Airflow velocity measurement of the electrostatic spray gun

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Abstract. The results of an experimental study of the airflow velocity measurement of the electrostatic spray gun are presented. It has been shown experimentally that airflow velocity rate varies in the range from 1 to 25 m/s depending on the distance from the nozzle of the spray gun and air pressure.

1. Introduction
Electrostatic powder coating was first introduced to the finishing industry in early 1960s [1]. In recent years, the polymer powder coatings are widely used in various industries. Electrostatic coating process is characterized by high efficiency, easy regulation of the parameters and a wide range of materials used [2].

A large number of spraying system both by tribostatic [3-4] and electrostatic methods have been developed [5]. Spray guns with external powder charging (i.e. electrostatic method) most commonly used at present [6].

Powder paint are polydisperse system consisting film-forming basis and air – separating medium [7]. There are two types of polymer powder coatings: thermosets and thermoplastics. Currently, thermoset polymer powders are used most widely. Well-proven thermosetting compositions are epoxy, polyester, epoxy-polyester, polyurethane and polyacrylate [8-9]. Such operational characteristics as strength, adhesion, resistance to external influences etc. depend on the type of powder composition. Such coatings parameters as thickness and uniformity largely depend on the spraying conditions [10].

We use spraying gun “START-50” (Radar, Russia) with external charging. In the spraying process, the powder particles enter the corona discharge region, where ionization of the air by electrons takes place. Free ions are deposited on the powder particles and transfer charge to them [11].

Aerodynamic force, electrostatic force and gravity act on powder particles. Under the influence of these forces, the powder particles are moved and deposited on a grounded surface (external corona discharge region).

In [12], it was shown that the aerodynamic force is decisive when moving particles to the surface. In [13], process of the deposition of charged polydisperse gas suspension on the plate surface in the electrical field was simulated.
The aim of this work is to study airflow velocity from the electrostatic spray gun “START-50”. In order to develop the most complete model of the process of gas suspension movement and the production of coatings with the required parameters for different application.

2. Materials and methods
The measurements were carried out using an ATT-1004 hot-wire anemometer (Aktakom, Russia) and an ATT-1006 anemometer (Aktakom, Russia).

The ATT-1004 operation principle is based on air cooling of a heated thread. The device has a remote measuring head, in which the sensor is located (glass thermistor). The ATT-1004 has a measuring range of airflow velocity from 0.5 to 25 m/s. Uncertainty is ± (0.2+0.05·V) m/s.

In the ATT-1006 anemometer, a small metal impeller is installed on the measuring head. The ATT-1006 calculates the volume of airflow passing through the impeller. The measuring range of airflow velocity from 0.8 to 25 m/s. Uncertainty is ± (0.2+0.05·V) m/s.

For measurements, the following measuring stand was assembled. The “START-50” spray gun was fixed in a stationary position. The measuring heads of the anemometers were located on the axis of the spray head and moved along this axis. The distance from the gun to the measuring head of the anemometer was measured using a ruler (GOST 427-75).

3. Experimental results and discussion
The airflow velocity from the spray gun was measured without powder particles and in the absence of potential at the corona electrode. The air pressure varied from 0.2 to 0.8 MPa. Such values are selected in accordance with the established operating spraying conditions [14]. The ambient temperature during the measurements was 25.3 °C.

Figure 1 shows results of airflow measurement using anemometer ATT-1004. The x-axis shows the distance from the nozzle of the spray gun. It can be seen that the airflow rate decreases with increasing distance.

![Figure 1. The dependence of the airflow velocity on the distance from the nozzle of the spray gun at different air pressure using ATT 1004.](image-url)
Figure 2 shows results of airflow measurement using anemometer ATT-1006.

![Figure 2](image)

**Figure 2.** The dependence of the airflow velocity on the distance from the nozzle of the spray gun at different air pressure using ATT 1006.

4. Conclusions
The results of an experimental study of the airflow velocity measurement of the electrostatic spray gun “START-50” are presented in this article. It has been shown experimentally that airflow velocity rate varies in the range from 1 to 25 m/s depending on the distance from the nozzle of the spray gun and air pressure.

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