CASE STUDY
FILTRALITE® PURE
DRINKING WATER TREATMENT

FILTRALITE®
FILTERING THE WATER FOR TOMORROW

" This solution provides high performance and reliability combined with low OPEX and CAPEX "

Denitrification biofilter at Formiche Alto (SP)

Filtralite® Pure is used as filter media in an anaerobic denitrification biofilter used to remove nitrates in the drinking water treatment plant of Formiche Alto (Spain). This solution provides high perfomance and reliability combined with low OPEX and CAPEX.

The process of denitrification in the field of drinking water treatment is a big challenge. Contamination of aquifers by nitrates, due to the excess of fertilization in agriculture, is a recurrent problem throughout the world and especially in regions with important agricultural development, like Mediterranean Europe.

Several nitrate removal methods such as ion exchange, reverse osmosis, electro-dialysis, distillation or chemical reduction have been developed. They achieve different rates of efficiency but the main issues are the high investment and operational costs. Biological denitrification has proved to be one of the most feasible, advanced, selective and cost effective processes for removing nitrate by dissimilatory reduction, which transforms it into nitrogen gas. This process has been applied to nitrogen removal of wastewater and contaminated groundwater, with biofilm technology achieving the highest nitrogen removal rate per volume. It has shown and outstanding yield for Drinking Water Treatment Plants (DWTP).

Biological denitrification involves the biological oxidation of organic substrates in water treatment using nitrate or nitrite as the electron acceptor instead of oxygen, thus organic matter has to be added as reagent to the water inlet. In the absence of DO (dissolved oxygen) or under limited DO concentrations, the nitrate reductase enzyme in the electron transport respiratory chain is induced, and helps to transfer hydrogen and electron to the nitrate as the terminal electron acceptor. The nitrate reduction reactions involve different reduction steps from nitrate to nitrogen gas. In a Drinking Water Treatment Plant, denitrification is carried out in just one step inside an anaerobic bio-filter filled with the filter media Filtralite® Pure which is the optimum carrier for the denitrification biofilm. As mentioned above, the process has to be fed with organic matter (such as methanol, ethanol, acetic acid, glucose...), the quantity depends on the nitrates to be removed. The size of the tank (for small schemes it could be in a simple PRFV tank) is linked to the contact time to remove the nitrates from the effluent. Other variables affect this parameter: nitrates content, water temperature and pH. Nevertheless the system is simple to design, very reliable, highly performant and with low operational cost.

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FILTERING THE WATER FOR TOMORROW

A good example of this technology is the DWTP designed and built by Ingeobras in Formiche Alto (Teruel Province -Spain) in 2017 with Filtralite® Pure as the biofilm carrier. The DWTP treats groundwater with almost quality of fresh water, according to Spanish regulations (RD 140/2003), only with the exception of the nitrates content which is around 60 ppm (content variable depending on the season). Spanish regulation sets 50 ppm as limit for nitrates. Thus a small drinking water treatment scheme (5 m3/h) was built in four steps: (1) Denitrification Bio-Filter Anaerobic to remove nitrates, (2) Physical Filtration to remove Suspended Solids (3) Biological Aerated Filter to remove remaining organic matter (4) Disinfection with Chlorine which eliminates any bacteria or pathogen coming from the biological treatment.

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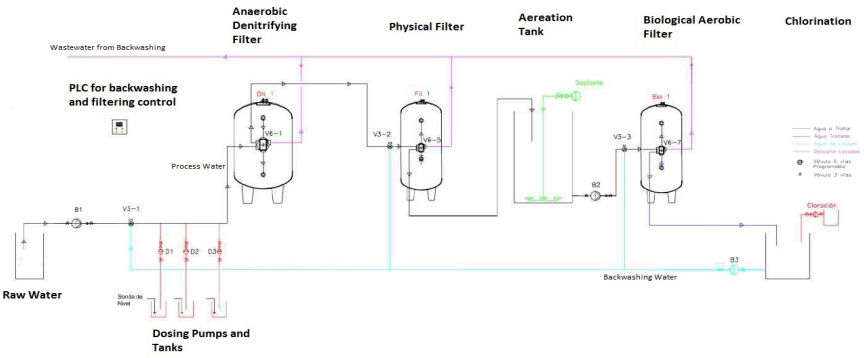
WATER SOLUTIONS



The DWTP of Formiche Alto has been designed to operate with a removal performance of 60% to get a final NO3 value in the outlet water below 25 ppm. This result guarantees a conservative safety margin in relation with the Spanish regulation.

The quantity of backwash water needed is between the 5-10% of the total filtered water produced. This wastewater quality allows it to be discharged into the sewage network or to be reused in agriculture. Nevertheless in this case, due to the DWTP location far from the sewage network, wastewater generated in backwash phase is stored in a sedimentation tank where is picked up.

The plant has an automatic operation which reduces the operational costs. It's estimated by Ingeobras that for a DWTP designed to treat NO3 (60 ppm/l) with a daily flow of 1000 m3, the total operation cost is around 0.16 €/m3 with the following cost breakdown:

- 0.08 €/m3 for reagents (mainly organic matter),
- 0.04 €/m3 for energy
- and 0,04 €/m3 for maintenance.

Additionally, the filter media Filtralite® Pure, which is the heart of the system, has a lifespan over 20 years.

On the other hand, the project's CAPEX to build up the DWTP is, in comparison with other solutions (reverse osmosis, electro dialysis, distillation or chemical reduction), substantially lower because of the simplicity of the technology used. Biological denitrification in DWTP removes between 70–95 % of nitrates: the most efficient of all technologies. Removal obtained with ion exchange, chemical reduction, electro dialysis and reverse osmosis were 80– 90 %, 33–90 %, 30–50 % and 50–96 %, respectively.

In conclusion, this design to denitrify in a water drinking plant by using Filtralite® Pure in a biological filter is an excellent option, in terms of water quality and CAPEX and OPEX. The process is very robust and reliable with a strong component of economic and environmental sustainability.

DWTP INDOOR: View of the DWTP indoor with the Bio-filers and the PLC.

THE SMALL PLANT: View of the small plant with the sedimentation tank outside.

FILTRALITE® FACTS:

Name of the Project: DWTP of Formiche Alto (Teruel Province -Spain)

Type of Facility: Drinking water treatment plant

Pollutant: 60 ppm/l of NO3

Flow Treated: 5 m3/h

Type of Technology used: Anaerobic Denitrifying Filter + Biological Aerated Filter

Type of Filtralite: Filtralite Pure HC 2.5-5

Comments: High performance and reliability combined with low Opex and Capex