

Why

Water is increasingly becoming a scarce resource that must be used very sparingly. Social pressure to reuse rainwater in dairy farming not only as cleaning water but also as drinking water for cattle is increasing. In order to use rainwater as drinking water for livestock, efficient treatment of the water is a must.

Clean drinking water is essential for optimal growth and development and provides the guarantee for quality production of meat, eggs and milk. Poor drinking water quality can result in lower water intake and have a direct impact on animal performance such as lower feed intake, growth and production. Degraded drinking water quality can also cause reduced resistance and increased susceptibility to infections.

Chickens and chicks as well as dairy cattle must have quality and microbially pure drinking water to avoid disease problems and further reduce antibiotic use in the industry.

What

Often alternative water sources, including rainwater, do not meet standards for all parameters. Different water treatment and purification techniques exist. As a livestock farmer, you must then apply the appropriate water treatment and purification technique.

Depending on the analytical results of the water sample, the most appropriate treatment technique(s) can be chosen.

How

Construction

Filtration

Filters are used to remove (suspended) contaminants from the water, thereby increasing water clarity. Depending on the presence of fine or coarse particles, a coarse filter or a fine filter or a combination of the two

types can be used.

1. **Microfiltration (MF)**

Microfiltration is a form of membrane filtration. With this technique, water, after oxidation, is forced under pressure through a membrane or fine mesh net, trapping virtually all particles between 0.1 – 20 micrometers.

2. **Nanofiltration (NF)**

In this technique, water is forced through a semi-permeable membrane under pressure. In this process, the membrane acts as an extremely fine filter that allows the water to pass through, but not the pollutants. With nanofiltration, micropollutants such as pesticides, dyes and divalent salts can be removed from water. If the water is too heavily polluted, pretreatment (e.g., de-ironing, softening, removal of suspended solids, etc.) is recommended.

Water purified by nanofiltration is generally suitable as drinking water. An advantage of nanofiltration is that, unlike reverse osmosis, nanofiltration allows dissolved salts (such as Na^+) to pass through.

3. **Reverse osmosis**

Reverse osmosis (RO) is a form of membrane filtration. This technique is applied only to water where a very pure quality is desired. Usually, reverse osmosis is not used as a separate treatment but requires a pretreatment (such as, for example: de-ironing, softening, removal of suspended solids,...).

As already indicated, the techniques described do not stand alone and can be combined into a “treatment train” in depending on the composition of the untreated stormwater and the intended water quality.

4. **Activated carbon filter**

An activated carbon filter filters water through a one-time or continuous flow through the filter column. Activated carbon is an adsorbent composed of crushed grains of coal or peat and is highly porous. Through adsorption, the molecules adhere to the outer surface of the activated carbon. Activated carbon is a solid (non-soluble) which allows the undesirable substances to be easily removed from the water.

An activated carbon filter is not backwashed but must be replaced depending on the contamination of the water. If the water to be treated is contaminated by suspended particles, it is best to provide a rapid sand filter or other filter media for the activated carbon filter.

5. **Sand Filter**

In a sand filter, the water is passed through the filter material, causing the dirt particles/floating particles to

remain in the grains and purified water to flow out of the sand filter. The sand filter consists of layers of loosely stacked filter material such as sand, gravel,... . This type of filter is usually part of a series of treatments as e.g. in de-ironing water or as pretreatment in reverse osmosis,...

This filtration process requires a regeneration process in which the rinse water is sent through the filter in the opposite direction, stirring up the filter material. The dirt particles are loosened more easily this way and can be disposed of.

Decontamination

1. **Disinfection based on UV**

Decontamination with a UV lamp is done in a tubular reactor with a mercury vapor lamp in the center protected by a quartz tube. Water flows between the quartz tube and the outer wall of the reactor. UV light has a wavelength between 100 and 400 nm. The smaller the wavelength, the greater the energy of the wave. Under the influence of this high energy, molecular bonds are broken whereby the DNA, RNA and enzymes of microorganisms are affected and they can no longer divide. This process destroys more than 99.9% of all pathogens (bacteria, fungi, viruses, etc.) in the water.

The effectiveness of UV does depend on the contact time and the amount of radiation. The amount of radiation from a UV lamp decreases over time (especially if it is switched on/off frequently), so the lamp should be replaced annually. Proper sizing of the UV lamp i.f. the required flow rate is necessary.

UV treatment is a localized treatment at the level of the lamp, has no after-effects in the drinking lines and also has no effect on biofilm in the lines.

2. **Chemical-based disinfection.**

Several disinfectants are available for treating water, ranging from the javel to the more expensive commercial mixtures.

3. **Javel**

Javel is a solution of sodium hypochlorite and water. It is easy to apply and fairly inexpensive. For disinfection, it is important that chlorine is present as "active chlorine. Active chlorine is the measure of the oxidizing power of a solution. The disinfectant has a broad spectrum of action, killing off bacteria, fungi, spores and viruses. However, javel cannot break down the biofilm present in drinking lines.

4. **Hydrogen peroxide**

Hydrogen peroxide is a powerful oxidizing agent and has good activity against microorganisms. The product reacts with a large number of substances and can also be used as a post-dosing agent in the drinking water lines to the barn.

5. Ozone

Ozone is a very powerful oxidant. Its oxidizing action ensures the inactivation of microorganisms (bacteria, fungi and viruses). Ozone affects the cell membrane of bacteria as well as the RNA and DNA structure. When unstable ozone molecules come in contact with the cell wall of the bacteria, an oxidizing reaction occurs, the cell wall is perforated and the bacteria cannot survive as a result. In viruses, the protein envelope is compromised, making it impossible for the virus to reproduce.

Disinfection by ozone normally occurs optimally at pH 6, while faster ozone breakdown occurs at alkaline pH. After ozone treatment, a small amount of ozone is still present in the water, which can have an after-effect in the pipes. This aftereffect is limited in time. The half-life depends on the pH.

6. Electrolytic decontamination

Electrolysis is a chemical reaction that uses salt placed in solution. The dilute salt solution flows past a membrane and is exposed to an electric field. This membrane electrolysis creates anolite at the positive electrode and catholite at the negative electrode. Anolite has strong disinfecting and sterilizing properties. Catholite is an antioxidant and alkaline solution, usually applied as a cleaning agent or pH correction.

A plant by which electrolytic disinfection of water is performed comprises

- a filter
- A hydraulic cabinet: contains the electrolysis cell. This cell consists of two chambers separated by a ceramic membrane or diaphragm. One chamber contains the anode and the other the cathode.
- a softener (if needed)
- a saltshaker
- a storage vessel for the anolyte fluid

Cost

Target price

Using treated rainwater as drinking water has potential but rainwater is not “free. There are costs for rainwater storage and water treatment.

The cost of water treatment depends primarily on the type of treatment and the various treatment steps required to achieve the target quality standards of the treated rainwater (see drinking water standards for dairy

cattle).

Plant size is determined by water demand (m^3/day) and peak flow rate (m^3/hr).

In addition to the investment cost, operating and maintenance costs of the plant must also be considered.

Indicative guide cost prices range from €0.50 / m^3 to €1.5 / m^3 .(*)

(*) Based on depreciation of the plant over 10 years and a water demand of 20 m^3/day .

Subsidy

For investments that contribute to increased farm resilience and more efficient water use, the Flemish Government provides VLIF investment support.

More info and conditions on VLIF support around efficient water use can be found on the website of the Flemish Government – Agency for Agriculture & Sea

Fisheries(<https://lv.vlaanderen.be/nl/subsidies/vlif-steun/vlif-investeringssteun-voor-land-en-tuinbouwers>).

For example, aid rates are provided for water reservoir/basin for rainwater harvesting and for water treatment/water purification. These can be found in the eligible investment list(https://lv.vlaanderen.be/sites/default/files/attachments/subsidiabele_investeringslijst_1.pdf

Benefits

Economic

At Hooibeekhoeve, treated rainwater has already been successfully used as drinking water for the animals for 8 months. An **underground rainwater storage tank and a purification train are used for treatment**. Within the treatment train, several steps are successively gone through to purify the water (sand filter – activated carbon filter – stabilized hydrogen peroxide – UV treatment). The **water quality in the cistern** was monitored for one year. The results showed that the **untreated rainwater did not meet** IKM quality standards and DGZ ruminant health standards. After treatment with the treatment train, these were not recovered. **The treated rainwater fully met drinking water standards**. No marked differences are also observed between tap water or treated rainwater as drinking water in terms of drinking water intake, milk production, milk quality, feed intake and other health parameters. The treated rainwater is clearly liked by the cows.

Due to high drinking water requirements, the annual drinking water requirements on a dairy farm will usually

exceed the amount of rainwater that can be collected annually. Available water depends on rainfall and collection and storage capacity. At Hooibeekhoeve, the water needs could not be fully met last year. By using treated rainwater as drinking water, 70% of tap water could be saved as drinking water.

There are costs associated with using rainwater such as rainwater storage, the water treatment plant and the use of treatment products. See the section on "Cost. If you use tap water, it is certainly interesting to consider rainwater treatment.

Compared to pumped groundwater, a system with rainwater is not yet financially interesting in certain cases. After all, groundwater is still cheap if the basic quality is good and no extensive water treatment is needed. But the VMM has for a number of years been pursuing a strict permit policy whereby a reduction of the permit for the use of groundwater from vulnerable aquifers is applied. As a result, there is a chance that livestock farmers will have to partially or, in some regions, completely switch to other (sustainable) water sources, such as rainwater, and upgrade this to high-quality drinking water. This will avoid the need to use (expensive) tap water as drinking water. Moreover, it will contribute to increasing awareness of the preciousness of water.

Using rainwater sustainably kills several birds with one stone:

- you are more economical with pumped groundwater or precious drinking water
- you save on the water bill
- through the sustainable use of water, you are helping to conserve aquifers.

What to look out for

Legislation

When using rainwater as drinking water, you must also take into account fluctuating rainfall amounts. Periods of abundant rainfall and prolonged drought alternate but can be extreme. It is necessary to make the necessary provisions to be able to switch to mains water or groundwater at any time during prolonged drought (preferably via alarm and 'smart switch system').

Useful links

- [Website: Water tool Inagro](#)
- [Rainwater meets drinking water standards for dairy cattle after treatment with treatment train - Life ACLIMA](#)

Sources

- [o Communication Poultry Breeding Pilot Farm: Project Demo Water \(2017\).](#)

Supported by



**Medegefinancierd door
de Europese Unie**



**DEPARTEMENT
OMGEVING**

The ACLIMA-project has received funding from the LIFE Programme of the European Union under contract number LIFE 20 CCA/BE/001720.

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

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Examples

Discover some examples of this measure at <https://www.lifeaclima.eu>

This sheet is the version of 18/10/2026