

THE RESIN DISPENSER: A MANUFACTURING TOOL FOR COMPOSITE MATERIALS

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What is the Resin Dispenser?

The Resin Dispenser is a tool which can be used to impregnate resin into the reinforcement material during the lay-up process of composite materials. It is a digital electro-mechanical hand tool which is micro-processor controlled. It was developed to improve the quality control of the hand lay-up process for composite materials. It presents a cost effective alternative to the pre-impregnated fiber (pre-pregs) lay-up process.

Why was it developed?

The development of an ultralight composite glider at the University of Pretoria has led to the development of this new manufacturing system. The requirement for minimum and consistent resin content in the composite wing skin layers could not be met by the conventional hand layup process. Pre-preg materials could not be utilized for the prototype development of the glider due to the high cost of tooling and materials.

How does it work?

The dispenser is a modular system (Figure 1). The main modules are:

- Micro Processor Module
- Pump Module
- Mixer and Discharge Module (Nozzle)

The micro processor needs to be set up for the particular hardware by entering hardware parameters into the system via its keypad. Information on the resin, like the mixing ratio between resin and hardener also needs to be entered.

There are four main modes of operation: a) Dump Station; b) Hand impregnation of woven materials; c) Extrusion wetting of unidirectional fiber; and d) Pre-impregnating fiber on a roll.

a) The dump station

In its simplest form the dispenser can be used like other dispensing stations. The user can receive resin and hardener in the accurate ratio. The difference is that the user can accurately specify any amount of mixed resin which he requires. Furthermore, the dispenser keeps a record of the discharged amounts.

b) Hand impregnation of woven materials

In this mode the device can be used to impregnate the reinforcement material with resin either in the mold or prior to the lay-up. A hand-held nozzle is connected to the pump module in place of the dump nozzle. The amount of resin required to sufficiently wet out the reinforcement material is entered into the system (in g/m²). The hand-held nozzle is then drawn

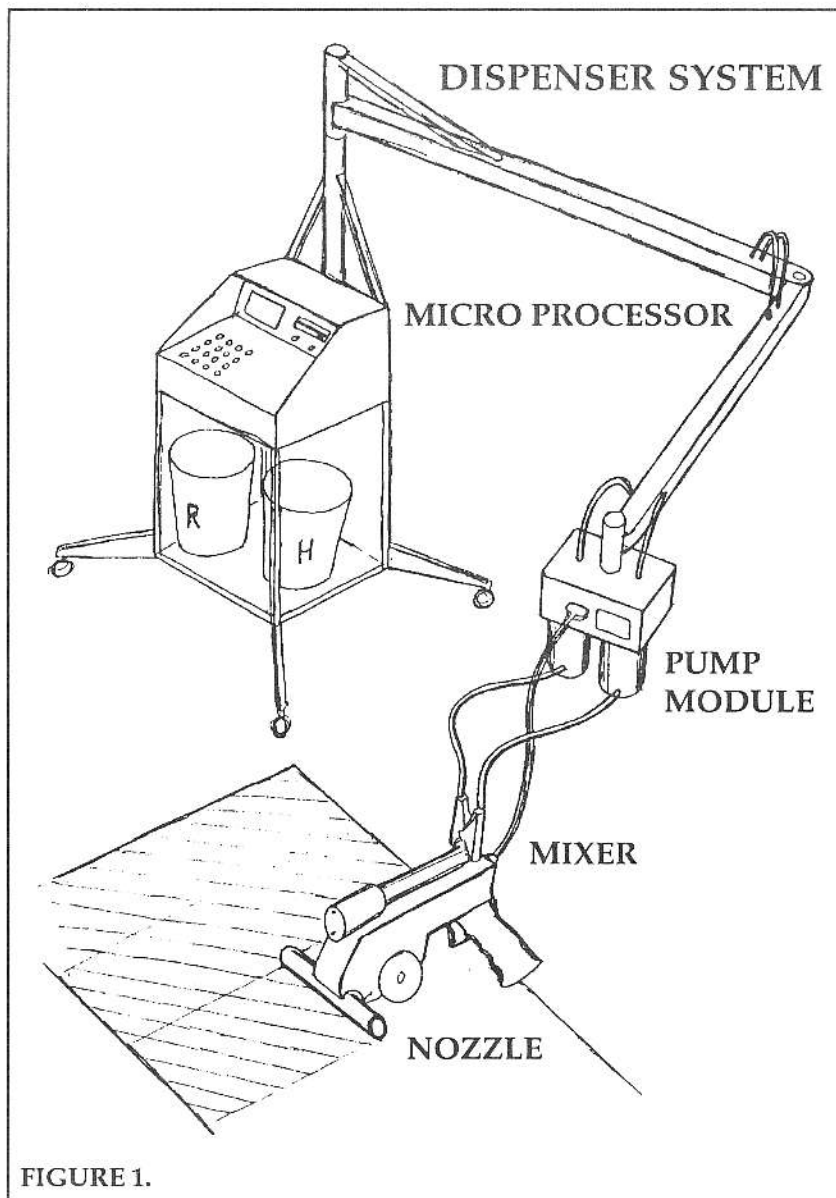


FIGURE 1.

over the fibers. The nozzle displacement along the fiber mat gives digital information to the processor. This in turn commands two controlled pumps to supply resin and hardener simultaneously at a calculated dispense rate and the selected mixing ratio. The nozzle is designed to evenly spread resin along its width with good penetration into the fiber.

The processor displays the amount of resin already discharged for a selected task. It also keeps a record of the discharged amounts. Several different task records can be kept simultaneously.

c) Extrusion wetting of unidirectional fiber

In place of the hand-held nozzle a stationary extrusion nozzle can be connected to the pump module. Tows, rovings or unidirectional tape can be drawn through the nozzle. Resin is once again discharged accordingly. The processor can display the length of the extrusion and it also keeps a record of the dis-

charged amounts.

d) Pre-impregnating fiber on a roll

The pump station can also be linked to a pre-impregnating mechanism which would produce pre-pregs on a roll. This means that pre-pregs could be produced prior to a lay-up in the desired amount. This would reduce shelf life and storage problems.

Resin and hardener are mixed in the nozzle prior to being discharged. The mixture viscosity is thus suitably low. It can be further reduced by heating the mixer. Impregnation through the nozzle ensures proper bubble-free penetration with minimum fiber distortion. Time required for the process of wetting the material is significantly reduced, so is the labor requirement. The process is cleaner and workers have far less exposure to unmixed resin and hardener. Resin wastage can greatly be reduced and product mass can easily be kept low. This process can be used in a way that would require less auxiliary materials like peel ply and breather bag.

The processing unit keeps a record of the amount of resin being discharged. Several record files are available to store information for different layers and/or products. The information can be extracted at the end of a layup for permanent filing. Information like the lay-up sequence can be transferred from a designer station to the dispenser.

The dispenser gives quality control options which are difficult or impossible to attain with the conventional hand lay-up process. It does not only improve the hand lay-up process in several aspects, it

also forms an attractive alternative to the pre-preg process.

The dispenser was very successfully used during the construction of a foot-launchable glider (the *Exulans*). The resin content is appropriately low, very consistent and known. Records of resin amounts are available. Differences in mass between wing pairs are insignificant. Furthermore, the lay-up of wing parts only required three people.

During the construction of the *Exulans* this new manufacturing system proved to be an indispensable item to cost-effectively ensure proper quality throughout the entire composite structure.