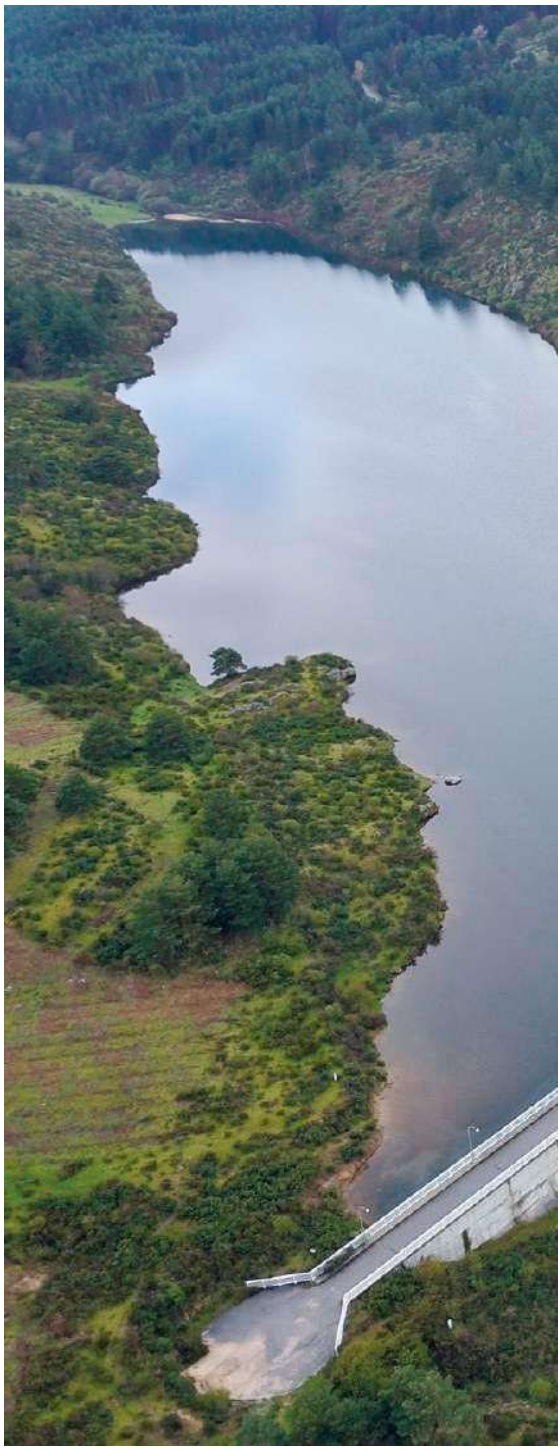
FILTRALITE® IN THE ETAP OF PEDRAZA,

THE SOLUTION TO REMOVE IRON AND MANGANESE BY INCREASING PRODUCTION

The DWTP of the Community of Villa y Tierra de Pedraza, built in 2012 and managed by ACUAES, uses water from the Ceguilla river reservoir. The concentration of iron and manganese in the reservoir in the late summer months made treatment complex and also limited the flow produced.

In 2021 ACUAES, manager of the plant, and ELECNOR SyP, the operator, replaced the sand in its filters with Filtralite® Pure. The results obtained after rigorous monitoring show that the choice was the right one.



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The DWTP of the Community of Villa y Tierra de Pedraza, in Segovia, was built by the then Ministry of Agriculture, Fisheries and Food through ACUAES in 2012. It currently supplies twenty-nine population centres belonging to twenty-one municipalities in the community. The project involved an investment of twenty-six million euros.

The works included the construction of a dam on the river Ceguilla with a capacity of 1.1 Hm3 and the construction of the 430 m3/h DWTP. Two regulating reservoirs with a capacity of 1,000 m3 and a supply network 113 km long were also built.

Traditionally, the river Ceguilla has had water catchments for supplying the nearest towns in the region. Its quality, not always proven, met the drinking water standards previously required. The water came from a high mountain torrent in a granitic area with no anthropic contamination.

At the beginning of 2021 Elecnor SyP replaced the existing filter media, anthracite and sand, of its four filters with Filtralite® Pure

The river water received no treatment other than disinfection before consumption. However, the flow of this small torrent was insufficient to supply the population of the region in the summer months. The only viable approach to ensure the availability of the resource was to store it for distribution in deficit months.

The construction of the system consisting of the reservoir, the DWTP and the distribution network led to a greater control of the water quality, detecting the existence of pollutants such as iron and manganese. The values were above the permitted levels, as a consequence of the special geology of the area, especially at low flow times, from July to October.

These compounds appear mainly in cationic forms and also partially complexed with organic matter. The raw water that reaches the Pedraza DWTP has seasonally variable concentrations of iron and manganese. In winter, they move within the range of average inlet values: iron (Fe) 0.15 mg/l and manganese (Mn) 0.07 mg/l. These values increase in the summer months -as a result of the lower flow of the river Ceguilla - reaching concentrations of 0.7 mg/l for Fe and 0.2 mg/l for Mn; values that were even higher before the installation of a floating intake at the dam.

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The limit set by RD 140 (Spanish regulation) for drinking water is 0.2 mg/l total iron, and 0.05 mg/l total manganese. These dry season concentrations were a management and operational challenge and a limitation in terms of production capacity. In concentrations above the standard, iron and manganese generate an unpleasant metallic taste and produce oxide stains.

In addition, WTP equipment can be affected by the accumulation of rust deposits, which affects its operability. In supply networks, precipitated oxides can reduce pipe cross-section,

Pedraza DWTP: View of the area of the Pedraza DWTP and the outlet tank.

increased load shedding and generation of uncontrolled bacterial growth affecting disinfecting agents.

The origin of both pollutants in water sources is diverse, but mostly natural causes. The presence of these metals is much more common in groundwater sources. This is a consequence of low dissolved oxygen levels, lower pH and higher CO2 concentrations. Although it is also present in surface water, as in the case of the Pedraza DWTP. In addition to mineral iron and manganese, it is possible to find these metals complexed with organic matter in surface sources.

It is essential for the treatment of this type of surface water to correctly characterise the status of each fraction.. It is necessary to determine whether both metals are present as dissolved cations or complexed with organic matter, as the treatment approach changes substantially.

Until 2021, the elimination of these components in their cationic forms was carried out at the Pedraza DWTP using the traditional approach of oxidation - with a strong oxidant - and filtration on sand-anthracite. This method, which was the only alternative with the treatment train installed. It had limitations and undesirable effects. At high concentrations, it is necessary to use strong oxidants such as potassium or sodium permanganate and to do so in proportion to the concentrations of each cation. This is difficult to adjust in real time.

These intensive pre-oxidations have clear disadvantages. The main disadvantage is the rapid clogging of the sand filters due to increased particulate matter. Conventional sand filters filter on the surface and clog quickly, requiring frequent washing and significantly reducing production capacity. In addition, the greatest amount of iron and manganese is produced in the summer months, the most critical months in terms of supply availability.

The Pedraza DWTP also supplies a region with a high summer seasonal population. Therefore, this pre-oxidation approach was very limiting for the production of drinking water, making it necessary to extend the number of operating hours of the plant.

Undesirable effects of these strong oxidations include possible water staining problems in case of overdosing, and the generation of oxidation by-products. ACUAES, as the operator, in collaboration with ELECNOR SyP has held the contract for the operation of the DWTP since November 2012. With the aim of improving the quality of the raw water from the DWTP, it has been carrying out different actions to improve this catchment, such as executing a floating intake in the reservoir that allows the water to be captured from the surface reservoir where the concentration of these compounds is lower.

In 2019, a first phase of column tests was carried out with Filtralite® Pure to verify the iron and manganese capacity of the material in its waters. The column was installed in the Ceguilla dam itself, and analytical monitoring was carried out over a period of three months. The results of the elimination of the cationic part of the iron and manganese were very positive, so the decision was taken to change the entire filter media of the plant.

In early 2021, the operator, Elecnor SyP, replaced the existing filter media, anthracite and sand, in its four filters with Filtralite® Pure.

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Throughout the whole of 2021, it has been possible to record the performance of the filters. It has been a great improvement. In summer, the plant has gone from being able to produce 220 m3/h with anthracite sand to 300 m3/h with Filtralite® Pure, which means an increase in flow per hour of 36%. This has made it possible to reduce the number of hours of operation of the DWTP in summer from eighteen hours to the current thirteen and a half hours.

Also, the frequency of filter backwashing in summer has been radically reduced. The DWTP, which used to backwash each filter twice a day with anthracite sand, is now backwashed with Filtralite® once every two or three days. The explanation lies in the fact that Filtralite®, due to its high specific surface area and porosity, can retain more solids without clogging.

> **The plant has gone from producing 220 m /h with sand-anthracite to 300 m^3/h with Filtralite® Pure. This represents an increase of 36%.**

View of the external façade of the DWTP.

The dosage of permanganate has also been reduced to a minimum thanks to the iron and manganese adsorption capacity of Filtralite®. In absolute terms, this is an increase in the Filtration stroke of more than 500%. This increase translates into powerful savings in filter wash water: emissions are estimated at around 140 m3 of water per day, which implies a decrease from a wash water consumption of 4.4 % of the water produced to only 0.9 %.

In economic terms, the reduction in water consumption leads to a return on investment from the change from sand-anthracite to Filtralite® of almost one year.

As far as the permanganate requirement is concerned, with anthracite-sand, dosing was started when the iron levels exceeded 0.25 mg/l and manganese 0.06 mg/l.. This meant that the reagent had to be used practically all summer and part of the autumn.

Currently, with Filtralite® Pure, and in order to guarantee the removal of the part of the iron and manganese that is complexed with organic matter and cannot be removed by adsorption, permanganate has only been dosed at specific times, and when the levels of iron and manganese were above 0.68 mg/l iron and 0.16 mg/l manganese.

The reliance on oxidation treatment has been drastically reduced and its use is a one-off aid to remove TOC, and in the second instance, iron and complex manganese. In terms of turbidity, the plant averages below 0.3 NTU with Filtralite® Pure.

In conclusion, Filtralite® Pure has enabled the Pedraza DWTP to meet the objective of increasing production capacity by more than 30%, reducing OPEX and associated washing water and energy losses by more than 75%. It has comfortably met the objective of eliminating iron and manganese, practically eliminating oxidation with permanganate.

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> **The ETAP that performed two washes per day per filter with the sand-anthracite, backwashes with Filtralite® once every two or three days**