



## **Hong Kong's First Tertiary Wastewater Treatment Plant: Protecting A Nature Preserve At A Tourist Landmark**

*By Louisa Leung and Thomas Getting, P.E., BCEE*

### **Background**

The Ngong Ping Wastewater treatment plant treats and then reuses the wastewater generated in the Ngong Ping tourist area in Hong Kong. It is situated in the watershed for the Shek Pik Reservoir and surrounded by country parks. Growth in the collection area is anticipated due to the opening of the newly completed Cable Car System. Other attractions include both the world's largest seated, outdoor, bronze Buddha, named the Tian Tin Buddha and the Po Lin Monastery. This area is considered to be environmentally sensitive due to the water supply catchment and the country parks surrounding the Lantau plateau. In order to protect the watershed water quality, the Ngong Ping Wastewater Treatment Plant utilizes the first tertiary treatment system in Hong Kong. To provide further protection of the watershed, the tributary collection system also collects stormwater from the tourist areas and the wastewater from Ngong Ping village. In case of unexpected high stormwater flows during the rainy season, there is an equalization tank on stand-by where ITT – Flygt ejectors have been installed. The treatment process generally consists of stand-by flow equalization, preliminary treatment, ITT-Sanitare ICEAS sequential batch reactors (SBR), ITT-Leopold dual media filters, ultra-violet (UV) disinfection and final chlorination. The treatment system reduces organic pollutants, suspended solids, nutrients, and pathogenic organisms to very low levels. In keeping with the tourist area the plant has an Information Center to reach out to the public to familiarize them with wastewater treatment.

To minimize the visual impact, a substantial portion of the facility is underground with the aboveground buildings designed to match the architecture of the other tourist facilities. The plant is located directly behind the terminus of the cable car system, so the facility is one of the first structures that tourists see when arriving by the Cable Car system. Due to its proximity to the cable car system and the tourist village, odorous gases generated in the facility are treated by a gas scrubbing system prior to discharge into the atmosphere.



*The Ngong Ping Outreach Center educates the public about the importance of water reuse.*

### **The Treatment Process**

An influent pump station with a coarse screen utilizes ITT-Flygt submersible pumps to pump the influent to the main plant. Preliminary treatment consists of fine screening to remove large objects, vortex grit removal and dissolved air grease removal.

Secondary treatment utilizes an ITT-Sanitaire Intermittent Cycle Extended Aeration System (ICEAS) Sequential Batch Reactors (SBR). An SBR combines both the activated sludge processes of aeration and the clarification settling into one tank. Unlike other SBR systems, the ICEAS process allows continuous flow, all the time to the units online. The process has three basic sequences, react, settle and decant. The react sequence has periods of aeration and mixing or anoxic reaction according to the nutrients to be removed. The aeration phase uses Sanitaire fine bubble diffusers while the anoxic, mixing phase uses ITT-Flygt mixers. During the settling sequence aeration and mixing are discontinued. This allows solids to settle to the bottom of the tank, forming a treated clear liquid layer on top. The decant sequence removes the treated, clear liquid using an automated, timed-controlled ITT-ABJ Sanitaire decant mechanism. During the entire process influent flow continues to enter the unit and is equally split between all units in operation.



*The effluent pond at the Ngong Ping Sewage Treatment Works prior to water reuse.*

Tertiary treatment uses the ITT-Leopold FilterWorx® dual media filters for gravity, downflow particulate removal. The dual media consists of silica sand under anthracite coal. The media is placed on top of reverse graded support gravel and the Leopold Type S® Universal® dual parallel lateral underdrain. The anthracite acts as a roughing layer because the grain size is larger than the sand. The smaller grain size sand is the polishing layer removing the smaller particles. This arrangement is ideal for extending filter runs compared to a filter with only the small grain size sand. When the particles accumulate enough to increase headloss in the media, the filter is backwashed. Air and water are fed into the Type S® dual parallel lateral underdrain and uniformly distributed across the filter bottom for uniform cleaning of the media. If the media is not uniformly cleaned, dirt accumulates in the filter causing poor water quality and short filter run times.

The final step is ultra-violet disinfection of bacteria and viruses. The disinfection of enteric pathogens occurs when certain wavelengths and a minimum strength of ultra-violet light change the chromosome structure of the micro-organism. This chromosome alteration prevents the organism from reproducing. Since turbidity in the water will block the ultra-violet light, the water must be sufficiently cleaned by the upstream processes to ensure optimum disinfection. This makes granular media filtration an ideal upstream process before ultra-violet disinfection.



*Ngong Ping Village's public rest rooms where reuse water is used to flush the toilets.*

After minimal chlorination, the effluent water is stored in a storage tank prior to reuse. In addition to the standard laboratory testing, a side-stream of effluent continuously flows through a small pond that contains fish. The sustainability of the aquatic life is a final check that the effluent water is acceptable for use.

### **Operations**

The system has been in operation for over two years. The operations staff reports that effluent Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are consistently less than 5 mg/L. Currently all of the effluent water is reused. A portion of the effluent is applied to gardens and planted areas around the tourist area. The remainder is used for toilet flushing for the public restrooms in the tourist area. A public restroom was constructed specifically to use the reuse water for toilet flushing.

### **Public Outreach**

The treatment facility has a building specifically devoted to public outreach. Called the Ngong Ping Sewage Treatment Plant Information Centre, it contains both static and interactive displays that describe the treatment process in Chinese and English. The Centre is open to the public and is free-of-charge. When visiting the sitting Buddha and tourist area, a visit to the Information Centre is highly recommended.



*The authors, Louisa Leung and Tom Getting visit the Ngong Ping project site.*

### **About the Authors**

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