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Environmental Protection
Agency

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Low-Tech Alternative to Activated Sludge Promises Big Savings

Ocean Drive Wastewater Treatment Plant
North Myrtle Beach, South Carolina

Prepared by:

U.S. Environmental Protection Agency
Region 4

Introduction

Increasingly, communities are finding it difficult to finance wastewater treatment plants that will meet more stringent effluent limits. For this reason, engineers are seeking low-cost treatment alternatives to the activated sludge process, commonly accepted as the favored process technology.

One such alternative consists of a short-retention time, aerated lagoon followed by an intermittent sand filter. One of these systems is the Ocean Drive Wastewater Treatment Plant located in North Myrtle Beach, South Carolina. To confirm the performance of the aerated lagoon-intermittent sand filter system and to study its costs, the EPA Region 4 Enforcement and Investigations Branch, conducted an intensive three-day, on-site study of the Ocean Drive plant followed by a six-month post evaluation.

Wastewater treated at Ocean Drive plant discharges into Intracoastal Waterway

The Ocean Drive plant, which consists of pretreatment units (screening/grit removal), aerated lagoons, intermittent sand filters, and a chlorine contact basin, occupies approximately 35 acres and discharges treated wastewater into the Intracoastal Waterway (Figure 1). The aerated lagoon component consists of two treatment trains in parallel, each consisting of four cells in series. Each lagoon has a total retention time of five days at design flow. The short retention time and multicellular configuration is required to reduce the effluent TSS and BOD5 caused by algae. Many of these aerated lagoons are in operation as stand-alone units where only secondary effluent limits are in effect.

Effluent from the aerated lagoons is applied in doses to nine intermittent sand filters at a rate of approximately 0.23 m3/m2d (5.6 gpd/ft2). Basically, the intermittent sand filter consists of a bed of sand, approximately one meter in depth resting on a 0.3 m layer of graded gravel though which an under-drainage is placed. (Design details may be found in several EPA publications, EPA 1983,1985.) Such filters provide nitrification and polishing to the lagoon effluent.

The City of North Myrtle Beach is an ocean-front tourist community with seasonal peak wastewater flows occurring during the summer months of June through August. Wastewater originates from non-industrial sources consisting of residential homes, condominiums, hotels, and commercial establishments such as stores, shopping centers, amusement parks, and restaurants. The city operates two wastewater treatment plants-the Ocean Drive plant designed for a flow of 3.4 mgd, and the Crescent Beach plant designed for a flow of 2.1 mgd. The facilities, which were placed into operation in 1986, are practically identical in composition.

In spite of wide seasonal variation, plant performance has been exceptional

The wastewater flow rates at the Ocean Drive Plant reflect the fact that North Myrtle Beach is a resort community. In spite of the wide variation in flow rates, due to seasonal changes in population, plant performance has been exceptional. The plant has, with few exceptions, consistently met the monthly NPDES permit limitations since start up in September 1986. The effluent BOD5 concentrations have been below 5 mg/L, both on an annual basis and during peak summer flows, well within the monthly permit limit of 10 mg/L.

Except on seven occasions when insufficient alkalinity was present and the monthly average ammonia (NH3-N) limit of 2 mg/l (effective March-October) was slightly exceeded, the plant has consistently met the limit. From 1995 through 1997, the effluent NH3-N concentrations averaged 1 mg/l or less, both on an annual basis and during peak summer flows.

Also, the plant showed excellent treatment during the EPA intensive study conducted Sept. 9-11, 1997. The aerated lagoons alone, reduced the influent BOD5 and TSS concentrations from 160 and 185 mg/l to an average of 11 and 6 mg/l, respectively. The average CBOD5 (carbonaceous BOD) in the lagoon effluent was 7 mg/l, indicating that a fraction of the BOD5 is algae. The final effluent BOD5 , TSS, and NH3-N concentrations, after passing through the sand filters and chlorine contact basin averaged 1.6, 1.2, and 1.18 mg/l, respectively. These numbers reflect removals of 99, 98, and 95 percent, respectively.

Only significant operational problem was sand accumulation in chlorine contact basin

The City of North Myrtle Beach employs five people (one wastewater supervisor, one laboratory technician, and three wastewater treatment plant operators) to operate and maintain the city's two wastewater treatment plants. The only significant operational problem at the Ocean Drive Plant appears to be an accumulation of sand in the chlorine contact basin. Although the sand has to be removed on a monthly basis, the condition does not adversely impact plant performance. The top layer of the sand in the filters is scarified on a monthly basis using a tractor and rake. Sludge removal from the aerated lagoons was necessary only after the first ten years of operation.

Ocean Drive Plant's capital costs almost $2 million less than oxidation ditch

The Ocean Drive plant's capital costs were $4.8 million compared with an oxidation ditch's costs at $6.5 million, on the basis of a 1986 present worth analysis. The present worth represents the investment necessary to meet all costs extending over the useful life of the treatment system. For purposes here the useful life is expected to be 20 years.

The capital costs for the Ocean Drive plant included a 1996 upgrade of the preliminary treatment units, replacement of sand for the filters, and the costs to remove sludge from the lagoons. In order to establish the costs of the oxidation ditch based on comparable performance to the Ocean Drive plant (BOD5 <10 mg/l), costs of the oxidation ditch included, in addition to chlorination and dechlorination, sludge drying beds and dual media filters for effluent filtration.

Operational costs for Ocean Drive plant $4.7 million less than oxidation ditch

The total estimated 1986 capital and O&M costs for both types of plants were calculated using EPA criteria (EPA 1980). The facility replacement costs, facility salvage value, and land costs were not included in either analysis. The present worth indexed to 1986 costs were found to be $7.3 million for the Ocean Drive Plant and $12 million for the oxidation ditch.

From the cost data presented, it is clear that the aerated lagoon-intermittent sand filter system is a viable alternative to the oxidation ditch provided that land costs and the cost of suitable sand are not excessive.

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Figure 1

Flow Diagram
Ocean Drive Wastewater Treatment Plant
North Myrtle Beach, South Carolina

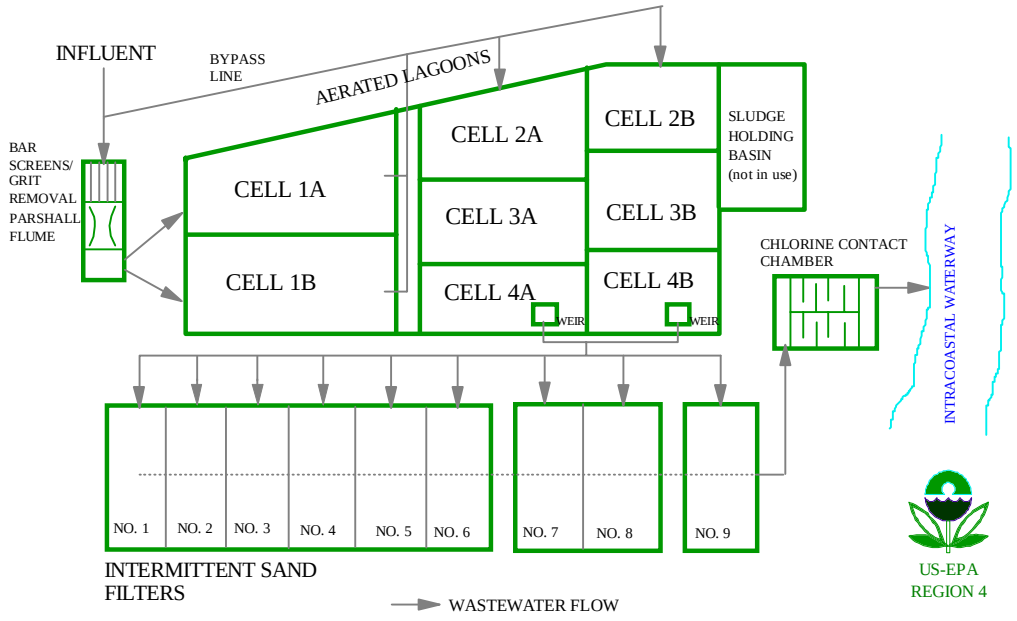
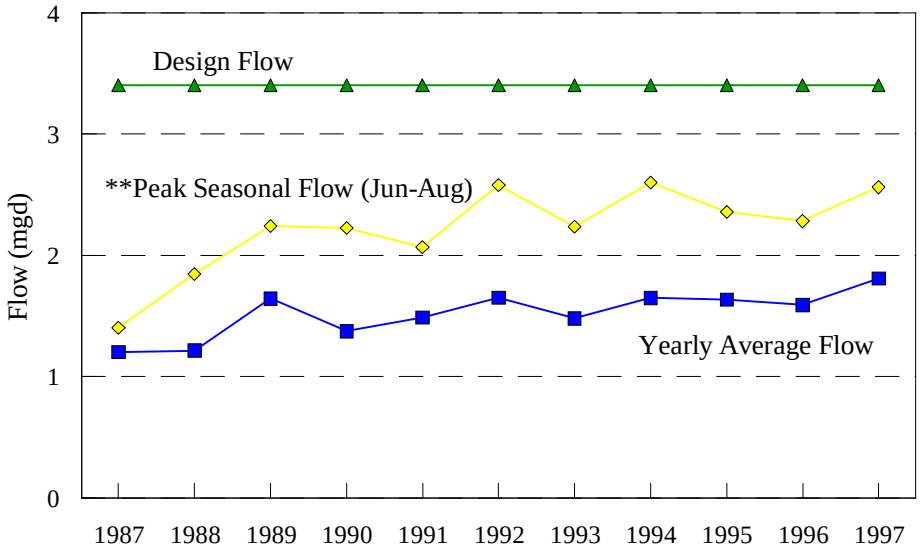


Figure 2

Flow Data (1987-1997)

Ocean Drive WWTP
North Myrtle Beach, SC



** Average flow for June, July, and August.

Figure 3

Yearly Average Effluent BOD, TSS, and NH3-N Concentrations (1987-1997)

Ocean Drive WWTP
North Myrtle Beach, SC

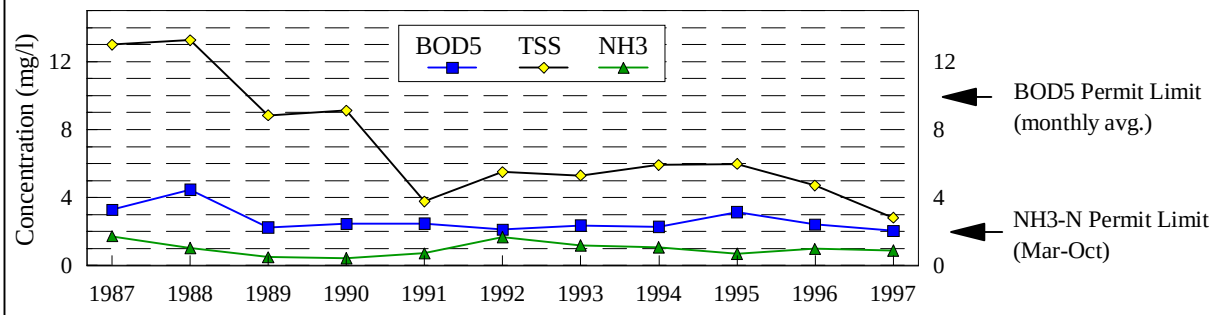
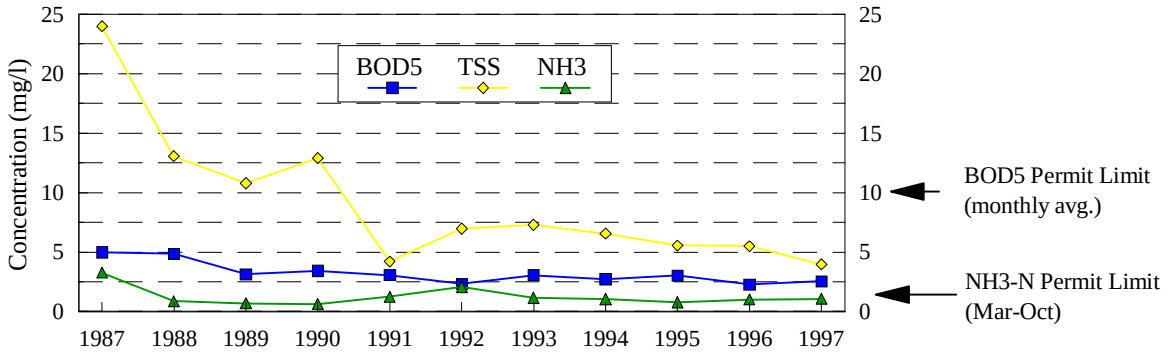


Figure 4

Average Effluent Concentrations During Peak Seasonal Flow (June-August)

Ocean Drive WWTP
North Myrtle Beach, SC



Complete Mix Cell

Intermittent Sand Filters

Sand Accumulation in Chlorine Contact Chamber