Canal de Isabel II

Water quality

The integrated water cycle

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1. Water quality throughout history

One of the biggest concerns throughout the history of mankind has been obtaining the purest, cleanest water possible.

Methods to improve the taste and smell of water are known to have been used 4,000 years before the common era (BCE). Ancient Oriental peoples used sand and porous clay to purify water and Greek writings have been found that recommend treatment methods such as filtration using carbon, exposure to sunlight or boiling. The Romans used filters to improve water quality and even separated water to be used for drinking and cooking from that to be used for irrigation and cleaning. In Ancient Egypt water would be left to stand in clay jars for several months so that the particles and impurities would precipitate out and a siphon would be used to extract the clarified water. It is known that around 1,500 BCE the Egyptians used alum to precipitate out particles suspended in water.

However, until the early twentieth century monitoring of water quality for supply mainly focussed on whether the water was free from flavours, odours, was not excessively hard and did not contain pathogenic bacteria. There was a great reliance on the regenerative power of reservoirs and rivers and the protection of tapping areas. This was complemented by simple treatment using subsidence, filtration and disinfection. In addition the performance of a few determinations generally checking for the absence of flavours and odours was sufficient to achieve acceptable quality.

It was not until the late twentieth century, as a result of greater pollution generated by industrial processes, that the need for new legislation and technical requirements to safeguard the health of consumers was raised.

2. Control of drinking water quality

Drinking water criteria are defined by the use the water is to be put to. Water destined for human consumption must comply with a suitable sanitary quality once it has been treated and present a biological stability in the distribution network. This means that from the collection point until it arrives at the tap the water follows a path full of controls, surveillance, processes and analysis.

2.1 Water quality in Spain

In our country, surface water quality has been controlled in a systematic way since 1962 with the creation of the OWQC Network (Official Water Quality Control).

Today, the stations integrated into the OWQC Network control the most significant discharges for parameters such as: temperature, dissolved oxygen, BOD5, suspended solids, coliforms, various anions, heavy metals, etc., with the objective of having a global and representative vision of water quality over a whole basin.

The results of the sampling allow the classification of each station according to the general quality index values obtained by the controls performed each year. This allows classification into one of 5 quality categories for each sampling point: excellent, good, intermediate, acceptable or unacceptable. In addition, the OCS Network (Official Control of Supplies) controls the water in rivers, lakes, reservoirs, etc., where there are intakes of water destined for supply.

Lastly, the Ichthyofauna Network controls the parameters in the reaches of rivers designated as fisheries.

All the data obtained has, since 1992, been collected by the IWQ Network (Integrated Water Quality).

3. Surveillance of water quality

Canal has established a strict surveillance programme from the source of the water supply up to its delivery to the consumer in order to guarantee its safety at all times. It is designed in such a way that it exceeds the provisions of existing laws regarding water intended for public consumption –both Spanish and European- and includes both possible available resources: surface water and groundwater.

Quality control is also performed on the effluent treated in the waste water treatment plants (WWTP) and on the quality of reclaimed waters destined for the irrigation of green areas.

Watch a video about water quality

3.1 Control of water quality in the supply network

The analytical surveillance of water quality in the supply network starts at the source, namely the reservoirs, rivers and wells. It continues during treatment in the drinking water treatment plant (DWTP) and during the water's journey through the distribution network up to delivery to the users' meters.

3.1.1 Surveillance of water at source

Canal analyses at source the waters extracted from the two resources used for supply: surface waters and groundwaters.

The surveillance of surface waters is carried out using limnological study of the reservoirs and tributaries used for collection, while the surveillance of groundwater involves the analytical characterisation of the resource in accordance with the requirements of the Community of Madrid regarding the environmental condition of groundwater.

Surface waters are sampled at different depths of the water body in the following sampling zones: surface, supply intake, epilimnion, hypolimnion, algal maximum, double Secchi disk and invert.

A range of parameters is measured in each sample, some of them in situ and others once the sample has arrived at the laboratory. The parameters measured in situ are: temperature, depth, light penetration using a Secchi disk or light meter –less commonly-, concentration of photosynthetic pigments and dissolved oxygen.

The analysis performed in the laboratory includes: dissolved oxygen, pH, conductivity, orthophosphate, ammonia, nitrite, nitrate, dissolved manganese, total iron, Redox potential, turbidity, colour, chlorides, silica, COD, chlorophyll (a, b and c), algae, detection of zebra mussel larvae, odour, microcystins (LR, YR and RR), biotic index, suspended solids and total phosphorous.

Most surface water intended for the production of drinking water usually has a high level of excellence, achieving the highest quality levels established by current legislation.

3.1.2 Surveillance of distributed water

The most comprehensive control, with the largest number of tests, is performed during the time water spends in the distribution network.

The surveillance of treated and distributed water involves two programmes based on the taking of classical manual samples. One of these involves sampling the input and output of the DWTP, header and regulator tanks and drinking water reservoirs and official sampling points located across the network. This is accompanied by the other, support programme, which is unscheduled and is established to focus on complaints and specific studies.

There is also a network of automatic surveillance stations (ASS) equipped with sensors that allow the continuous measurement of a series of chemical parameters. The results are sent in real time to the Control Centre using Canal's own communications network. All of these stations analyse: chlorine, ammonia, nitrites, pH and conductivity; while only some also measure total organic carbon, nitrates and turbidity.

3.1.3 Central water testing laboratory

The company, which is a pioneer on many fronts, is also ahead of its time in controlling the quality of the water consumed in Madrid and, as of 1925, it has analysed samples taken from the distribution network, mainly from the Second, Third and Partidor drinking water tanks.

The main laboratory undertakes microbiological determinations of coliforms, permanganate index, hardness (foam method) and pH.

This laboratory has been functioning since 1964, when its location was changed to allow its expansion, as it was considered necessary to update the existing physical-chemical analytical methods and increase the number of parameters analysed due to the new requirements demanded.

New, modern facilities entered into service in 2002, equipped with the latest advances and designed to improve delivery of its main objective: the surveillance of drinking water quality, before and after the treatment process and up to the point of delivery to the users. The new building has a number of specialised laboratories covering different analytical techniques: physical-chemical, microbiology, limnology, chromatography and heavy metals.

3.1.4 Peripheral network of laboratories

In order to complement the work carried out at the central laboratory there is a peripheral network comprised of 15 laboratories spread across the geographical area of the Community of Madrid. The aim of the network is to decentralise the analytical control of the drinking water supply network of the region's large municipalities.

3.2 Control of water quality in waste water treatment and reclamation plants

A treated water laboratory was commissioned in 2010 to deal with the large number of samples requiring analysis, both of treated waste water from the plants managed by the company as well as of reclaimed water. The laboratory's characteristics and analytical capacity is similar to the existing laboratory for drinking water but its focus is on controlling the quality of treated waste water within the Community of Madrid area.

The organic parameters analysed are: BOD5, COD, TOC, VOCs (volatile organic compounds), PAHs (polycyclic aromatic hydrocarbons), phenols, detergents, oils and greases and total hydrocarbons.

The physical-chemical parameters are: pH, conductivity, turbidity, total phosphorus, total nitrogen, ammonia, nitrate, nitrite, TON, Kjelhdal nitrogen, total and dissolved metals, chlorine and total, total free and combined inorganic carbon.

The following microbiological parameters are also measured: total coliforms, E. coli, toxicity and nematode eggs.

In addition, water quality is monitored in the reaches of the rivers affected by effluent discharges from the WWTPs managed by the company, as required by environmental responsibility legislation. The monitoring is carried out upstream and downstream of the discharge point with analysis of the rivers' physical-chemical and biological (macroinvertebrates) quality.

3.2.1 Central laboratory for testing treated and reclaimed waters

The building entered into service in 2010 and is located in Majadahonda (Madrid), it has a surface area of 2,200 m2 and has the following facilities:

- Physical-chemical laboratory.
- Sample digestion laboratory.
- Microbiology laboratory, containing clean and dirty seeding rooms.
- Incubation room.
- Microscopy and data processing room.
- Metals laboratory.
- Solid samples laboratory.
- Organic pollutants analysis laboratory with three differentiated areas: sample preparation, sample extraction and chromatographic analysis and standards preparation area.

3.3 Automatic water surveillance network

The manual sampling system is complemented by a network of 40 automatic surveillance stations (ASS), installed at the DWTP output point, large drinking water reservoirs and most important points in the supply network. There are 15 more ASSs analysing reclaimed water. They are all equipped with sensors that allow continuous measurement of a series of chemical parameters and they send the results in real time to the Control Centre.

4. Quality management system

The management system of Canal de Isabel II's water analysis laboratories has been certified to accord with the requirements of the following quality systems: ISO 9001, ISO 14001, UNE-EN ISO/IEC 17025 and OHSAS 18001.

A number of work criteria and objectives have been set that must be known and applied by all the people running activities related to the quality of testing performance and service provision. These ensure the required service level either in response to customer requirements or those of a legal or regulatory nature.

Their implementation ensures the quality both of the analytical results and the service provided.

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