Smart-Rinse Verification System for Agricultural Sprayers

AGCO Your Agriculture Company

SCOPE Senior Capstone Program in Engineering

The Problem

Chemical residue in the system "burns" crops, which greatly reduces yield.

Operators have no feedback as to how clean their sprayer is until crops have died – two weeks later.

Accidental creation of chemical mixtures can form hazardous gases.

Crop insurance premiums are one of the greatest costs for farmers and they regularly file claims each year.

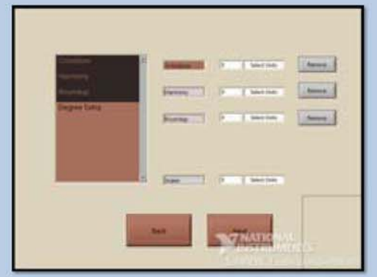
Our Goal

To create a verification system which provides operator with valuable information regarding the spray system's residual chemical levels.

Spray System

Real-Time Feedback

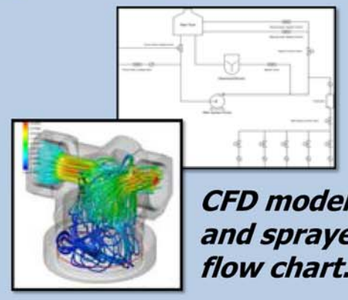
Spray Operator



Screenshot of display system in the cab.

Fluid Model

Fluid is stored in the main tank and pumped through the main system pump to maintain suspension while spraying crops. In the spray booms the fluid is split in a manifold and each of the five boom sections are controlled and filtered individually. Each boom consists of approximately 10 individual nozzles. Understanding both the layout of the system and the behavior of the flow within the system allowed us to create a fluid model of the system. This model is crucial to our system as it extrapolates fluorometer data to quantify cleanliness levels at key points in the system.



CFD model and sprayer flow chart.

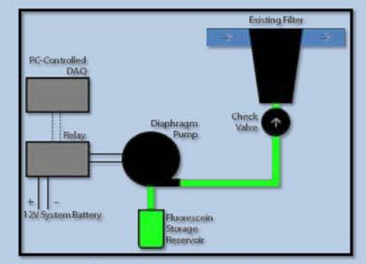
Sensor Suite

The sensor suite consists of a fluorometer mounted in-line with the spray system, located between a filter and a nozzle. A fluorometer measures the concentration of fluorescein, a fluorescent dye within wavelengths of 494-540 nm. This dye is the tracer chemical that is injected into the flow in order to sense how quickly the system is rinsing. The readings from the fluorometer are transferred to a National Instruments DAQ which sends and receives data from the on-board computer. Information is displayed on a touch screen located inside the cab. This system is designed to be placed into any existing filter point in the system, giving the engineer some flexibility in adapting to new systems.

In-line fluorometer from Turner Designs.

Fluorescein Injection System

A diaphragm pump pulls fluorescein from the storage reservoir and moves it through a one-way check valve into the bottom of the filter assembly. This check valve ensures that fluorescein and chemical both are unable to flow backwards throughout our addition to the spray system. The pump itself is controlled by a relay which, when open, completes the circuit between the pump and the sprayer's onboard battery.



Flow chart of our in-line tracer injection system.

User Interface

The operator interacts with the system via a touchscreen located in the sprayer cab. The user interface allows the operator to input information about the job they are working, including the user name, field, and chemical type and amount.

The operator can then review the job and choose to begin the rinse cycle. A system cleanliness overview is displayed on the screen, and the operator can also choose to view real-time data or the chemical MSDS and labels.

Future Work

Although we met all of our original goals, there are additional tasks and projects that we have identified for future development. To continue with where we left off, we recommend that a team continues to look for new methods to measure chemicals directly, test our model on a multi-branched setup, and work to integrate our design with other AGCO products, such as AGCOMMAND.

Additionally, having the processing power and touchscreen display integrated into the sprayer allows for a multitude of new projects, such as automatic chemical loading, in-field rinsing, and exploring nozzle point injection systems.

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