



8] Hygroscopic dehumidification with salt

More closed growing requires a different way of dehumidifying the greenhouse air. Growers in various places throughout the world have gained experience with 'hygroscopic dehumidification' in the past few years. Also in the Netherlands, the first greenhouse horticulture companies will be working with this system. A pilot is being performed with a new variation.

"If you want to save energy in greenhouse horticulture, you have to close the greenhouses. If you grow in a more closed greenhouse, you need new ways to dehumidify the greenhouse air. The machines for hygroscopic dehumidification that we installed do just that. For the time being, it is the best way for us." That, in brief, is the reasoning of Kai Lonne Nielsen, of kalanchoë grower and breeder Knud Jepsen in Hinnerup, Denmark. The 12 hectare nursery has

17 machines sold in Western Europe under the name Eco Climate Converter (ECC). The Dutch trading company ArcaZen supplied the machines developed by AGAM Greenhouse Energy Systems in Israel.

One and a half years ago, the Danish kalanchoë grower tested the first machine - with impressive results. Nielsen: "We did not have to open the airing windows anymore in fall, winter or spring in order to get rid of the damp air. That saved us over 25% in energy. A vital additional benefit was that the presence of fungal spores in the greenhouse air dramatically decreased. Plant health noticeably improved and we had less waste. Since we have 17 machines running, we have not seen any fungal spots anymore, although we are not applying any fungicides. We even switched off the sulphur evaporators. Not that sulphur is such a high-cost item, but it is aggressive to plastics, including screens and film. Now that we have no mildew in the greenhouse anymore, we prefer to do without it."

Return after two years

For the 17 machines, which cost around € 22,500 each, according to importer ArcaZen, Jepsen expects a return on investment within just over two years thanks to the above-mentioned benefits. Another factor is the 40% subsidy from the Danish government. Hygroscopic dehumidification of greenhouse air is considered a vital energy-saving measure in glass greenhouses.

In Germany and other neighbouring countries, hygroscopic dehumidification is starting to emerge. Dutch greenhouse horticulture companies are not yet queuing up to buy the Eco Climate Converters. Leo Boon, the managing director of importer ArcaZen, suspects that this is due to his company being seen as an outsider between the established Dutch greenhouse climate technology companies. Another key reason could be that the unfavourable economic climate has decreased the willingness for significant investment in long-term

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measures. However, in certain niches in greenhouse horticulture, where specific requirements apply to air humidity rates or disease pressure, such as in seed growing or herb growing companies, experience is quietly being gained with the system for hygroscopic dehumidification.

Practical experiment

Lans Tomatoes was one of the companies that picked up the idea of hygroscopic dehumidification in 2011. An experimental test set-up of an in-company hygroscopic dehumidification system has been running since late 2011 in one bar of the Closed Greenhouse in the Dutch village of Rilland. "We already had an air treatment system in that greenhouse," says Patrick Dekker of Lans. "This was fairly simple to adjust on a small scale for experimenting with hygroscopic dehumidification." A second-hand vacuum evaporator is placed in the processing area, where the captured calcium chloride solution being centrally regenerated. In the air treatment cupboards on the walls of the Closed Greenhouse, a type of gauze box blocks serve as air filters on which the concentrated salt solution is flushed.

"Calcium chloride is slightly less hygroscopic than the lithium chloride used in ArcaZen's system," compares researcher Bas Speetjens of Wageningen University, which is involved in Lans's experiments. "But we have a fairly open set-up and we are dealing with food safety. Calcium chloride is a well-known fertiliser

that can safely be applied in tomato growing, for one. Calcium chloride is also much cheaper as a raw material. The limitation may be the air purification effect, which may be better when using lithium chloride.

Promising

In spite of the improvisation and the necessary technical failures in the first experiments, the dehumidification results are very promising, according to Speetjens and Dekker. In the next year, the researchers and Lans Tomatoes aim

to pilot the technology year-round on a larger floor area. Lans expects to maintain the idea of regenerating all hygroscopic solutions for dehumidification of the greenhouse complex. This ensures that all heat released can be deployed in a useful place in the greenhouse nursery's energy system.

Jepsen's Nielsen suspects that hygroscopic dehumidification should be applied slightly differently for each crop. For kalanchoë, this is fairly easy. We have to dehumidify and heat almost continuously. If there is no demand for heat in the summer, we switch off the machines and air the greenhouses via the windows to get rid of damp air. We do not lose any energy in this system."



In addition to hygroscopic dehumidification, more dehumidification methods have been developed outside glass greenhouses, which may find their way into greenhouses in the longer term. The energy

managers of both Jepsen and Lans indicate that they keep their eyes peeled for such developments. However, the growers, importer and researchers agree, for the time being, on the potential benefits of hygroscopic dehumidification for more closed greenhouses: "Dehumidification can be used to reach The New Way of Growing in a few steps", says Lans's Dekker. "ECC gives The New Way of Growing a new dimension," ArcaZen writes in its brochure. Meanwhile, a ready-made system is made available to glass greenhouses. This new method will undoubtedly be applied more often during the coming years.

Eco Climate Converter combined with LED

Hygroscopic dehumidification

A system for hygroscopic dehumidification sucks damp greenhouse air through air filters in which a concentrated, hygroscopic salt solution flows. Humidity in the air makes contact with the salt and is absorbed in the salt solution. The flow then rinses it off the filter. This releases some heat. The resulting dry, warmer air is fit to re-enter the greenhouse. This part of the process is in itself sufficient for dehumidification of

the greenhouse.

The hygroscopic fluid, however, will eventually be thinned to such an extent due to the water absorbed, that it loses its damp-extracting properties. To combat this, systems for hygroscopic dehumidification contain a process to recycle or 'regenerate' the weakened salt solution. In

technical terms, a number of variations would be possible, generally based on heating and partially reducing the salt solution. Regenerating the drying substance costs energy. The efficiency of regeneration and the extent to which the energy used can still be used in the greenhouse horticulture, determines the economic feasibility of hygroscopic dehumidification in greenhouse horticulture to a great extent. Apart from regeneration, a system will need just a little power to drive the fans and pumps.