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RESPONSE SURFACE METHODOLOGY TO EVALUATE THE EFFECTS OF GEOMETRIC PARAMETERS ON THE ELECTROSTATIC PRECIPITATION

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Introduction

The electrostatic precipitator (ESP) collection efficiency is influenced by geometric parameters and operating conditions. In this study, the influence of the number and diameter of the discharge electrodes on the performance of the ESP, with different air velocities and electric field intensities, were evaluated through an ANOVA analysis and the response surface methodology.

Materials and Methods

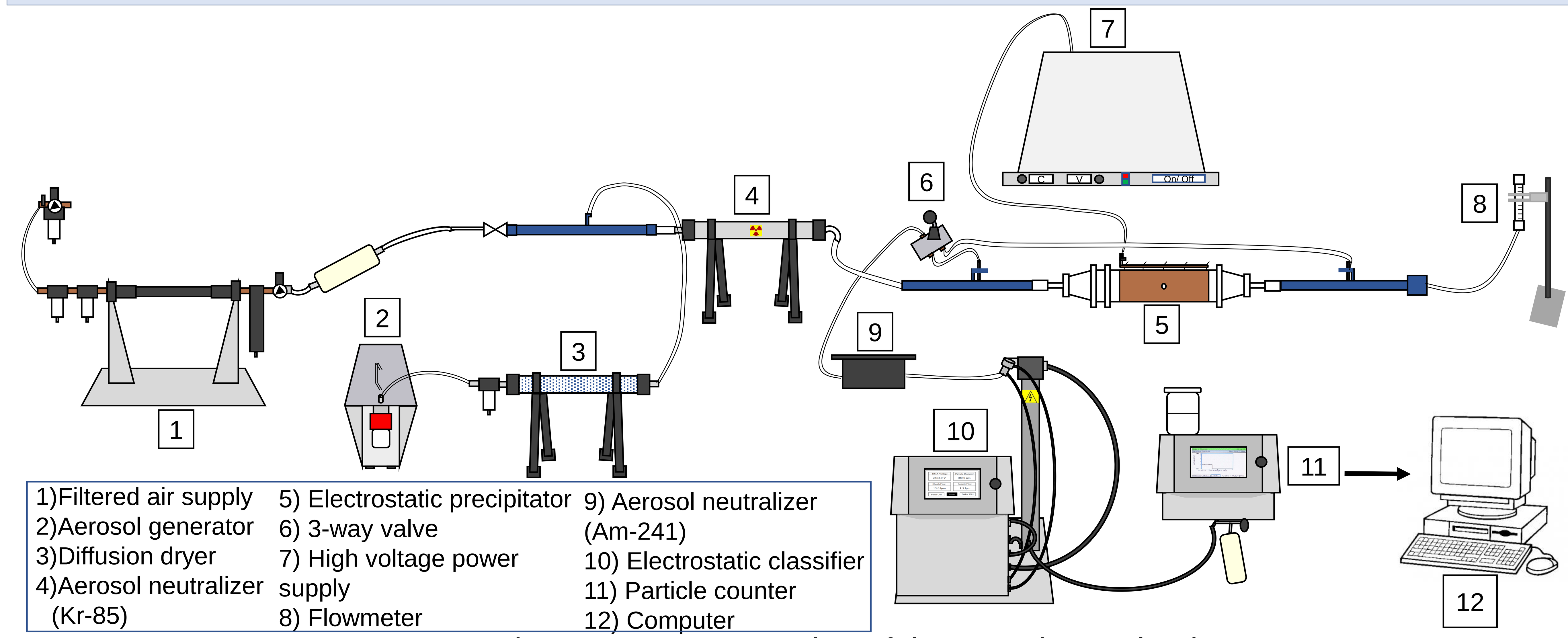

Figure 1: Representation of the experimental unit. Adapted from Andrade and Guerra (2021).

Wire-plate single-stage ESP

- 2 collecting electrodes (10 x 30 cm);
- 1-2 discharge electrodes (0.3 and 0.4 mm of diameter);
- Spaced in 6.5 cm

Operating conditions

- Air velocity: 1.03 and 4.08 cm/s
- Electric Field: 3.08 and 3.38 kV/cm
- Particle diameter (5.83 – 228.8 nm)

Statistical analysis

- Confidence interval of 95%.
- 2^4 factorial design

Results and Discussion

The wire diameter and the air velocity presented a negative effect, which means that the particle collection efficiency reduced (14-30%) with the increase of these parameters. On the other hand, the number of wires and electric field showed a positive effect, with an increase of over 36% on the particle collection.

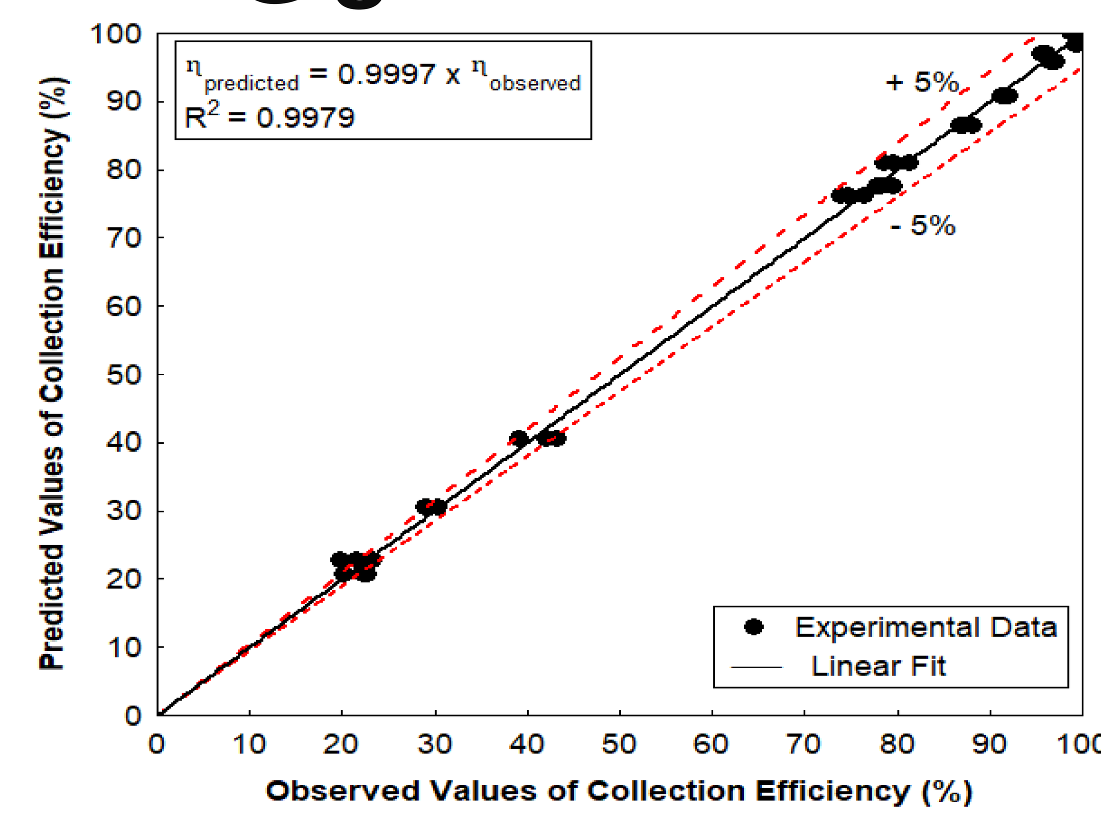

Figure 2: Predicted values of collection efficiency versus observed.

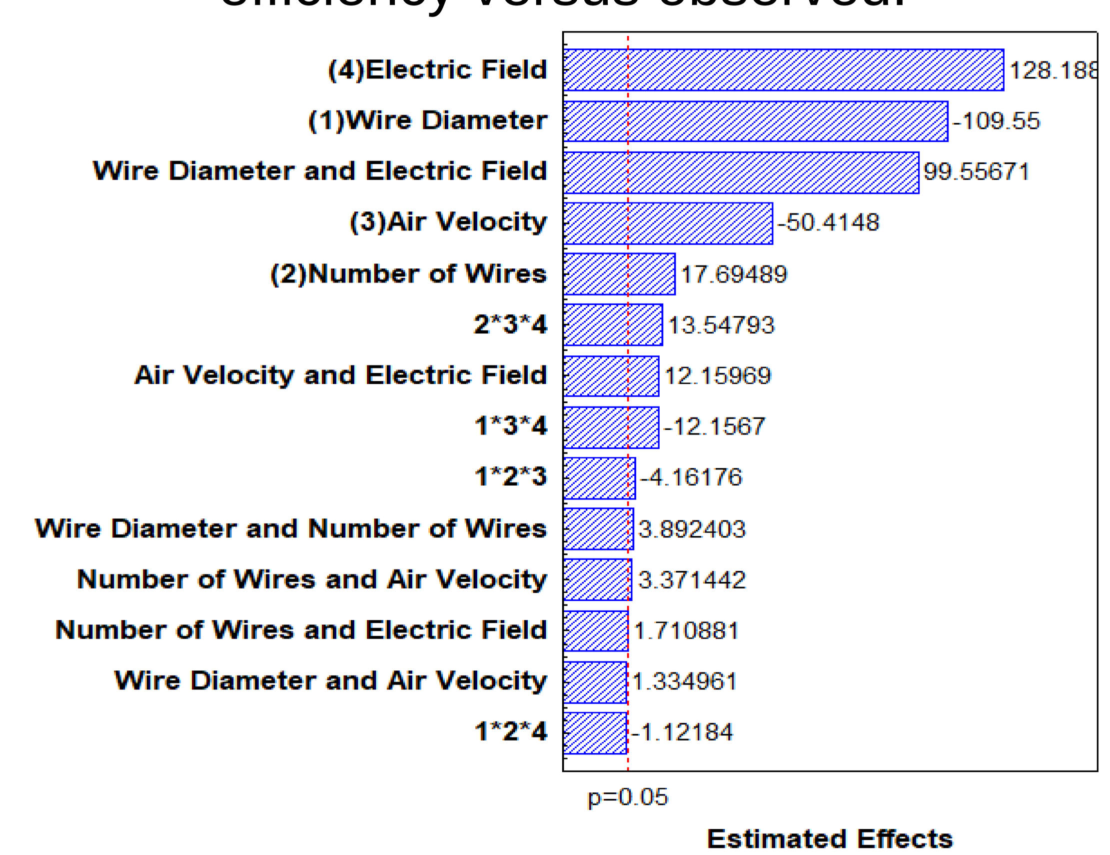

Figure 3: Pareto chart.

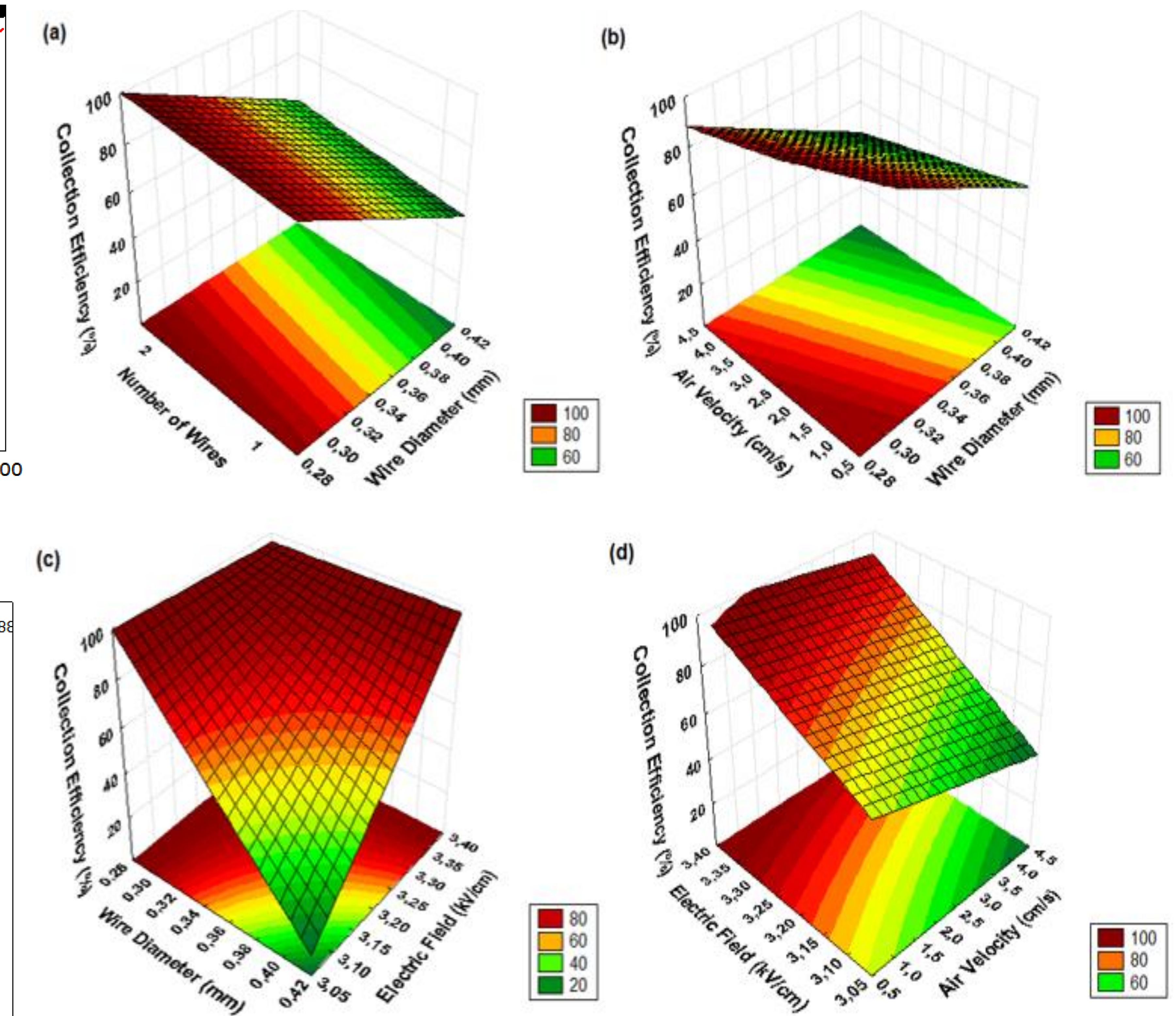

Figure 4: Response surface as a function of: (a) number of wires and wire diameter, (b) air velocity and wire diameter, (c) wire diameter and electric field and (d) electric field an air velocity.

Conclusions

The electric field and wire diameter were the most significant factors for the particle collection, achieving the highest values (higher than 95%) with the wire diameter of 0.3 mm and the electric field of 3.38 kV/cm.

References

Andrade, R. G. S. A., Guerra, V. G., 2021: Discharge electrode influence on electrostatic precipitation of nanoparticles. Powder Technol., **379**, 417- 427, https://doi.org/10.1016/j.powtec.2020.10.087.

Acknowledgments: