Electrostatic Spraying System.

Sapkal Rohit J.[1], Mulla Swaliha S.[2], Patil Akansha A.[3], Patil Gayatri M.[4], Patil Priyanka P.[5]

[1-4] *Student, Electrical Engineering Department, RIT Sakharale, Dist. Sangli, (MS) 415414*
[5] *Lecturer, Electrical Engineering Department, RIT Sakharale, Dist. Sangli, (MS) 415414*

Abstract - *There is an urgent need for new chemical application sprayer in Indian agricultural Pesticides spraying. The present paper aims to design and develop of an air-assisted electrostatic nozzle based on induction-charging with a specific focus on Indian agricultural and geographical Scenario. A new air-assisted electrostatic nozzle has been designed and developed for small scale. This nozzle is light weight, highly efficient, reduces pesticide use and human health risks, and eco-friendly. An air-assisted electrostatic nozzle system is a combination of an air-assisted nozzle and induction based electrostatic charging mechanism. The portable high voltage power supply is generated from a rechargeable dc battery, raised to few kilovolts, in-house with nozzle itself.*

Key Words: *Electrostatic spraying system, pesticides, aerodynamic trajection, nozzle, space charged gradient.*

1. INTRODUCTION

Electrostatic spray technology was invented in the early 1930's and the aim was to improve spray deposition on the canopy. The first electrostatic application system in 1940 However, the droplet size requirement of many target pests are not always clear as there are conflicting requirements in relation to safety, coverage or cost. Customarily, more chemical than theoretically needed is often applied due to the variability in field conditions and the need to ensure complete coverage. Some cases in rather old data, 95% of the chemical applied can be wasted to the ground or at most 50% of mass transfer onto the desired plant. The optimum droplet size for maximum retention with an aqueous solution is reported to be 100 mm or less and such a reduction in droplet size would also improve coverage due to an increase in the number of droplets at the same volume application rate. Thus, if drift is not a problem, a decrease in droplet size increases retention and coverage. The use of small droplets is, however, not so popular with the environmentalists as it is feared that non target plants and organisms outside the treated area may be affected. Electrostatic spraying would offer a possible solution to those environmental problems; by reducing spray drift and improving coverage of chemical to target plant. The idea of electrostatic spraying had been examined as early as in the 1940's, and since then various prototype sprayers and commercial machines have been developed for years. These application areas broadly include ground equipment for spraying plaints of row crops, orchards, and greenhouse, even aircraft spraying. By using the embedded electrode induction nozzle, which was developed by University of Georgia, the commercial greenhouse and row crop electrostatic machines, which are marketed by Electrostatic Spraying Systems, now in routine crop production use.

2. LITERATURE SURVEY

[1] M. R. Jahannama, A. P. Watkins and A. J. Yule, "Examination of Electrostatically charged sprays for agriculture spraying purpose".

Study conducted by M. R. Jahannama, A. P. Watkins and A. J. Yule Thermo fluid division, Dept. of Mechanical Engineering, UMIST, PO BOX 88, Manchester M60 1QD, UK a two fluid concentric mixing induction charging nozzle suitable for electro static crop spraying of conducting pesticide has been investigated by experimental and horizontal nozzle situation were carried out. The droplet size distribution of horizontal sprays showed a significant difference between charged and uncharged cases, whereas there was no remarkable difference between vertical cases. Tests were made to assess the asymmetry of horizontal sprays comparing droplet size across the spray. The spray cloud was measured using Faraday cage to collect the charged spray. This analysis used a VOF model to simulate the flow field inside the nozzle. This simulation confirmed the creation of a vortex and negative pressure field in central part of nozzle. Mixing of two phases and atomization of liquid phase by air stream are described based on vortex and suction zone due to negative pressure field. Experimental and computational results have laid a foundation for further understanding and charging and atomizing mechanism involved in twin fluid sprayer. The experimental result presented here in comparison with result reported show a good agreement in spite of unspecified situation of nozzles. The computational result confirmed the creation of vortex and negative pressure field in middle part of nozzle. This vortex plays a significant role during mixing of fluids and liquid atomization process. The results, compared with description of annular gas atomizers shoe the same.

3. PROBLEM STATEMENT

The recent concept of spraying is to spray the target pest more efficiently by selecting optimum droplet size and density for maximum retention and coverage. We know that. In a normal spray 60% fertilizers are applied to the plant and

40% just falsies in the direction of wind. That means 40% are wasted. In the winter season there are a lot of water vapors are present in the atmosphere that causes a lot of diseases are come to the plant. That's time farmers applies a lot of pesticides to the plant for protection. Big farmers spray pesticides through Tractor and medical class formers applies through STP, small pump or tractor as a rent. That causes a lot of money are flow but profit is not comes a large because of tractors rent.

4. DESIGN & DEVELOPMENT

As shown in figure, Block diagram of Electrostatic spraying system battery use as a supply source to provide 12 volt 7.5 Ah to voltage multiplier. Main function of voltage multiplier is to multiply 12 volt DC to high voltage DC up to 30 KV. Positive terminal of this high voltage DC is directly given to the nozzle of sprayer and negative terminal is grounded, due to positive terminal the spray particle which pass through nozzle and get positively charged. Then the electrostatic field is form between spray nozzle and object spray covers the both side of object front side as well as back side.

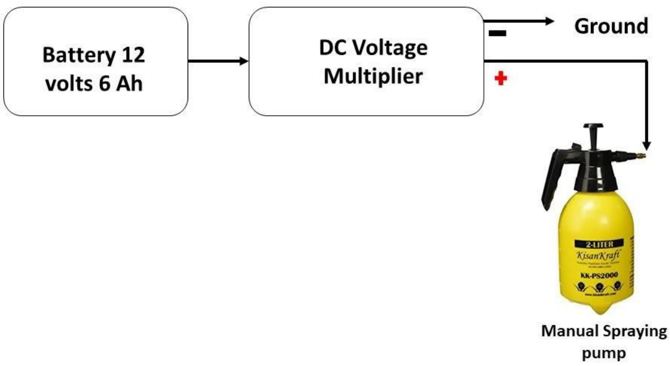

Figure 1 Block diagram of electrostatic spraying system.

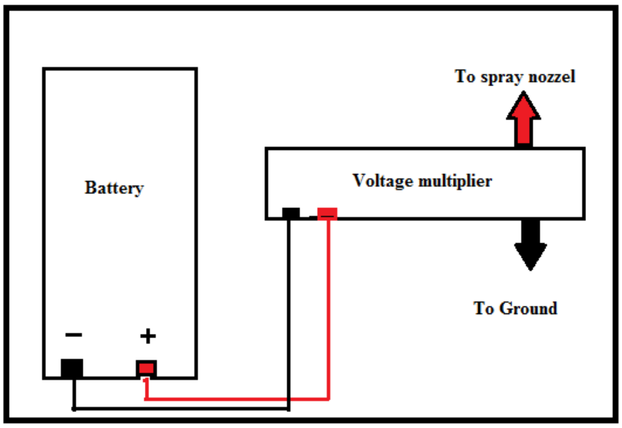

Figure 2 Circuit diagram of electrostatic spraying system.

As per the circuit diagram we built the circuit connection. After that battery use as a supply source to provide 12 volt 7.5 Ah to voltage multiplier. The voltage multiplier also knows as cascade added rectifier. Is an electrical circuit that converts DC electrical power from a lower voltage to a higher DC voltage. Typically using network of capacitor and diodes. If we applied V volt supply to cascade added rectifier, the 1 st pair of capacitor and diode gives 2V voltage. 2 nd pair gives 4V voltage and so on. This high voltage DC supply obtained from cascade added rectifier is applied to circular electrode, which is held by spray nozzle. The positive terminal of high voltage DC is given to circular electrode and negative terminal is grounded. Because of this the electrostatic field is generated around the electrode. The spray from nozzle is passed through electrode to getting the positive charge on spray particles of liquid. The tree has already negative charge on it because of grounding effect. Due to principle of electrostatic the spray of liquid efficiently cover the object.

5. WORKING

First battery use as a supply source to provide 12 Volt 6Ah is connected to voltage multiplayer. , the 12V 6AH Sealed Lead Acid Battery with T2 Terminals, also known as an SLA battery. The main function of voltage multiplayer is to multiply 12 volt DC upto 30 KV. Then positive terminal of this high voltage DC is directly given to the nozzle of sprayer and negative terminal is given to grounded Because of this the electrostatic field is generated around the electrode. The spray from nozzle is passed through electrode to getting the positive charge on spray particles of liquid. Due to positive terminal the spray particles which pass through nozzle and they get positively charged. Then the electrostatic field is formed between spray nozzle and object spray & it cover the front side as well as back side. The tree has already negative charge on it because of grounding effect. Due to principle of electrostatic the spray of liquid efficiently cover the object.

6. APPLICATIONS

1. Electrostatic agriculture sprayer.
2. Spray painting.
3. Electrostatic precipitator.
4. Photocopier.

7. FUTURE SCOPE

1. We can use this electrostatic sprayer with sensor containing on the top front side of electrode. This electrostatic spray can sense the target object, its size and shape and according to that it sprays the liquid content on the object.

2. We can use the microprocessor/PLC based programming for large scale automatic operation. In microprocessor, by programming input we operate whole system and get effortless output.

8. RESULT & ANALYSIS

Figure 3 Complete setup of Electrostatic Spraying system

Area covers by spray in both conditions (with and without electrostatic system)

Figure 4 When electrostatic spray is not applied on bottle.

Figure 5 When electrostatic spray is applied on bottle.

9. CONCLUSION

Electrostatic spraying system improves the efficiency and reduces the work load. It also minimizes the cost and material required for spraying. This paper is summery of scientific contribution of various application related to agriculture spraying. In this paper the interaction between space charged gradient and electric field produced is also been discussed.

10. ACKNOWLEDGEMENT

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11. REFERENCES

[1] R. C. Anantheswaran and S. E. Law, "Electrostatic precipitation of pesticide sprays onto planar targets". IA-19

[2] W. Kirk, W. C. Hoffmann and J. B. Carlton, "Study Production model of USDA-developed aerial electrostatic spray application system

[3] S. Edward Law, "Electrostatic Pesticide Spraying". Department of Agricultural Engineering, Driftmier Engineering Center

[4] Appah S, Wang P, Ou M X, Gong C, Jia W D, "Review of electrostatic system parameters, charged droplets characteristics and substrate impact behavior from pesticides spraying". IEEE transactions on Industry Applications, 1983

[5] G. A. Mathews, "Modeling of electrostatic-based pesticide spray systems Concepts and Practice". IEEE1995