Case 4: Wastewater Treatment and Reuse for Golf Course Irrigation in a Large Beach Resort in Punta Cana, Dominican Republic

General aspects Punta Cana (Dominican Republic) is the main tourist destination in the Caribbean with over 40 resorts and hotels located on the seashore. Their size varies from 300 to 2 000 rooms and the water consumption of one complex is close to that of a small town of 10 000 to 20 000 inhabitants.

PROAMSA, a group of companies, which provides services in the area of wastewater treatment, including design, construction, operation and maintenance, was hired in 2012 to refurbish the treatment plant of a large resort that was not working properly.

Planning aspects The engineering team decided to perform a detailed evaluation of all the components of the existing plant to determine the main problems and to identify improvement measures. Figure 1 shows the company's approach to solve the problem. During the evaluation of the existing system, the following problems were identified:

- There was no historical data about operation and control parameters
- Screens at the inlet works were not working
- Flow was not evenly distributed among the components
- Gas and liquid phases were not properly separated within the anaerobic reactors
- High concentration of algae in the effluent
- Low global treatment efficiency (only 45% reduction of organic matter)

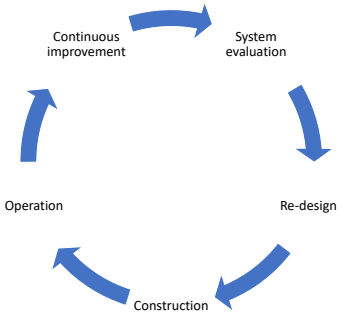

Figure 1: *Project cycle for the evaluation and improvement of an existing wastewater treatment system*

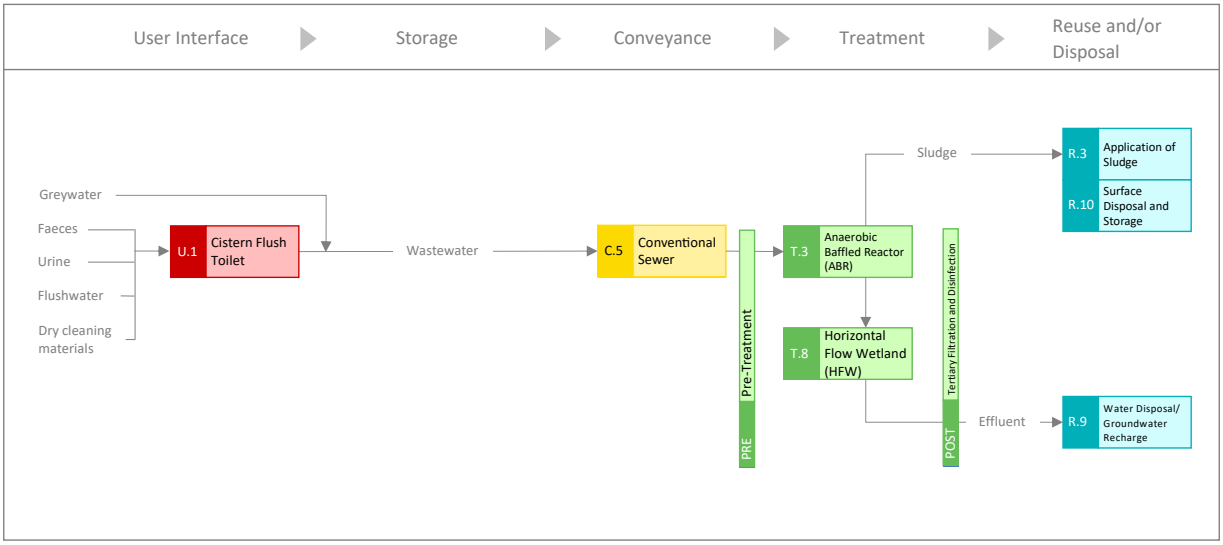

Figure 2: *Sanitation system for collection, treatment and reuse of wastewater generated in a beach resort*

Technical aspects The treatment system consists of the following components:

Collection network (C.5): This includes all the pipes and pumping stations to collect and transport blackwater from all sanitation services (bathrooms including flush cistern toilets, showers and sinks) of the resourt as well as from all the restaurants in the complex.

Preliminary treatment (PRE): Fixed screens installed at the inlet works of the plant that separates water from large solids that might have been collected in the sewer network.

UASB Reactors (T.12): Four Upflow Anaerobic Sludge Blanket Reactors in parallel, which digest organic matter present in wastewater.

Stabilisation ponds (T.5): Two facultative ponds and two clarification ponds.

Chlorination unit (POST): It is part of the post-treatment. The chlorination unit injects chlorine gas into the effluent for pathogen reduction.

Golf course irrigation (R.4): This is the irrigation system for a golf course in the same resort. The treated effluent is directed to lakes located in the golf course and then pumped for irrigation, using a sprinkler system.

Figure 3 shows the layout and main components of the sanitation system at the resort.

The sanitation system for the resort collects, conveys, treats and reuses a total flow of 4 000 m^3 of water per day. The wastewater is basically from domestic activities that take place in the residences (hotel rooms) and restaurants of the complex. Based on water samples, it was determined that the following concentrations of organic matter in the suspended solids were: BOD_5 = 399 mg/l and TSS = 200 mg/l.

After evaluating all of the components, it was decided to perform the following improvements to the system:

- All screens were repaired and adjusted, according to the local conditions
- UASB reactors were modified to insure proper hydraulic retention times, good phase separation (liquid/gas) and even flow distribution among them
- The flow in the stabilisation ponds was improved to avoid dead zones (areas with stagnated water)
- The filtration system (post treatment) was rehabilitated and the chlorine gas disinfection system was replaced by a new one that uses chlorine in liquid form.

Additionally, the algae count was significantly reduced once the treatment plant was operating in its new condition (See Table 2) and the water lakes in the golf course where the treated effluent is discharged improved visibly, changing from green colour due the excess of algae to blue (See Figure 5).

Success factors and lessons learned The efficiency of the UASB reactors at the initial evaluation of the system was as follows: BOD_5 18% - 45%, COD 12% - 45% and TSS 25% - 45%. After all the improvements were implemented, the efficiency rose to BOD_5 67%, COD 65% and TSS 70%. These efficiencies are congruent with typical efficiency ranges reported in the literature for UASB reactors of 65% - 75%.

There are thousands of wastewater treatment plants that have been built in the last 20-50 years in Latin America and the Caribbean that are not operational. This case demonstrates that old infrastructure can be refurbished, updated or improved to provide efficient treatment.

References & Further Reading

can be found on page 263

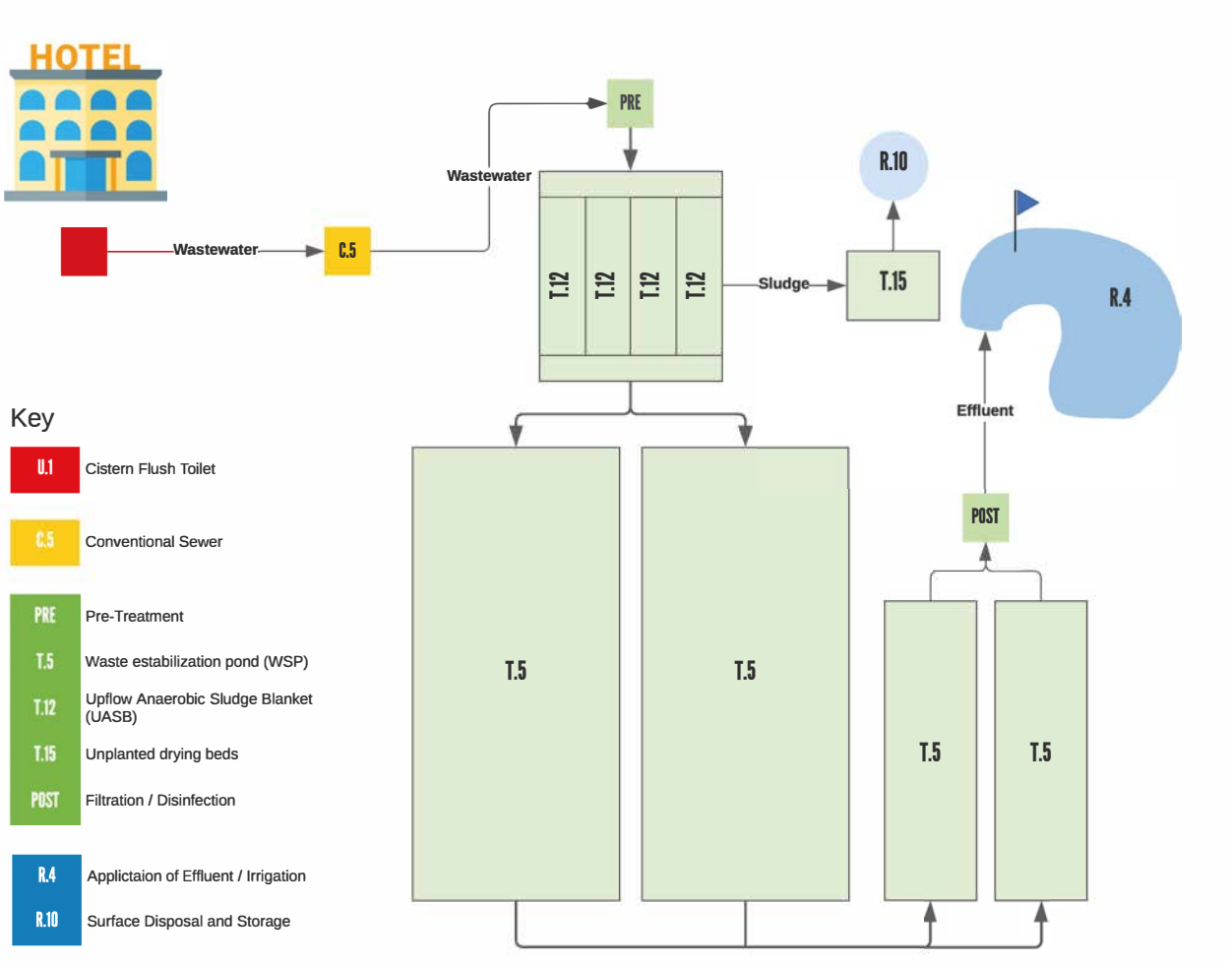

Figure 3: *Layout and main components of the wastewater treatment system at the resort*

Table 1 presents characteristics of waste water before and after treatment and highlights the positive impact of the retrofitting and improvements in the system performance of the 4 UASB of the treatment plant.

Tab. 1: *Summary of monitoring parameters before and after the improvements*

Parameter	Avg. value before improvements	Avg. value after improvements	Limit according to local standards
BOD_5 [mg/l]	56	26	35
COD [mg/l]	202	96	130
TSS [mg/l]	170	43	40

Tab. 2: *Algae count in lakes before and after the improvements*

Algae type	Algae count before improvements	Algae count after improvements
Chlamydomonas sp.	81 680,000	30 000
Spirulina sp.	20 000	0
Euglena sp.	10 000	0
Chorella sp.	80 000	7 500

Figure 4 shows some of the construction works and retrofitting that took place to improve the performance of the 4 UASB of the treatment plant.

Figure 4: *Improvements in UASB reactors for higher treatment efficiency*

Figure 5: *Improvement in the quality of water in the lakes*