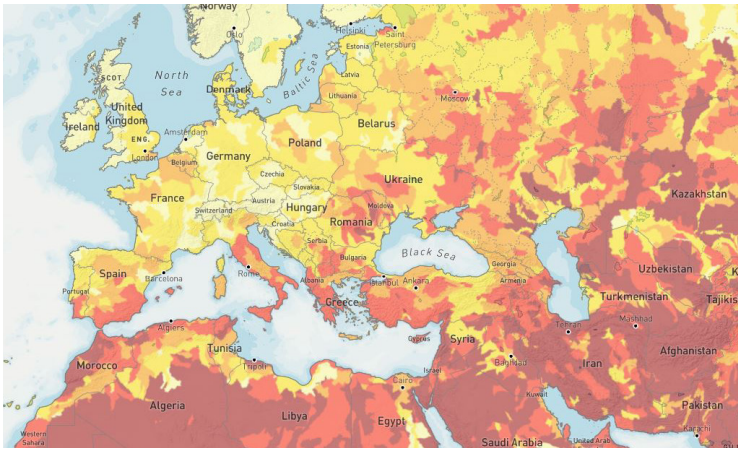
The 5 keys to understand the new European Regulation of water reuse for agricultural irrigation

In May 2020, the new European regulation governing the reuse of reclaimed water for agricultural irrigation was approved: Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 concerning minimum requirements for water reuse.

Motivation and background

There have been several motivations for the development of this regulation, however, the growing **water scarcity**, which already affects **17% of the European territory**, and which is being aggravated by the effects of climate change, stands out.



Water risk in Europe. Source: WRI Aqueduct Water Risk Atlas

The high consumption of water in agriculture has also been one of the reasons why this regulation has prioritized the application of irrigation over other uses such as industrial and urban uses, since **it consumes 70% of the fresh water extracted worldwide.**

Moreover, this initiative is favored by the previous existence of reclamation regulations in some countries of the Union, which proves the acceptance by society of this irrigation practice, a really important step for the application and implementation of this type of community regulations.

However, **there are few countries within the European Union that use reclaimed water for irrigation** or other applications to any significant extent. This practice is mainly located in the Mediterranean area and includes 6 countries: **Spain, France, Italy, Portugal, Greece and Cyprus.**

That said, which are the keys to understand this new regulation?

1st KEY: Application and entry into force

Regulated applications

First of all, the European regulation only regulates the reuse of reclaimed water for **agricultural irrigation**. For the time being, the European Union has decided to focus on the agricultural sector, as it is by far the sector that consumes the most water resources.

This Regulation is only applicable to agricultural irrigation

However, it also states that **reclaimed water can be used in applications other than agricultural irrigation**, as cited in consideration 29, in accordance with the specific legislation of each Member State:

> *"There is great potential for the reclamation and reuse of treated water. With a view to promoting and encouraging the reuse of water, the indication of specific uses under this Regulation should not prevent Member States from allowing the use of reclaimed water for other purposes, such as industrial, recreational or environmental purposes, as deemed necessary according to national circumstances and needs, provided that a high level of protection of the environment and of human and animal health is ensured."*

Waters suitable for reclamation

This regulation only covers the reclamation of **treated urban wastewater from urban wastewater treatment plants**, in accordance with Directive 91/271/EEC. Therefore, this regulation is not applicable for the reuse of industrial wastewater, unless this water enters a collecting system and is treated in an urban wastewater treatment plant (Article 2).

Entry into force, implementation and penalties

The new regulation will be applicable as of **June 26, 2023**, the date from which it will be mandatory in all its elements and directly applicable in each Member State.

In other words, the European Union has prescribed a period of three years (from its publication in 2020) for the adaptation of new and existing systems to the new requirements.

In case of non-compliance, the applicable penalty regime is to be established by each Member State (Article 15).

2nd KEY: Reclaimed Water Quality and Parameters

Reclaimed water quality classes

Drip irrigation

The control parameters will have different maximum limits depending on the category of crop and the irrigation method used.

According to these characteristics, this new regulation defines four quality classes with different levels of requirements:

- **Quality A:** this is the most restrictive quality in terms of the physico-chemical parameters required and, therefore, the one that will need a more robust water treatment line. It refers to crops that are consumed raw where the edible part is in contact with reclaimed water. Example: lettuce, carrots, ginger, etc.
- **Quality B and C:** these qualities, less demanding than A, refer to crops that are consumed raw but are grown above ground, and therefore must not be in contact with irrigation water. Example: apples, pears, avocados, etc. The difference between quality B and C is marked by the type of irrigation: drip irrigation (no water-fruit contact) or sprinkler irrigation (possibility of water-fruit contact).
- **Quality D:** refers to crops intended for industry, energy and seed production. Example: poplars, eucalyptus, etc.

Control parameters and limits

This new regulation introduces new parameters to be controlled, such as the biological oxygen demand (BOD_5) and tightens the limits of other existing parameters, such as the level of E. coli, total suspended solids (TSS) and turbidity (NTU).

These values can be found in **Table 2 of Annex I** at the end of the document, together with other related tables.

On the other hand, **a validation control is defined to be carried out before a new water reclamation plant is put into operation** and whenever the equipment is modernised or new equipment or processes are added. The limits are defined in **Annex I, Table 4**. However, stations already in operation and complying with the quality requirements set out in Table 2 of Annex I are exempted from this control.

The frequency of routine monitoring depends on the water quality class.

3rd KEY: Available technologies

During the development of these regulations, numerous studies were carried out to check whether existing technologies could meet the new limits in a feasible way, especially those defined for the most restrictive quality class, category A.

For this class, the indicative treatment (Table 2, Annex I) consists of secondary treatment (at the treatment plant) and tertiary treatment consisting of a filtration and a disinfection stage. For grades B, C and D only secondary treatment and disinfection are required.

Filtration technologies

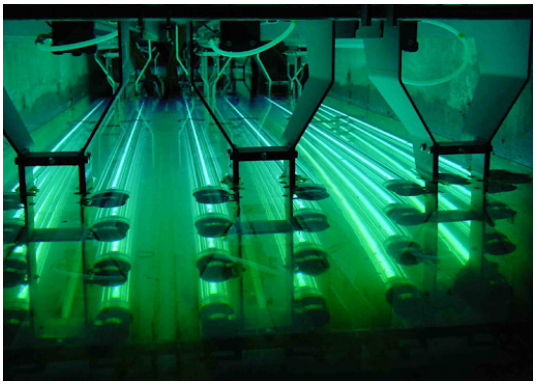
- **Microfiltration**: this is a filtration with a microporous medium that retains suspended solids in the water. This technology is used in many water treatments and has been included in several pilot projects as a filtration stage.
- **Ultrafiltration**: this is a membrane filtration that allows the mechanical separation of suspended solids. This technology has also obtained good results in the various pilot tests carried out.

Ultrafiltration membranes

Disinfection technologies

After the filtration stage, a disinfection process is needed to ensure a high safety level for the water. Several disinfection treatments have been studied with varying results:

- **Sodium hypochlorite**: although this is one of the most widely used disinfection treatments, it is not entirely effective in eliminating viruses and protozoa in accordance with the performance targets defined in Annex I of the Regulation.
- **Ozone** treatment: ozone has been studied both for its disinfectant action and for the possibility of increasing the dissolved oxygen in the water, which would be beneficial for crops. It is also considered as a pretreatment for ultraviolet disinfection, as it significantly increases the transmittance of the water, making ultraviolet radiation more effective.



Ultraviolet lamps

- **Ultraviolet lamps**: Ultraviolet disinfection has shown high efficiency in killing bacteria, viruses and protozoa according to the values of the new Regulation. To achieve high levels of efficacy, pre-treatment is recommended to ensure a significant reduction of suspended solids and turbidity to avoid shading and oversizing of the system.

Activated carbon

On the other hand, **activated carbon** cartridges have been mainly used as adsorbent media to improve the transmittance of water. Several experts point out that the development of this material and other alternatives would be very interesting to improve the available treatment lines.

4th KEY: Pre-filtration, a key stage

In the systems proposed in the previous section for **class A**, the pre-filtration stage will have the main function of **protecting the filter medium**, in this case the microfiltration and ultrafiltration equipment. This avoids rapid clogging and thus the need for frequent cleaning, as this would significantly reduce their service life.

This risk will be especially important in cases where the treated wastewater is of poorer quality: higher organic load, large amounts of suspended solids...

In the case of **classes B, C and D**, a filtration stage is not required, however, the disinfection performance will be strongly influenced by the suspended solids present and the turbidity of the water. Because of this, including **a filtration stage is an option to be considered to increase the disinfection efficiency.**

For this stage we have, among other technologies, **self-cleaning disc filters**. This filtration technology is especially interesting for water with a high load of suspended solids of an organic nature, as is the case with treated water. It also has various filtration rates, which allows it to adapt to a wide variety of water qualities.

In some studies, **this technology has been used as a filtration stage in the regeneration process for class A**, complemented by adsorption with activated carbon (for the elimination of emerging pollutants) and ultraviolet disinfection. In this case, a high percentage reduction of suspended solids was obtained, protecting the activated carbon and increasing the effectiveness of the ultraviolet treatment.

Pilot plant for the study of regeneration of treated wastewater

5th KEY: Wastewater treatment infrastructure condition

Despite the points mentioned above, water reclamation will only be possible in those territories that have a **sufficient urban wastewater treatment infrastructure**, as they are the starting point of the reclamation process. In many countries, this infrastructure is not evenly distributed throughout the territory and tends to be concentrated around urban centres and to become scarcer as we move away from them.

Does this mean that regions that do not have adequate wastewater treatment will not be able to benefit from reclaimed water?

Not necessarily. In recent years, a large number of decentralised wastewater treatment solutions have been developed that are able to provide this service in a decentralised manner and within the limits of wastewater regulations.

MBBR technology is one of the most widely used technologies in this type of installation, as it offers great advantages in terms of energy efficiency and treatment capacity. As reflected in the standard, **this treated water can be used for reclamation**, provided that the installation complies with the parameters of Directive 91/271/EEC.

In this way, the MBBR treatment plant could be installed, followed by treatment for the regeneration of treated water, giving these populations the possibility of storing the regenerated water for agricultural irrigation or other activities such as the irrigation of green areas, industrial use or aquifer recharge (although for uses other than agricultural irrigation, the permitted applications and minimum limits are regulated by the regulations of each State).

Containerised MBBR plant

AZUD and the reuse of wastewater

We hope that after reading these key points you will have a clearer idea of this new regulation. Although this does not replace the full text (which you can download here), we wanted to compile the most frequent doubts raised in technical conferences.

In addition, so that you can easily consult it, we include below Annex I of the regulation, extracts from other regulations mentioned and links with additional information of interest on water reuse in Europe and in other countries.

And if you are interested in knowing more about water reclamation research projects, don't miss this article by Beatriz Masdemont, coordinator of R&D&I projects at AZUD, about the REUSAGUA project.

*The content of this article is intended to be informative. It is not intended to supplant the interpretative role of legal professionals, who should be consulted for an in-depth knowledge of the rule under discussion.

ANNEX I: USES AND MINIMUM REQUIREMENTS

Section 1

Uses of reclaimed water

Agricultural irrigation

Agricultural irrigation means irrigation of the following types of crops:
— food crops consumed raw, meaning crops which are intended for human consumption in a raw or unprocessed state;
— processed food crops, meaning crops which are intended for human consumption after a treatment process (i.e. cooked or industrially processed);
— non-food crops, meaning crops which are not intended for human consumption (e.g. pastures and forage, fibre, ornamental, seed, energy and turf crops).

Without prejudice to other relevant Union law in the fields of the environment and of health, Member States may use reclaimed water for further uses such as:
— industrial water reuse; and
— amenity-related and environmental purposes.

Section 2

Minimum requirements

Minimum requirements applicable to reclaimed water intended for agricultural irrigation

The reclaimed water quality classes and the permitted uses and irrigation methods for each class are set out in Table 1. The minimum requirements for water quality are set out in Table 2 of point (a). The minimum frequencies and performance targets for monitoring reclaimed water are set out in Table 3 (routine monitoring) and Table 4 (validation monitoring) of point (b).

Crops belonging to a given category shall be irrigated with reclaimed water of the corresponding minimum reclaimed water quality class as set out in Table 1, unless appropriate additional barriers as referred to in point (c) of Article 5(4) are used, which result in achieving the quality requirements set out in Table 2 of point (a). Such additional barriers may be based on the indicative list of preventive measures referred to in point 7 of Annex II or in any other equivalent national or international standards, e.g. the standard ISO 16075-2.

Table 1 – Classes of reclaimed water quality and permitted agricultural use and irrigation method

Minimum reclaimed water quality class	Crop category (*)	Irrigation method
A	All food crops consumed raw where the edible part is in direct contact with reclaimed water and root crops consumed raw	All irrigation methods
B	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	All irrigation methods
C	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	Drip irrigation (**) or other irrigation method that avoids direct contact with the edible part of the crop
D	Industrial, energy and seeded crops	All irrigation methods (***)

(*) If the same type of irrigated crop falls under multiple categories of Table 1, the requirements of the most stringent category shall apply.

(**) Drip irrigation (also called trickle irrigation) is a micro-irrigation system capable of delivering water drops or tiny streams to the plants and involves dripping water onto the soil or directly under its surface at very low rates (2–20 litres/hour) from a system of small-diameter plastic pipes fitted with outlets called emitters or drippers.

(***) In the case of irrigation methods which imitate rain, special attention should be paid to the protection of the health of workers or bystanders. For this purpose, appropriate preventive measures shall be applied.

(a) Minimum requirements for water quality

Table 2 – Reclaimed water quality requirements for agricultural irrigation

Reclaimed water quality class	Indicative technology target	Quality requirements				
		E. coli (number/100 ml)	BOD_5 (mg/l)	TSS (mg/l)	Turbidity (NTU)	Other
A	Secondary treatment, filtration, and disinfection	≤ 10	≤ 10	≤ 10	≤ 5	*Legionella* spp.: < 1 000 cfu/l where there is a risk of aerosolisation Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage
B	Secondary treatment, and disinfection	≤ 100	In accordance with Directive 91/271/EEC (Annex I, Table 1)	In accordance with Directive 91/271/EEC (Annex I, Table 1)	-	
C	Secondary treatment, and disinfection	≤ 1 000			-	
D	Secondary treatment, and disinfection	≤ 10 000			-	

Reclaimed water shall be considered to be in compliance with the requirements set out in Table 2 where the measurements for that reclaimed water meet all of the following criteria:

— the indicated values for E. coli, Legionella spp. and intestinal nematodes are met in 90 % or more of the samples; none of the values of the samples exceed the maximum deviation limit of 1 log unit from the indicated value for E. coli and Legionella spp. and 100 % of the indicated value for intestinal nematodes;

— the indicated values for BOD5, TSS, and turbidity in Class A are met in 90 % or more of the samples; none of the values of the samples exceed the maximum deviation limit of 100 % of the indicated value.

(b) Minimum requirements for monitoring

Reclamation facility operators shall perform routine monitoring to verify that the reclaimed water is in compliance with the minimum water quality requirements set out in point (a). The routine monitoring shall be included in the verification procedures of the water reuse system.

The samples to be used to verify compliance with the microbiological parameters at the point of compliance shall be taken in accordance with standard EN ISO 19458 or with any other national or international standards that ensure equivalent quality.

Table 3 – Minimum frequencies for routine monitoring of reclaimed water for agricultural irrigation

	Minimum monitoring frequencies					
Reclaimed water quality class	*E. coli*	BOD_5	TSS	Turbidity	*Legionella* spp. (when applicable)	Intestinal nematodes (when applicable)
A	Once a week	Once a week	Once a week	Continuous	Twice a month	Twice a month or as determined by the reclamation facility operator according to the number of eggs in waste water entering the reclamation facility
B	Once a week	In accordance with Directive 91/271/EEC (Annex I, Section D)	In accordance with Directive 91/271/EEC (Annex I, Section D)	-		
C	Twice a month			-		
D	Twice a month			-		

Validation monitoring shall be performed before a new reclamation facility is put into operation.

Reclamation facilities that are already in operation and that meet the reclaimed water quality requirements set out in Table 2 of point (a) on 25 June 2020 shall be exempted from that validation monitoring obligation.

However, validation monitoring shall be performed in all cases where equipment is upgraded, and when new equipment or processes are added.

Validation monitoring shall be performed for the reclaimed water quality class with the most stringent requirements, Class A, to assess whether the performance targets (log10 reduction) are complied with. Validation monitoring shall entail the monitoring of the indicator microorganisms associated with each group of pathogens, namely bacteria, viruses and protozoa. The indicator microorganisms selected are E. coli for pathogenic bacteria, F-specific coliphages, somatic coliphages or coliphages for pathogenic viruses, and Clostridium perfringens spores or spore-forming sulfate-reducing bacteria for protozoa. Performance targets (log10 reduction) for the validation monitoring for the selected indicator microorganisms are set out in Table 4 and shall be met at the point of compliance, considering the concentrations of the raw waste water entering the urban waste water treatment plant. At least 90 % of validation samples shall reach or exceed the performance targets.

If a biological indicator is not present in sufficient quantity in raw waste water to achieve the log10 reduction, the absence of such biological indicator in reclaimed water shall mean that the validation requirements are complied with. The compliance with the performance target may be established by analytical control, by addition of the performance granted to individual treatment steps based on scientific evidence for standard well-established processes, such as published data of testing reports or case studies, or tested in a laboratory under controlled conditions for innovative treatment.

Table 4 – Validation monitoring of reclaimed water for agricultural irrigation

Reclaimed water quality class	Indicator microorganisms (*)	Performance targets for the treatment chain (log_{10} reduction)
A	*E. coli*	≥ 5,0
	Total coliphages/F-specific coliphages/somatic coliphages/coliphages (**)	≥ 6,0
	Clostridium perfringens spores/spore-forming sulfate-reducing bacteria (***)	≥ 4,0 (in case of *Clostridium perfringens* spores) ≥ 5,0 (in case of spore-forming sulfate-reducing bacteria)

(*) The reference pathogens *Campylobacter*, Rotavirus and *Cryptosporidium* may also be used for validation monitoring purposes instead of the proposed indicator microorganisms. The following log_{10} reduction performance targets shall then apply: *Campylobacter* (≥ 5,0), Rotavirus (≥ 6,0) and *Cryptosporidium* (≥ 5,0).

(**) Total coliphages is selected as the most appropriate viral indicator. However, if analysis of total coliphages is not feasible, at least one of them (F-specific or somatic coliphages) shall be analysed.

(***) *Clostridium perfringens* spores is selected as the most appropriate protozoa indicator. However, spore-forming sulfate-reducing bacteria are an alternative if the concentration of *Clostridium perfringens* spores does not make it possible to validate the requested log_{10} removal.

Methods of analysis for monitoring shall be validated and documented in accordance with EN ISO/IEC-17025 or other national or international standards that ensure an equivalent quality.

Other regulations mentioned

Annex III to Directive 91/271/EEC: Industrial sectors (referred to on page 2)

1. Milk-processing
2. Manufacture of fruit and vegetable products
3. Manufacture and bottling of soft drinks
4. Potato-processing
5. Meat industry
6. Breweries
7. Production of alcohol and alcoholic beverages
8. Manufacture of animal feed from plant products
9. Manufacture of gelatine and of glue from hides, skin and bones
10. Malt-houses
11. Fish-processing industry

Annex I, Table I to Directive 91/271/EEC (referred to in Table 2, Annex I)

Parameters	Concentration	Minimum percentage of reduction (1)	Reference method of measurement
Biochemical oxygen demand (BOD5 at 20 °C) without nitrification (2)	25 mg/L O_2	70-90 40 under Article 4 (2)	Homogenized, unfiltered, undecanted sample. Determination of dissolved oxygen before and after five-day incubation at 20 ° C ± 1 ° C, in complete darkness. Addition of a nitrification inhibitor
Chemical oxygen demand(COD)	125 mg/L O_2	75	Homogenized, unfiltered, undecanted sample Potassium dichromate
Total suspended solids	35 mg/L (3) 35 under Article 4 (2) (more than 10 000 p.e.) 60 under Article 4 (2) (2 000- 10 000 p.e.)	90 (3) 90 under Article 4 (2) (more than 10000 p.e.) 70 under Article 4 (2) (2 000-10 000 p.e.)	- Filtering of a representative sample through a 0,45 micron filter membrane. Drying at 105 °C and weighing - Centrifuging of a representative sample (for at least five mins with mean acceleration of 2 800 to 3 200 g), drying at 105 °C and weighing

(1) Reduction in relation to the load of the influent
(2) The parameter can be replaced by another parameter : total organic carbon (TOC) or total oxygen demand (TOD) if a relationship can be established between BODS and the substitute parameter.
(3) This requirement is optional.

Annex I, Section D to Directive 91/271/EEC (referred to in Table 3, Annex I):
D. Reference methods for monitoring and performance evaluation

1 . Member States shall ensure that a monitoring method is applied which corresponds at least with the level of requirements described below.

Alternative methods to those mentioned in paragraphs 2; 3 and 4 may be used provided that it can be demonstrated that equivalent results are obtained.

Member States shall provide the Commission with all relevant information concerning the applied method. If the Commission considers that the conditions set out in paragraphs 2, 3 and 4 are not met, it will submit an appropriate proposal to the Council.

2. Flow-proportional or time-based 24-hour samples shall be collected at the same well-defined point in the outlet and if necessary in the inlet of the treatment plant in order to monitor compliance with the requirements for discharged waste water laid down in this Directive.

Good international laboratory practices aiming at minimizing the degradation of samples between collection and analysis shall be applied.

3 . The minimum annual number of samples shall be etermined according to the size of the treatment plant and be collected at regular intervals during the year:

— 2 000 to 9 999 p.e.:	12 samples during the first year. four samples in subsequent years, if it can be shown that the water during the first year complies with the provisions of the Directive ; if one sample of the four fails, 12 samples must be taken in the year that follows.
— 10 000 to 49 999 p.e.:	12 samples
— 50 000 p.e. or over:	24 samples

4. The treated waste water shall be assumed to conform to the relevant parameters if, for each relevant parameter considered individually, samples of the water show that it complies with the relevant parametric value in the following way :

(a) for the parameters specified in Table 1 and Article 2 (7), a maximum number of samples which are allowed to fail the requirements, expressed in concentrations and/or percentage reductions in Table 1 and Article 2 (7), is specified in Table 3 ;

(b) for the parameters of Table 1 expressed in concentrations, the failing samples taken under normal operating conditions must not deviate from the parametric values by more than 100 % . For the parametric values in concentration relating to total suspended solids deviations of up to 1 50 % may be accepted ;

(c) for those parameters specified in Table 2 the annual mean of the samples for each parameter shall conform to the relevant parametric values.

5. Extreme values for the water quality in question shall not be taken into consideration when they are the result of unusual situations such as those due to heavy rain.

Further information

Directive 91/271/EEC:

Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment (pdf)

Regulation (EU) 2020/741:

Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 concerning minimum requirements for water reuse

Aqueduct Tools: Interactive maps with water risk data:

https://www.wri.org/aqueduct

Report on the legislative framework for water reuse in Europe (2018):

Water Reuse in Europe (pdf)

Water reuse in Orange County, California:

https://www.ocwd.com/gwrs/

Aquifer recharge with reclaimed water (among others) in Australia:

Managed aquifer recharge (MAR)