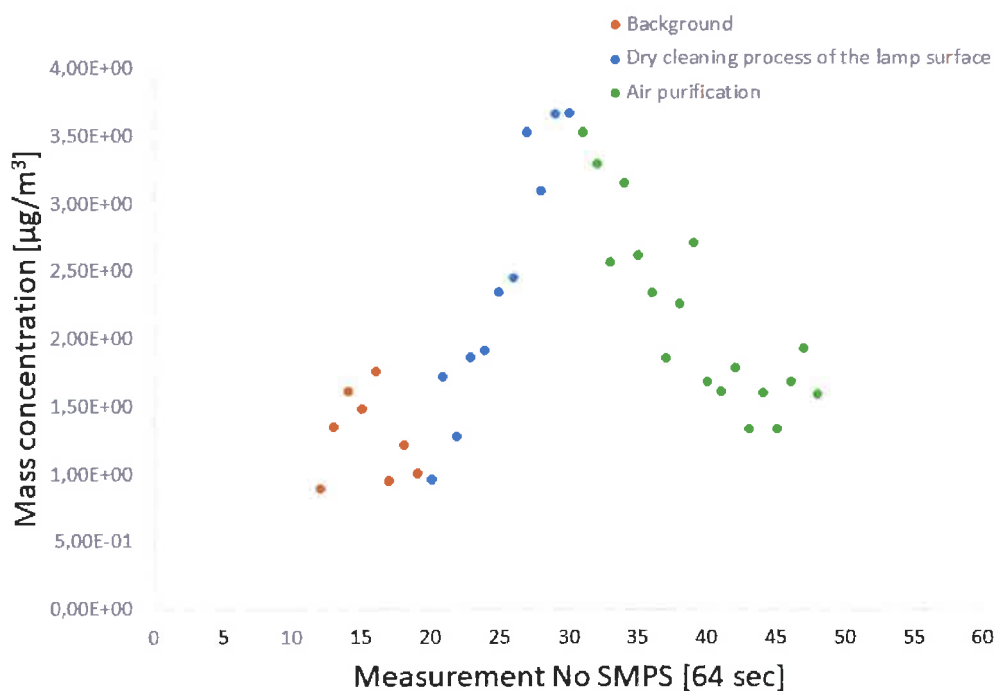


Figure 3.4 Changes in the mass concentration of particles with sizes from 15.7 nm to 495.8 nm during the dry cleaning process of the lamp surface

3.2. Test results on the release of nanoparticles during the wet cleaning process of the lamp surface

The results of the studies on the release of nanoparticles from samples of Surface Mount Downlights 24W Model EVLN-SDL-24W(S) 6000K EV SUN during **the wet cleaning process** are presented in the form of tables and graphs.

During the conducted studies, the air parameters were controlled: temperature, relative air humidity and atmospheric pressure (Table 3.2).

Table 3.2. Atmospheric conditions during the measurement of nanoparticle emissions

Air parameter	Temperature [°C]	Pressure [hPa]	Relative humidity [%]
average	24.3	1004.0	36.2
min	22.4	1003.4	34.7
max	24.9	1004.5	38.8

At the background stage, the following values of the number and mass concentration of aerosols were recorded: $1.03 \cdot 10^3$ [particles/cm³] and $1.88 \cdot 10^0$ [µg/m³] for particles from 15.7 nm to 495.8 nm.

Figures 3.5 and 3.6 present the averaged particle size distribution and changes in the mean geometric diameter of aerosol particles released during the wet cleaning process of the lamp surface, respectively.

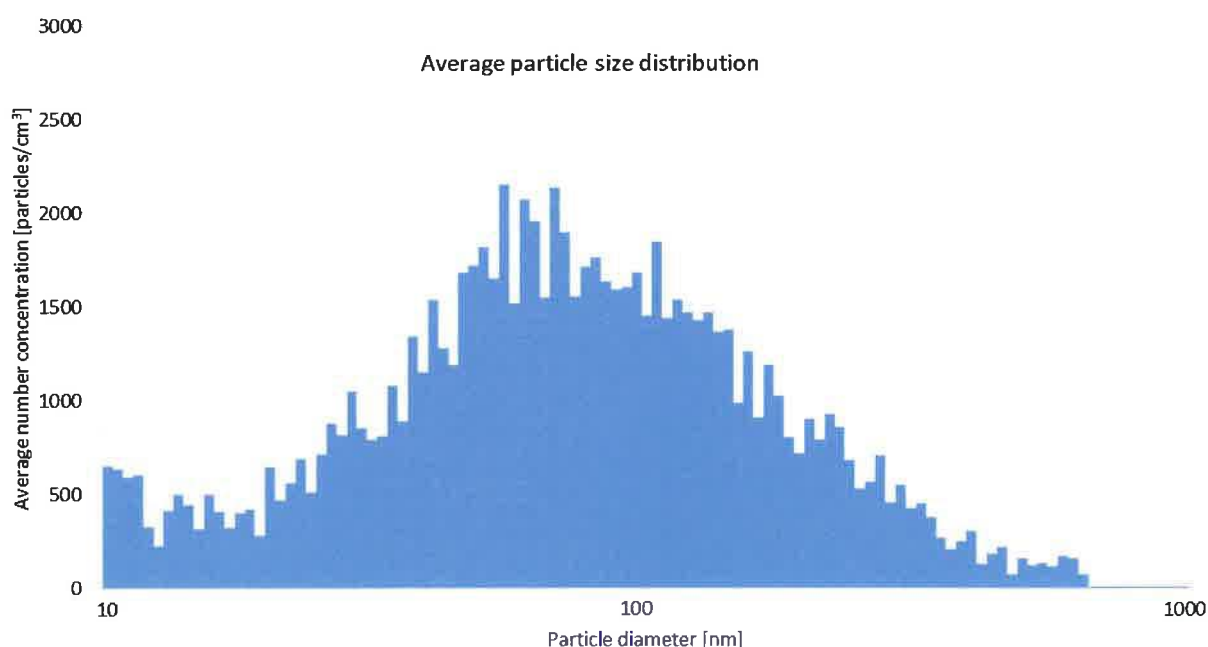


Figure 3.5 Average size distribution of aerosol particles during the wet cleaning process of the lamp surface

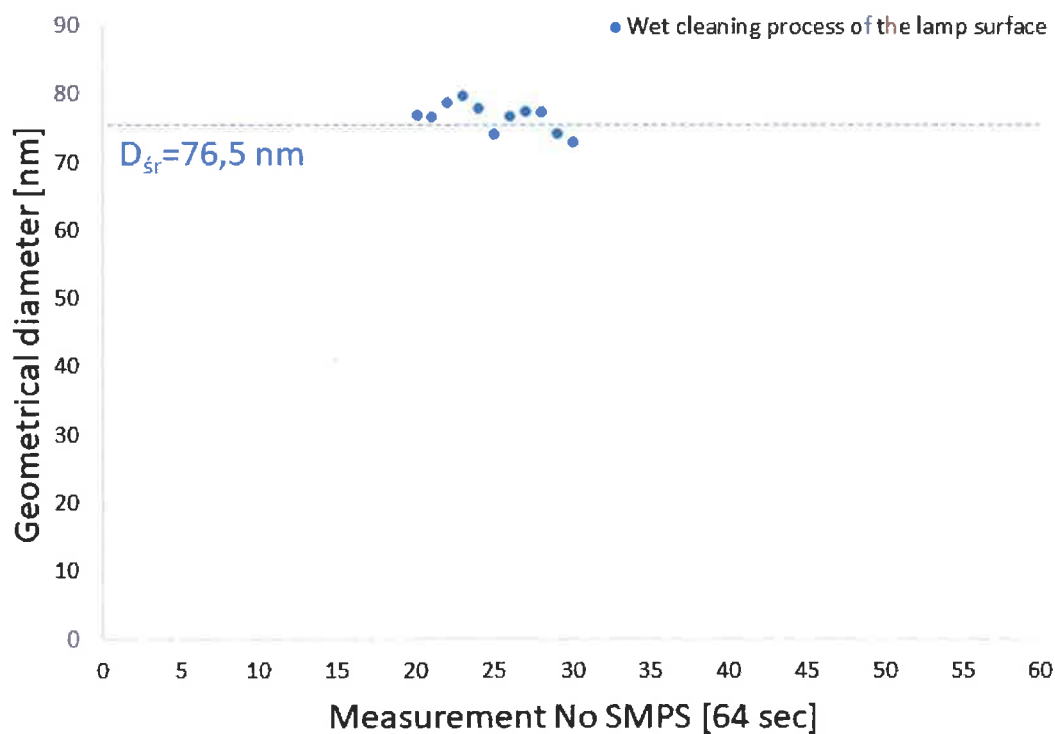


Figure 3.6 Changes in the mean geometric diameter of aerosol particles during the wet cleaning process of the lamp surface

Figures 3.7 to 3.8 show the changes in the averaged 3-sample number and mass concentration of aerosols in the particle size range from 15.7 nm to 495.8 nm released during:

- the background stage (red)
- the wet cleaning process of the lamp surface (blue)
- the air purification process in the test chamber (green).

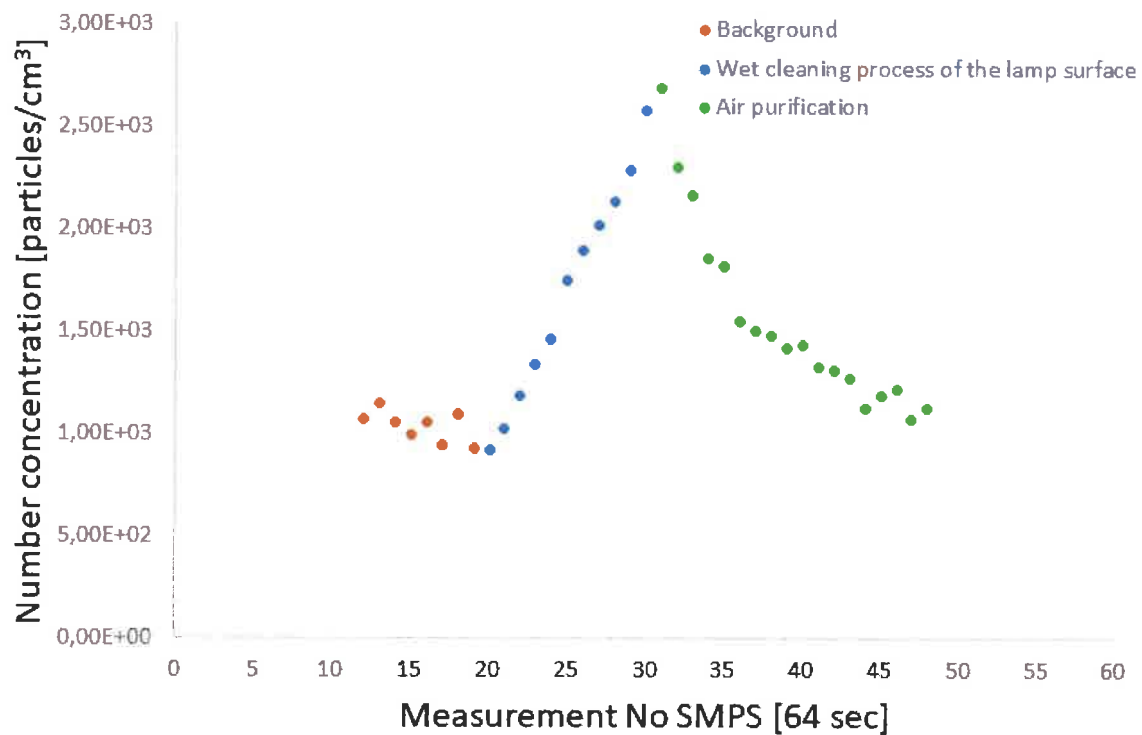


Figure 3.7 Changes in the number concentration of particles with sizes from 15.7 nm to 495.8 nm during the wet cleaning process of the lamp surface

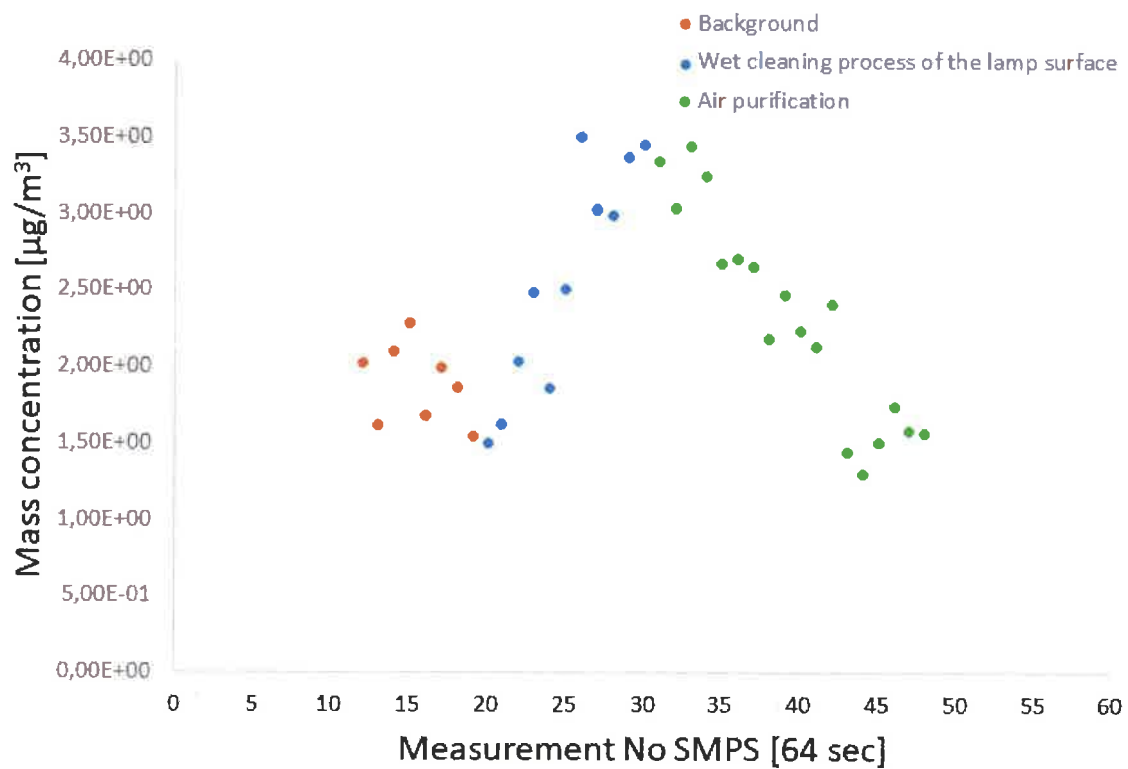


Figure 3.8 Changes in the mass concentration of particles with sizes from 15.7 nm to 495.8 nm during the wet cleaning process of the lamp surface

4. Summary and conclusions

- As a result of cleaning the surface of the lamp, the number and mass concentration of particles below 500 nm increased to the following average values by:
 - $1.63 \cdot 10^3$ [particles/cm³] and $3.66 \cdot 10^0$ [μg/m³] for the dry process
 - $2.58 \cdot 10^3$ [particles/cm³] and $3.45 \cdot 10^0$ [μg/m³] for the wet process.
- The averaged values of the number concentration of particles in the vicinity of the Surface Mount Downlight in the chamber ranged from 518 [particles/cm³] to 654 [particles/cm³] depending on the type of lamp surface cleaning process. These values are definitely below the assumed reference threshold of 40,000 [particles/cm³], and even below the lower threshold of 20,000 [particles/cm³].
- The dominant size of particles emitted during cleaning of the Surface Mount Downlight surface was 90 nm (dry process) and 77 nm (wet process).
- Turning on mechanical exhaust ventilation in the test chamber caused the concentration of nanoparticles to drop to the background level.
- The analysis of the obtained data shows that for the 3 Surface Mount Downlight samples tested, dry and wet cleaning processes did not cause significant release of nanoparticles into the air.

STATEMENT

The measurement results refer only to the tested 3 samples of Surface Mount Downlights 24W Model EVLN-SDL-24W(S) 6000K EV SUN.

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The interpretation of the results included in the test report is not covered by PCA accreditation.

END OF THE REPORT