

# GOLF COURSE IRRIGATION WITH RECLAIMED WATER

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## Scope and Purpose

Green Turf Consult (GTC) is a small consulting company devoted to golf course irrigation, based in Sant Gregori, Girona, Spain. It was created in 1991 when its manager, Xavier Millet, a biologist specialized in ecology, took over the responsibilities of green keeper at a golf course in Costa Brava, Spain. Since then, the company has steadily expanded and includes 4 additional agronomic engineers. Golf course irrigation with reclaimed water became an early challenge for Xavier Millet, who has been able to turn it into a new opportunity for alternative water supply at several golf courses under his supervision.

Although public perception in Spain raises considerable issues concerning the use of reclaimed water, Xavier Millet emphasizes that, if properly managed, there is absolutely no difference in managing the agronomic properties of reclaimed water and those of conventional waters used for landscape irrigation. Emphasis should be placed on the actual quality of the water, instead of on the name used to designate it.

Current responsibilities of GTC include landscape irrigation at:

1. Two 36-hole golf courses in Madrid, one irrigated with reclaimed water and other with groundwater.
2. A 36-hole golf course in Valencia, irrigated with local groundwater. Reclaimed water available in the area has a better agronomic quality than the groundwater currently used.
3. An 18-hole golf course in Valladolid, irrigated with groundwater, whose

electrical conductivity is close to 3,000  $\mu\text{S}/\text{cm}$ .

4. Four golf courses in Costa Brava and Barcelona: three 18-hole fields and one 36-hole field.

The main success of GTC has been to recognize and promote the value of reclaimed water as a new water resource. That proposal has been made possible thanks to the significant progress achieved by sanitation projects around the country, which have resulted in increasing flows of high quality treated effluents.

## Driving Forces

The main driving force for the use of reclaimed water in golf course irrigation has been the regulatory requirement to use reclaimed water, as a substitute for water from conventional sources. The water supply agency in Madrid, Canal de Isabel II, began requiring the use of reclaimed water in 1996, and has extended that requirement to the whole regional area of Madrid during 2005, as a result of the severe drought conditions experienced during that year. That requirement comes about 16 years after the use of reclaimed water for golf course irrigation started to be locally promoted in Costa Brava in 1989. The gradual application of that requirement has resulted in a more collaborative attitude between water reclamation agencies and water users, which has resulted in the regular provision of detailed information on reclaimed water quality, as it has been practiced by Consorcio de la Costa Brava (Water and Sanitation Agency for the Costa Brava Consortium) for more than 15 years. Reclaimed water users are increasingly aware of the considerable benefits

derived from: 1) the supply reliability of reclaimed water, regardless of climatic conditions, 2) the systematic information provided by Consorci of Costa Brava, and 3) the affordable cost associated to this alternative water supply service.

The golf course in Valladolid is irrigated with groundwater, with a significantly high salinity level. To improve water quality, demineralization was applied for some time; however, the resulting increase in sodium concentrations in the soil, due to unfavorable SAR values, and the inherent higher water production costs brought the demineralization process to a halt. The current challenge for water users like this one is to become aware of the benefits and requirements of using non conventional water resources, such as reclaimed water. The lower salinity concentration of drinking water, as compared to current groundwater sources, renders the reclaimed water subsequently obtained a more favorable solution. Furthermore, the reliability of reclaimed water is a significant positive feature of this new water source.

Water scarcity and recurrent drought episodes are the main driving forces for golf course irrigation with reclaimed water in the Valencia area. Although irrigation is currently practiced with surface waters, frequently borrowed from irrigation districts, current environmental concerns, urban demands for surface waters, and increasing availability of high quality treated wastewater effluents are gradually promoting the use of reclaimed water for landscape irrigation projects.

Golf course irrigation with reclaimed water in Costa Brava has been practiced since 1989, when the City of Castell Platja d'Aro required the use of reclaimed water as the water source for irrigation of a new golf course. The experience gained over the last 17 years shows the interest of using ornamental lakes as a mid and long-term strategic storage of irrigation water, and the convenience of using reclaimed water for irrigation as it comes directly from the reclamation plant. The direct use of reclaimed water

as it comes from the reclamation facility ensures compliance with disinfection requirements, without the need to implement any additional disinfection process at the point of use, and provides a more stable and controlled physico-chemical quality, as water quality is not affected by biological processes taking place over time in the storage facilities or by external microbial contributions from wild or introduced animals. Analytical information provided by the reclamation agency can be directly used to closely manage the irrigation and fertilization systems. Stored water can be used sporadically, when additional flows are necessary, or when reclaimed water quality has to be modified by mixing to conform to a given fertilization strategy.

The basic observation obtained by GTC from all the golf course irrigation projects under its supervision is the need to "get back to basic agronomic principles".

To promote that approach, it is necessary that agencies and service companies in charge of water reclamation: 1) expand their operation and maintenance programs from conventional wastewater treatment facilities and into water reclamation plants, 2) take a leading role in developing and providing relevant information on reclaimed water quality, and 3) favor integrated management of water resources, beyond the plants territorial boundaries and into their watershed limits. By a continuous evaluation process of the results obtained, in close collaboration with reclaimed water user, it will be possible to promote and optimize the use of reclaimed water, while further advancing simultaneous recycling of water and nutrients, and diminishing fertilizers inputs to the natural environment.

### **Benefits and Requirements**

The most obvious practical benefit of using reclaimed water for golf course irrigation is water supply reliability. However, some of the golf courses still feel comfortable with the conventional sources they have, even if water quality poses real challenges due to its salinity or its seasonal availability. Increasing

appreciation of the supply reliability of reclaimed water, particularly in the context of recent supply restrictions, is gradually changing the traditional approach, and convincing golf course managers on the benefits derived from expending close to 10,000 euros annually to cover the cost of a reclaimed water supply. Although that figure is still higher than that associated to certain conventional water sources, it becomes certainly more favorable when water supply reliability is taken into consideration.

Nutrients contributions are perceived by reclaimed water users as an added benefit, as they may add up to 30% of all the nitrogen needs, which amounts to annual savings close to 10,000 euros for a 18-hole golf course. This fact poses a serious dilemma when considering the growing interest of sanitation agencies for incorporating biological nutrient removal in wastewater treatment processes. Nutrient contributions of reclaimed water are seen by green keepers as beneficial by themselves, and also as an added expense for water users, when they are removed during wastewater treatment. The quality of the nutrient species themselves, as compared to those provided by industrial fertilizers, is perceived as an added benefit of reclaimed water. Furthermore, the energy required by the nitrification and denitrification processes could be instead spent on production and transportation of reclaimed water.

The need for improved management of irrigation water quality in golf courses has prompted a larger participation of irrigation specialists, which has indirectly promoted lower water consumptions. Control of soil salinity has become an added concern for irrigation projects, as soil salinity build-up can be induced even by irrigation with the best mountain quality water. Similarly, extensive irrigation of golf course runs, using reclaimed water from conventional activated sludge plants without nutrient removal, has normally resulted in excessive nutrient percolation and potential contamination of nearby groundwater and surface waters.

Two of the main concerns related to reclaimed water use for golf course irrigation are the potential odors generated during sprinkler irrigation, and the potential need for using chemical pest control. Odor prevention can be achieved using reclaimed water of good quality and particularly using adequate design and management techniques for water storage. Golf course irrigation has fewer limitations than a horticultural irrigation project, and allows for a simpler adjustment of wastewater treatment to the quality requirements of the golf course. Although it is well known that reclaimed water alters the life cycles of certain turf pests, there is nothing unusual about them that can not be controlled using well known agronomic practices, as to achieve more effective pest control measures. Streamlining certain administrative aspects of integrated management of water resources, and improving the efficiency of those services will further promote the use of reclaimed water.

Trihalomethanes generation during chlorine disinfection of reclaimed effluent can be adequately controlled using chloramination processes. Soil salinity build-up can be adequately managed taking into consideration rainfall series of up to 8 years; the relative proportion of cations is certainly of higher concern that salinity in general.

### **Future Prospects**

The future prospects for reclaimed water quality are very favorable. The quality of urban water supplies is expected to improve, as a result of the public positive perception of good drinking water quality, the increasing discharge controls in sewerage systems, and the growing concern for environmental conditions of surface water and groundwater. Those same environmental concerns will further improve the levels and reliability of wastewater treatment processes currently applied. As a result, reclaimed water quality will gradually improve, even more so in a relative context marked by the deterioration of other marginal waters. Spanish society is immersed in a dynamic process by which

reclaimed water will gradually gain a more favorable position, up to become a prime resource for landscape and agricultural irrigation. The political will to promote this trend will be a determining factor for its practical implementation.

### Summary

The use of reclaimed water for golf course irrigation does not present any technical problem that can not be solved using well known agronomic principles. The experience gained so far in numerous golf courses in Spain has served to identify the costs involved in its production, the practical ways to use it, and the management strategies applicable to the irrigation and fertilization programs. The overall costs, including nutrient contributions, are

normally affordable when compared to those of conventional water sources. The supply reliability of reclaimed water will become a paramount factor in coming years, as a result of competition among urban and agricultural users. Reclaimed water quality is expected to improve gradually, as a result of advances in water quality of urban supplies, better wastewater treatments, optimized reclamation processes, and deterioration of available marginal water sources. Widespread use of reclaimed water for golf course irrigation will require a profound restructuring of water resources management, and of cultural attitudes of users and the public at large, as well as further improvements in monitoring strategies of reclaimed water quality.

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