Steam Filters Improve Consistency of Department of Agriculture Experimental Plants

The greenhouse at the National Center for Agricultural Utilization Research (NCAUR), Peoria, Illinois is responsible for growing starter plants used in a wide range of experiments primarily designed to improve productivity and open new markets for agricultural products. The NCAUR greenhouse pasteurizes the potting media used to grow these plants with steam in order to eliminate insects and bacteria. In the past, chemicals used to treat feedwater to avoid corrosion in the boiler carried over into the steam and contaminated the soil, generating variability in the experimental results. “Balston steam filters solved the problem by removing impurities down to .01 microns from the steam used to pasteurize potting soil,” said Brian Maubach, additional tasks project manager for the NCAUR. “Since we installed the filters we have seen major improvements in the consistency of our starter plants. With the carryover removed, starter plant consistency has been improved which means similar plants grow at the same rate to the same height even if they were grown in a different lot.” Rich Stessman, Greenhouse Manager, added that: “The filters were economical to purchase and require maintenance only once per year.”

As the designated lead technology transfer facility for the United States Department of Agriculture (USDA), the NCAUR invents new industrial and food products from agricultural commodities, develops new technologies to improve environmental quality, and provides technical support to Federal regulatory and action agencies. Microorganisms and their enzymes are being developed to transform raw agricultural materials such as starch, proteins and oils to commercially valuable products such as food additives, fuels, cosmetics, and industrial lubricants. Processing technologies that include extrusion, jet cooking, high-pressure reactions, and supercritical extraction are being used to make new value-added products such as biodegradable plastics, edible films, printing inks, novel flavors, and pigments. Modern biotechnology tools are being used to produce new products for many industrial uses, improved food quality, and better human nutrition. The techniques are also being used to control agricultural pests including microorganisms, weeds, and insects that decrease crop yields, pose health hazards, and limit exports for American crops in world trade.

Need for consistency in growing starter plants

The primary mission of the NCAUR greenhouse is to grow experimental plants for the Northern Research Laboratory. These starter plants can consist of staples like wheat, corn and soybeans or they may be much more rare varieties. The primary potting medium is a mixture of vermiculite and peat which is provided by suppliers in 2.8 cubic foot bags. Four to five bags of potting medium are placed in the pasteurizing bed and steam is passed through the bed for 45 to 50

minutes to kill insects or bacteria that may have infiltrated the media during storage. The water used to purify the steam is treated as part of the greenhouse's water disinfection and reclamation program. This program involves treatment with a variety of chemicals including sulfuric acid, caustic soda, and others. Small amounts of these chemicals remain in the water after treatment. In the past, these chemicals would carry over into the steam and affect the properties of the potting medium. The amount of carryover varied from batch to batch and even within a single batch of potting media. The result was that starter plants that were identical gave different results, reducing researchers' confidence in their experimental results.

"It's absolutely critical that we maintain the consistency over time of the starter plants that we grow in our greenhouse," Stessman said. "These plants are used in research projects that carry on for long periods of time. In order to ensure reliable results the starter plants that we provide over the life of the project must be consistent throughout the study. At the same time we have to use water treatment chemicals to conserve water and prevent corrosion in our boiler. Yet we strongly suspected that some of these chemicals were carrying over into the potting media and introducing variability. It was obvious that we needed to find a way to remove these chemicals from our steam. I did some research and discovered that highly efficient steam filters had been developed for the many industries, particularly food and pharmaceutical manufacturers, which require steam with a high level of purity."

Selecting the right steam filter

Maubach and Stessman researched the steam filters that were available. "We were looking for a filter with the ability to remove all of the contaminants that were hurting our experimental results at the lowest possible cost," Maubach said. "We talked to Parker because of their leadership position in steam filtration. They recommended the Model 23/75-SR which removes 98% of particles 0.01 micron and larger and 100% of all visible particles and removes liquid condensate at the same efficiency as solid particles. The filter is specially designed to remove feedwater chemicals and complies with US Food and Drug Administration and USDA accepted practices. We also reviewed the cost and maintainability of these filters. Their cost was very reasonable and they appeared to require very little maintenance. These filters are designed for a 24x7 operation and since we only use the steam process for perhaps 10 hours per week Parker told us that it would only be necessary to replace the filtration media once per year."

Balston steam filters use microfiber filter cartridge technology with fluorocarbon resin binder. Balston steam filters are available to handle flow rates of up to 3,000 lbs/hr. These filters reduce steam condensate mixing with the end products when steam is used for agitating, mixing or

cooking. They significantly reduce carryover of boiler feedwater chemicals into the product, eliminating any impact on end product quality. They also can greatly reduce maintenance requirements for valves, cookers, heat exchangers, and other equipment. Balston steam filters are in full compliance with the requirements of the US Food, Drug and Cosmetic Act. They meet the regulations for Indirect Food Additives used as Basic Components for Repeated Use Food Contact Surfaces as specified in 21 CFR Part 177, and Current Good Manufacturing Practices, 21 CFR Part 110. Balston Steam Filters have also been accepted by the USDA for use in federally inspected meat and poultry plants. They are also in full compliance with the 3A Accepted Practices for producing steam of culinary quality. Balston also makes gas and liquid sample filters, coalescing compressed air filters, high-flow rate compressed gas filters, vacuum pump exhaust and inlet filters, and sterile air filters.

Improving experimental consistency while requiring minimal attention

“The Balston filter has been in place for almost a year and has demonstrated its ability to remove carryover from the steam and improve the consistency of the starter plants produced in our greenhouse,” Maubach said. “The researchers have told us that starter plants from our greenhouse now give consistent results whether they were grown in the same batch or months apart. In particular, now that the starter plants are grown with identical potting medium, plants of the same type now all grow at the same rate and to the same height regardless of when they were planted. This removes a significant unknown from our studies which in turn increases the accuracy of our experimental results. Our researchers have told us that they are very pleased with the improvement because they now know the changes they are seeing are from the factors that they are studying rather than variability in the potting media.”

“The Balston filter is not only effective in removing the chemical carryover, it also has proven to be economical and trouble-free in operation,” Stessman added. “In almost a year of service, the filter has done everything we have expected it to do without requiring any preventive or emergency maintenance. We are planning to replace the filter cartridges after the unit has been in operation for a full year. Beyond that, these filters have not required any attention. They are a very trouble-free and easy to maintain addition to our greenhouse that provides an extra level of assurance that helps support our other quality control efforts. The implementation of these steam filters provides an excellent example of the value that we place on quality in the operation of this greenhouse.”