Electrostatic Method to Measure the Size of the Sprayed Droplets

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Abstract

In the paper is presented the new method the measurement of the main parameters the atomised stream of liquid. This method base on the measurement of the electric charge carried by water drops charged by high voltage. The electrostatic sensor to measure of the droplets size, is associated with precision mechanic system scanning the sprayed surface. The amplified and conditioned signals from electrostatic sensor are send to the computer system equipped in virtual instrument to analyse the size and spatial distribution of droplets. The virtual instrument control also the scanning system.

Keywords**:** droplets size, electrostatic, measurement systems.

Introduction

The spray technique is largely used in the agriculture, food technology and industry. To obtain the good results in spraying of the liquid, the droplets created by the sprayer have to possess exactly determined properties. The most important properties of the spraying droplets are: the size of droplets, the homogeneity of size and uniformity of the covering surface by the drops. Actually exist a few method to measure the droplets size there are the optic and photographic methods to measure the traces of the droplets made on special paper or to photograph the droplets during their movement from sprayer to the target. If it is necessary to obtain pinpoint measurement of this parameter the best manner is so called Doppler-Laser method. But the weakness the most currently used methods is their high cost and big dimensions like the Doppler Laser method, or complicated and long procedure to measure and pick-up the data in the optics and photographic methods. The electrostatics method to measure the droplets size, associated with the computer controlled scanning system, make possible to measure and evaluate the main properties of the spraying system. This method give the possibilities to obtain all information about sprayed stream, instantly on the computer screen in the intuitive graphical form. The measurement system permit to evaluate and regulate the sprayers precisely and quickly.

In the classical electrostatic method the measure system is composed the two main modules: the first is the loader drops of electric charge. The second module is a measuring unit measures the size of the lifted electric charge and specifying on this basis the size of atomized droplets of liquid. This movement of the charged drop can be investigating like a convection current between charging electrode and receiving electrode, which is connected with measurement system .

Laboratory stand

To exam the dependence presented above the laboratory stand has been constructed by the author in, University of Life Sciences in Lublin Poland (fig.1). This stand makes possible to change the range of charging voltage, the size and distance of passage the drops.

This work-stand simulate the condition of drop movement and let to determinate influence different factors of the spraying on the value of convection current. To obtain repeated results was applied a drop distributor which assured emission drops with various size . The distance between the drop distributor and the receiving electrode was changed from 2 cm to 200 cm.

The measurement system is composed with input circuits, instrumentation amplifier, digital oscilloscope, analog to digital converter (AD converter) and computer. The electrostatic sensor and measurement unit give the possibility to measure the convection current. On this base we can calculate the electric charge carried by drops. All these results were recorded on PC.

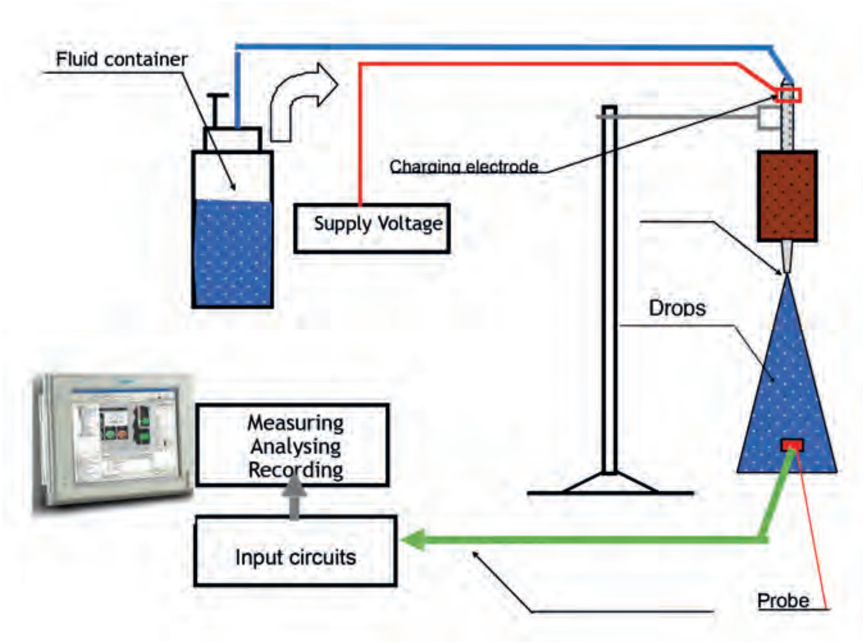

Fig. 1. Laboratory stand.

On the fig.2. are presented the waveforms of the signals coming from receiving electrode.

During the experiment the charge of the water drop was measured as the function of the distance passed by drop. The range of the distance passed by drop was from 2 cm to 200 cm. The experiment for each test was repeated 10 times. During this test was also observed influence of charging voltage on the results.

Fig. 2 shows the waveforms of the voltages on the receiving electrode during the discharging the water drops for selected highest.

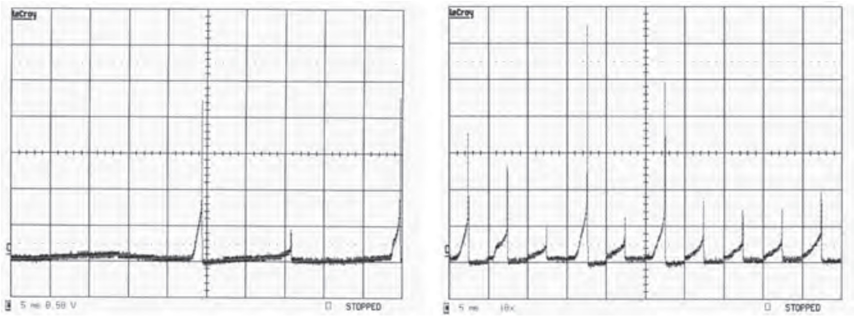

Fig. 2. Waveforms of the signals received from measurement system a) single signal b) series of signals.

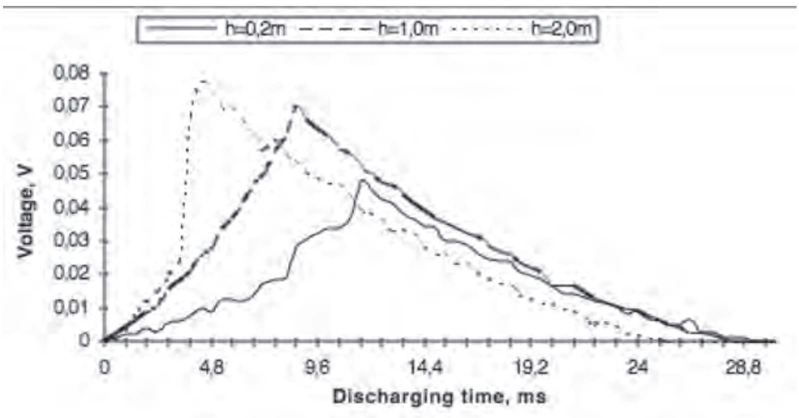

Fig. 3. Waveforms of discharging voltage.

Because the theoretical and experimental investigation confirm that electric charge is proportional to the mass of drop it was possible to construct small electrostatic drops mass detector, which can determine the dimension each individual droplet. The research proved also that electric charge carried by drops doesn't depend on distance passed by charged drops if the distances are located in the range between 10 cm to 200 cm.

Results of the research

A special virtual instrument was constructed to control the system of the scanning the analyzed area of spraying and to receive and analyze data from sensor. The electrostatic sensor to measure of the droplets size, was associated with precision mechanic system scanning the sprayed surface. The amplified and conditioned signals from electrostatic sensor were send to the computer system equipped in virtual instrument to analyze the size and spatial distribution of droplets. The instrument can define the parameters of scanning to obtain desirable "density" the points of measure as it is shown on fig.4.

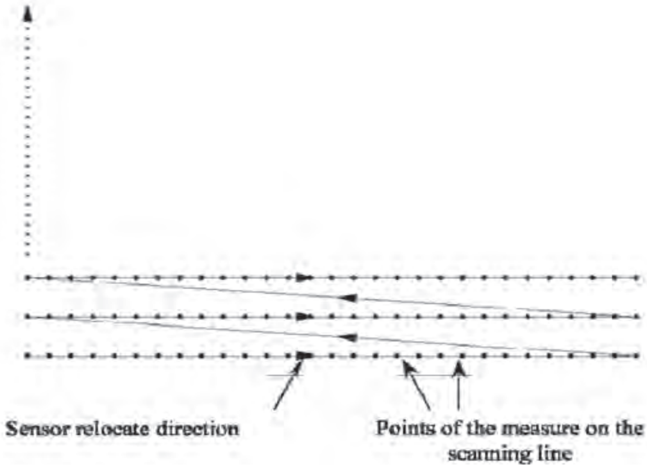

Fig. 4. Schema the relocate of the electrostatic sensor on the sprayed area.

The data are transmitted to the computer and analyzed by the program allocate in the virtual instrument. The results of the analyze are visible immediately just on the computer's screen. Each point of the measure on the scanned sprayed area is represented by group of pixel on the screen.

Conclusion

The investigation proved that the electrostatic method to measure the mass of drops, associated with precision scanning system, controlled by virtual instrument can possible to measure the main properties of spraying system. This method is quickly and give the instantaneous results of the measure and analyze of the distribution the droplets on the investigated area of spraying. Low cost, small dimensions of the instrument and the possibility to be mounted directly on the spryer working on the field, give the opportunity to this method to be applied for periodically control the quality of spraying. The instrument permit also to evaluate the drift of the spray created by the wind.

References

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User concerns about sprayer inspections in the Comunidad Valenciana (Spain). Importance of adequate communication for the higher involvement of stakeholders.

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Directive 2009/128/EC for a Sustainable Use of Pesticides was transposed to the Spanish legislation in 2011 through the Royal Decree 1702/2011, which established the national core legislation for the inspection of sprayers. According to the Spanish regulatory system, Regions (Comunidades Autónomas) are in charge of the technical implementation of the inspections. The government of the Comunidad Valenciana published the executive regulations for this Region on July 29th 2014. Furthermore, as of March 2013, four training courses for inspectors have been organised jointly by the Conselleria de Agricultura (Regional Ministry of Agriculture) and the Universitat Politècnica de València. Special care has been taken to harmonise inspection procedures with the rest of the Spanish Regions, as well as Europe.

The Centro de Agroingeniería of IVIA belongs to the Conselleria de Agricultura and is in continuous contact with national sprayer manufacturers, farmers and end-users. Moreover, it organises courses for professionals and is involved in research projects and tests related to field sprayer machinery (Fig. 1).

Fig. 1. Training activities conducted by the Centro de Agroingeniería.

From the participants in these activities, the Centro de Agroingeniería has collected a series of feelings related to the condition of the sprayers and the farmers' perceptions regarding the compulsory sprayer inspection, not only in the Comunitat Valenciana, but also in other regions of Spain.

As positive feelings, it could be said that there is an increasing sensitivity of farmers towards food and environmental safety. A growing number of farmers are becoming increasingly aware that pesticide treatments are necessary but generate risks to people and the environment, as well as being a potential threat to themselves. On the other hand, the emergence of new technologies is promoting the renewal of the equipment currently in use, which improves the condition of the sprayers, although this change is still only occurring in a minority of cases. These positive changes may be largely due to the generational change and the professionalisation that is taking place in the agricultural sector.