

# SEMI-AUTOMATIC TRANSPORT SYSTEM FOR ELECTROSTATIC SPRAYING OF CUT FLOWERS

*Sr. Carapaz, José Miguel<sup>1</sup> Ing. Villarreal Carlos<sup>2</sup>*

Faculty of Engineering in Applied Science, Universidad Técnica University, Ibarra, Ecuador  
miguelcarapaz@hotmail.com, cavillarreal@utn.edu.ec

**Abstract.** The present project is oriented to semi automation of electrostatic spraying system of cutting flowers. The fumigation area has a tunnel type design; it is the critical meeting point because each car loaded with flowers will have towards the tunnel fumigation.

The movement stage in the spraying area is an autonomous system of kinematic transmission for a motor to a "way wire". It has an average speed of 1 m/s, because the maximum load is approximately 25kg.

The tunnel fumigation has motion sensors and solenoids. The main function of the motion sensors is to emit a presence signal, when the flower's car is in the tunnel.

The solenoids execute the open or close the way to the chemical product to the electrostatic spraying system.

Also the agrochemical process in to flowers has a control device for the fumigation, because the time recommended for application is 8 to 10s. This is constructed to change the time of fumigation as determined the user.

The control and interpretation of each of the signals emitted by the elements in the tunnel, is through a programmable device.

These elements and autonomous processes, is expected to improve production and environmental protection.

**Keywords.** Spraying, electrostatic, tunnel, transmission, semi automation, "way wire".

## 1. Introduction

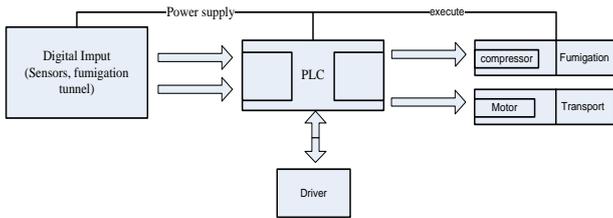
Years ago, the fumigation has been an activity that comes from the need of controlling pests. Early detection of pests and the application of rational and effective control measures are prioritized to those who are responsible for plant protection (PÉREZ & MONTANO, 2 007). In floriculture and other agricultural areas trying to control the progress of pests in products, being insects, pathogens or

weeds, these organisms are responsible for 37 to 50% of the losses reported in global agriculture (BARRERA, 2 007).

The World Health Organization (OMS) proposes that each year occur between one and five million cases of pesticide poisoning, especially in developing countries as well as chronic diseases caused by regular exposure to pesticides (PÉREZ & MONTANO, Curso Taller Plaguicidas, Salud y Ambiente. Contaminantes Orgánicos Persistentes. Módulo de aprendizaje 1, 2 006). Actually in the process of fumigation of cut flowers, there is a minimum percentage of human involvement. When the worker starts spraying, it is not a fixed time of application, so there is not confidence that you have applied a sufficient level of agrochemical, or on the contrary the chemical is being applied and wasted without measure, factors affecting the marketing of flowers, the care of the environment and the health of the operators.

Technological progress is a tool to improve the application of chemicals on cut flowers. The implementation of a semi-autonomous system for the fumigation process delivers results in the care and prevention of human health, also does the optimization in the use of agrochemicals and in time that fumigation; the benefits for the development of any flower company. Also, get a high level of industrialization and automatization fundamental at the present time for competitiveness at national and international level. The semi-automatic process of fumigation and transport of cut flowers, it can control the mobilization and application of chemicals to any car with flowers, controlling time of fumigation, preserving the health of workers, the protection of the environment and complying with quality standards that the flower companies must handle, to improve within the productive field.

The semi-automatic system of transport and fumigation of cut flowers was configured according to the following architecture:



**Figure 1.** Diagram of the control of electrostatic spraying system

The block diagram describes a macro the semi-automatic process of transport and electrostatic spraying of cut flowers.

PLC responds to logical digital signals final career sensor located in the tunnel of fumigation, emitting a signal, subsequently, the controller responds, for actuators (compressor – motor), perform operation of the system of transport or fumigation according to the schedule of these processes.

The operation of the semi-automatic system of transport and electrostatic spraying of cut flowers depends of:

- The fumigation area.
- Transport system.
- Control system.
- Pneumatic spraying system.
- Electrostatic spraying equipment.

### 1.1 The fumigation area

Analyzing the risk produced by exposure to chemicals, decides to consider as a construction model design type tunnel. For its location was to determine the direction of air currents which flow constantly into the site; so the agrochemical to not disperse in the environment. For this, it was determined the flow of air in the area of implementation of the project of 4.56 m/s, the area of application (tunnel) was built perpendicular to air flow.

Also, developed a design that saves geometric and dimensional harmony. The measures corresponding to a car for transportation of cut flowers as design hypothesis (2,40 x 0,5 x 1,2 m).

Finally, fumigation tunnel includes the protection of the environment, to the presence of a drainage system able to handle the remains of agrochemical product to a collection point. The tunnel is constructed based on metal structure (stainless steel AISI 304) and concrete as shown in the following Figure 2.



**Figure 2.** Spraying tunnel

### 1.2 Transport system

The semi-autonomous mobility of cars with flowers, He made it through a monorail in closed loop, as shown in Figure 3.



**Figure 3.** Transport system for cars with flowers cut into the tunnel of fumigation

This system of transportation is constituted by a semi-automatic traction subsystem, it uses a drag chain, moving are solidarity to the transporter car; this car is suspended in a subsystem consisting of pulleys that allow you to move about the Monorail to or from fumigation tunnel. Then, the drive system was constituted by: motor, pulley, belt, bearings, steel shaft, gearwheel, wheels and chain. All these elements form a transport system that allows you to control your speed and maintain constant power.

So, the speed that the motor is reduced and transmitted towards the final element (friction wheels), Once wheels keep movement, these transmit frictional speed, to a string that is pressed by the pair of wheels as shown in Figure 4. The chain will keep a constant movement, elliptical in closed trajectory, following the design of the cable via following the design of the "cable via". When chain becomes movement, transporter car will fit this, to provide the adequate transportation to every one of the cars with flowers. It will be electrostatically sprayed during its passage through the tunnel of electrostatically, and then directed toward the area of selection and cutting.



Figure. 4. Traction system, drag chain drive

### 1.3 Control system

The system of control and automation within the development of the project occurs in two stages: in the transport of cars with cut flowers and in the process of electrostatic spraying.

The movement of cars with flowers cut into the tunnel of electrostatic spraying and post-harvest, It is subject to the automation and control of a motor. While, the fumigation process depends on the positioning of the car, and passive elements drive (solenoides).

To complement the response of movement and stop used detection equipment (sensors end of career). Also, any unscheduled event is prevented with emergency devices (emergency button).

Finally, displacement and automated spraying cars with cut flowers displacement and automated spraying cars with cut flowers, It is done with two controls: main control; that is located at the entrance of the tunnel on external side, and remote control; It is located in the cargo area, running function staff avoid contact with the fumigation chamber. Each and every one of the decisions of the semi-automatic system of fumigation of cut flowers responds to a programmable logic controller (PLC Zelio Logic SR2A201FU).



Figure. 5. Control system

### 1.4 Pneumatic spraying system

The pneumatic system is fundamental in the process of prevention and care of flowers. As shows in Figure 6, the pneumatic system is developed according to the requirement of the process of electrostatic spraying; each of the elements that are part of the kit of electrostatic spraying, attached to the semi-automatic system of transport and fumigation.

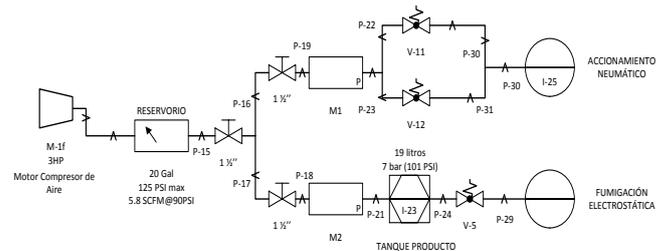


Figure. 6. Diagram P&ID, pneumatic system of electrostatic spraying

Then, pipes and valves form a logic circuit which routed air and control the appropriate application of agrochemicals in cut flowers, to be finally classified in the pos-cosecha area.



Figure. 7. Pneumatic spraying system

### 1.5 Electrostatic spraying equipment

“Electrostatic spraying is a process by spraying, to produce a mist of droplets with electric charge that takes to the floor through a flow of air at high speed” (ANÓNIMO, FUMIGACION ELECTROSTÁTICA, s.f).

Electrostatic spraying is a process where tiny drops of water acquired a negative electric charge. When, the substance in the form of drops of steam in the environment produces an effect of attraction 40 times larger than the force of gravity. The plant to become positively charged attracts the droplets from steam, producing the effect of fumigation.

In Figure 8, you can see that the application of the product to the leaves and stems of plants improves considerably because drops with electrical load take direction and movement. This means that the area of

incidence on a sheet is face top, bottom and back of the stem. This phenomenon is called "electrostatic envelope".

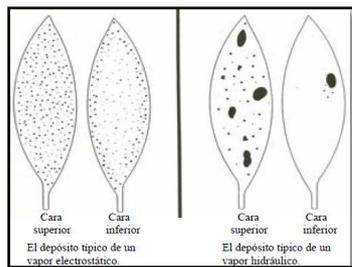


Figure 8. Electrostatic spraying

### 1.6 Electrostatic spraying nozzle

The main feature of the electrostatic system is the spraying nozzle, because its function is of atomizing air and provides an electrical charge to agrochemical drops.

Air and liquid are separated in the back of the nozzle. The air flows at high speed along the nozzle and collides with the fluid at the tip of the nozzle, causing the formation of numerous steam droplets. The diameter of the droplets is of 30 a 60 micrones. Air pressure required by the system is of 30 a 40 psi.

"While steam is atomized, an electrode placed an electrical charge on each droplet. Then, the turbulent flow of air force carries the charged droplets to the plant" (Systems, 2 006, pág. 5).



Figure 7. Electrostatic spraying nozzle

## 2. Conclusion

Implementation of semi-automatic transport system optimizes the process of mobility, reducing production times to 30% in comparison to non-automated systems. This result contributes to the proper use of resources and above all the production, fundamental basis in the development of a company.

The process of electrostatic spraying reduced by 50%, the use of agrochemicals. The amount of liquid fumigant is optimized with the fumigation process automation. Determining the proper functioning and obtaining positive results for the production and the environment.

Programmed control of the application of agrochemical products and the use of modern technology (electrostatic spraying), decreased by 50% the incidence of pests and

diseases in cut flowers. Result that collaborates with the large-scale production that manages a flower company.

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## 4. Biography

### Carapaz M., author



José M. Carapaz Caranqui, was born in El Angel - Ecuador on June 24, 1990. He studied at the Unidad Educativa "Leon Ruales", where he obtained the degree of Bachelor specialty physicist - mathematician.

He graduated in the Técnica del Norte University in engineering in Mechatronics in 2014. He currently works on projects of automation, control and mechanics in the city of Ibarra.

Areas of interest: mechanics, robotics, automation (miguelcarapaz@hotmail.com).

### Villarreal C., author



Carlos a. Villarreal Bolaños, was born in El Playón de San Francisco-Ecuador on June 19, 1975. He studied secondary school and Pedagogical Institute Superior Juan Montalvo, where he obtained the degree of Bachelor in Sciences specialty Fisico-matemático.

He graduated from the Escuela Politécnica Nacional as a mechanical engineer.

Areas of interest: Renewable energies, Machine Design and Automation and Materials Science (cavillarreal@utn.edu.ec).