A single-stage biological process for municipal sewage treatment in tourist areas

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**Abstract**

This pilot scale study aims to test the effectiveness of an innovative compact biological system (SBBGR – Sequencing Batch Biofilter Granular Reactor) for treating municipal wastewater in tourist areas characterised by intense seasonal water demand and wastewater discharge. The results obtained after a long term operation of 463 days have shown that the proposed system is able to assure average removal efficiencies higher than 90% for COD (chemical oxygen demand), total suspended solids and TKN (total Kjeldahl nitrogen) independently of the influent concentration values and organic loading, which ranged from 0.2 to 5.1 kgCOD/m³·biofilert. d Furthermore, the plant showed a high degree of operation flexibility and stability in response to the organic load variations occurring in tourist areas. In fact, no significant deterioration in the plant’s effluent quality was observed even during a sudden several-fold increase in organic loading. High nitrogen removal efficiencies (80%, on average) were also achieved thanks to the establishment of simultaneous nitrification-denitrification process favoured by the plant’s high biomass concentration and operating conditions. Finally, the system was characterized by an excess sludge production much lower (60–80% lower) than that of conventional biological systems operating without a primary clarifier. An acceptable level of stabilization of excess sludge was also obtained so that a further stabilization process was no longer required.

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**1. Introduction**

Tourist areas are usually featured by a considerable population variation during the holiday season which determines an intense seasonal water demand (Salgot and Tapias, 2004). For example, the Mediterranean region with about 46,000 km of coastline is the world’s favourite holiday destination area, attracting more than one third of global tourist arrivals every year (Borelli and Brogna, 2000). About 40% of all arrives are concentrated during the summer period; moreover, the increase in population within this period does not follow a gradual trend but surges on certain dates.

Population fluctuation in tourist areas affects not only water demand but also wastewater quality and quantity. In fact, in comparison with a typical municipal sewage the wastewater coming from heavily tourist areas is more concentrated in terms of typical pollutant parameters, more variable in terms of both flow and contaminant variation, and less disintegrated in terms of particular matter because of the shorter sewerage system (Odegaard, 1989).

A reliable wastewater collection, treatment and disposal system should be implemented in tourist areas since in these areas, especially in coastal ones, the receiving water is not only the area’s main asset, but also its main cause for concern with regard to potential pollution (Orhon et al., 2002; Vaananen and Gavrielides, 1989).

In tourist areas wastewater treatment is usually carried out decentrally by small plants each serving single or group of homes, hotels and other tourist establishments (Christoulas and Andreadakis, 1989). In fact, wastewater collection based on a branched sewer network, whose cost may contribute by more than 60% to the total budget for wastewater management in large systems (Massoud et al., 2009), should be too expensive for coastal recreational areas (such as resorts, hotel restaurants and bars) often located along coastlines at a considerable distance from one another.

Wastewater treatment systems in use in tourist areas, mainly based on extended aeration activated sludge processes, suffer from a series of problems, including shock loads, sludge bulking, absence of regular supervision and maintenance, and flow fluctuations, which may lead to poor effluent quality (Christoulas and Andreadakis, 1989). The situation is particularly critical at the...