THE INFLUENCE OF IRRIGATION *system on drain water disinfection*

BY RICHARD CROWHURST

In most cases the choice of irrigation system will be determined by the crop and growing method. For example, salad crops grown on stonewool slabs or fruit in growbags will utilise some form of drip system. Pots and pack bedding grown on concrete may use overhead irrigation booms, while irrigation floors, benches and other systems may utilise ebb and flood or flood irrigation systems.

Reusing drain water can require large amounts of water storage [Van der Ende Group].

However, as the pressure on resources - particularly water and energy, but also moves to reduce environmental pollution - continues to increase, more and more growers are recycling their irrigation drain water. This means that as well as ensuring the primary irrigation system is suitable for the crop, growers also need to consider how different types of irrigation will affect the choice and operation of systems to disinfect drain water before its reuse - as will the initial source of water (for example rainwater, mains, reservoir or borehole).

"Across Europe, various irrigation systems are used depending on the type of crop and production method," points out Corné Verduijn of ErfGoed. "These include drip irrigation for avenue tree crops, while nursery crops predominantly use overhead irrigation, but occasionally ebb and flood systems. Potted plants commonly utilise ebb and flood systems, sometimes combined with overhead irrigation, and vegetable cultivation (and young plant production) may well use ebb and flood systems."

A good introduction and overview of the different systems available is ErfGoed's white paper on irrigation systems, which is available from their website. The document, which covers the five most common irrigation systems, aims to help growers decide on the best and most profitable solution for their particular situation, but it also investigates how different systems can be combined in practice. As the white paper also points out, 'One irrigation system may be more prone to diseases or uneven growth than another. At the same time, an irrigation system needs to be cost-effective for your operation.'

"There are of course advantages and disadvantages to different irrigation systems," continues Corné. "Ebb and flood systems have the advantage of uniform water distribution, the plants remain dry, and growers have the ability to influence humidity levels. The disadvantage is that they require significant water movement, and they are the most expensive system in terms of initial investment, but this is outweighed by low operational costs due to reduced labour requirements."

In contrast, drip irrigation offers precise water delivery and reduces the risk of fungal infections as water is applied directly to the roots. But drip systems can be susceptible to clogging and therefore require a high-quality filtration system, although the investment cost is relatively low. Overhead irrigation is easy to implement and has lower capital costs, but can provide uneven water distribution, is susceptible to wind in outdoor cultivation, and can increase the risk of diseases due to wetting the foliage. Overhead systems tend to have low operational costs, but you may have less uniform plant growth than with other systems.

ErfGoed water treatment system.

“Modern irrigation systems are becoming increasingly intelligent, incorporating PLC technology to enable precise monitoring of water distribution and efficient water footprint management,” adds Corné. “The ErfGoed WaterSystem also utilizes PLC technology, providing growers with complete insight into all water flows within the nursery.”

“In most cases drain water treatment is the same for different irrigation systems, although some will need a bigger treatment capacity,” explains Ruud Schulte of the Van der Ende Group. “For example, with floor systems you apply a lot of water, so you have a lot of water coming back and you have a lot of recirculation water. When using substrates to grow tomatoes you will have 30-40% of the applied water returned in the drain, but on floor systems you have 80-90% drain water coming back, so your treatment installation has to be much bigger. There are also differences in the amount of nutrients dissolved in the returned water; when using coir or stonewool the nutrient content is usually higher than for other systems.”

Corné Verduijn also points out that different irrigation systems can present different biological risks which need to be considered when choosing water treatment technologies. “Drip irrigation is highly susceptible to biofilm formation and clogging, while overhead irrigation increases the risk of plant diseases due to wet foliage,” he explains. “Ebb and flood systems with a vertical drainage floor, such as the cultivation floors from ErfGoed, help prevent disease spread by ensuring that water does not flow between plants.

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The Kathari ultrafiltration system for drain water disinfection from Van der Ende Group.

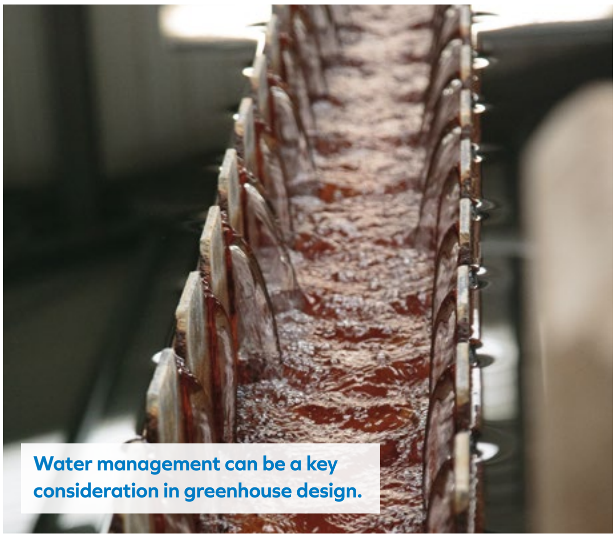
"To maintain water quality and minimize disease risks, advanced water treatment methods are becoming increasingly popular, including ultrafiltration, oxygen enrichment, and nanobubbles. Oxygen is also often added to day storage tanks to keep stagnant water healthy and promote root development."

"Most floor systems are used in ornamental production, and so the drain water can contain a lot of material such as leaves or compost, so the first step is to install a sieve filter to remove the big particles before the dirty water is stored in a tank or silo," explains Ruud. "Then you typically have a disinfection unit (although not all the growers disinfect the water that's going back to the greenhouse and it tends to be more common in vegetable production than for ornamentals) and the treated water is then kept in a clean water silo."

"However, one issue is that you are circulating and storing so much water that the tanks or silos have to be very big and the disinfection unit typically needs to run for 20 hours a day, so you need a lot of space. That can mean some growers invest in less water storage but with oversized disinfection systems."

Van der Ende Group specialises in advanced water treatment systems, such as the Kathari ultrafiltration system for drain water disinfection. Ruud explains, "With ultrafiltration technology, you don't just neutralise bacteria or organic particles—you physically remove them. The result is exceptionally clean irrigation water, significantly reducing disease pressure. The particles and contaminants filtered out by ultrafiltration are collected on a paper belt filter, which makes disposal easy and safe."

As with irrigation systems, there


Water management can be a key consideration in greenhouse design.

Different irrigation systems will create different amounts of drain water.

In most cases drain water treatment is the same for different irrigation systems, although some will need a bigger treatment capacity

are pros and cons to each type of water treatment. "One option is UV disinfection which is very common and which has been used for 30 or 40 years," he continues. "UV works by changing the DNA structure of organisms so they are no longer a threat to the crop, but turbidity is a major issue. If the water is too turbid then the UV light cannot pass all the way through the water and you won't get thorough disinfection."

Both ultrafiltration and UV systems employ a pre-filter of around 25 microns to remove suspended particles, something that is actually used in all treatment systems. "The better the pre-filtration, the better the disinfection system will work," comments Ruud. "Turbidity can be a particular issue when growing in coir or cocopeat, and so the treatment can be slower as it takes longer for the UV light to pass all the way through the water.

"A third treatment option is to add ozone to the water, which reacts chemically in the water to 'burn' the organic particles, but as with UV, while those particles may then be inert, they are still present in the water. Ozone treatment needs a lot of energy and it is a very dangerous chemical which burns the skin, so it is important that the insulation and safety features are well maintained.

"The last common option is heating to pasteurise the water, but this is unpopular due to the large amount of energy required. You have to ensure the water is heated to 85°C for the required amount of time, which is effective, but it needs a lot of energy. You also need to lower the pH from around 5.5-6.5 to 4, so you have to add acid, and then later add a base to increase the pH again before the water re-enters the irrigation system. You are also increasing the temperature of your drain water which is not what you want as that limits the amount of oxygen the water can hold."

Because of the costs and logistics of storing large amounts of drain water, Ruud explains that some customers opt to have a single tank containing a mixture of untreated and treated drain water, resulting in a smaller overall system. "The problem is you can never treat the entire water source, just a certain percentage, but is that good enough?" he asks. "It comes down to how much money you want to spend and how well do you want to disinfect the water. In terms of energy, ultrafiltration is the most efficient installation as you are using 80-90% less energy compared to UV or ozone systems, with even greater savings compared to pasteurisation." ■

Flooding floors have advantages but produce large amounts of drain water [ErfGoed].