TREATMENT BEVERAGE WASTEWATER USING BIOLOGICAL TECHNOLOGY

ABSTRACT
Wastewater treatment plant (WWTP) of Beverage Kirin Acecook Co. with capacity 380 m$^3$/day was designed and constructed by using anaerobic treatment process UASB and aerobic biological treatment Aerotank. The results of all important parameters treated by UASB in outlet wastewater are over 90%, showing the outstanding advantages of UASB technology. Accompanied with Aerotank, the outlet wastewater meets the standard A level, TCVN 5945:2005 at all investigated parameters.

Keywords: Beverage wastewater, Anaerobic tank (UASB), Aerotank

1. INTRODUCTION
The WWTP of the Beverage Kirin Acecook Co. is used to collect and treat two types of wastewater: beverage wastewater from manufacturing processes and sewage wastewater from activities of workers in the company factory. Because the major products of Kirin Acecook are milk jasmine juice, milk peach juice and milk tea, the main components of wastewater from manufacturing processes of Kirin Acecook Co. are ingredients with low concentration produced from equipments’ washing process, from permitted leaks of equipments, or even from preservation and transportation processes. Besides, manufacturing wastewater contains a small part of wastewater from boiler, from air conditioners, as well as leaked oil from engines. Therefore, if wastewater from toilets is separated, the major pollutants of wastewater of Kirin Acecook Co. are milk and other ingredients in manufacturing processes (which occupy 90% of BOD concentration). As the matter of fact, the most important parameters of wastewater from Kirin Acecook Co. are BOD, COD, Suspended Solids SS, Nitrogen, and Phosphor.

In general, wastewater with high BOD concentration is a good condition for the development of microorganisms, causing the severe DO shortage. The initial pH of manufacturing wastewater of Kirin Acecook Co. is neutral to alkaline, but it tends to acidic fast and completely due to the fermentation of lactose to lactic acid, causing the precipitation of casein. This is the reason why wastewater of Kirin Acecook needs to be adjusted pH before the biological treatment processes.

Because the inlet wastewater of the WWTP of Kirin Acecook is the combination of beverage wastewater and domestic wastewater with high organic matters concentration, the compatible treatment process is the aerobic biological treatment and the anaerobic treatment. After treated by mechanical treatments (coarse screens, comminitor) and physico-chemical treatment (pH adjustment), wastewater is treated by the aerobic biological method with 80% of BOD and COD removal performance, and then by the anaerobic biological method with 50% of the BOD and COD remains.

Comparing to the aerobic biological treatment, the anaerobic treatment process has many outstanding advantages, such as: low energy consumption, low sludge production, ability of treat
wastewater with high organic matters concentration and low nutrients concentration. Therefore, the anaerobic treatment process is suitable to wastewater with high BOD and COD.

Until now, there are many kinds of the anaerobic treatment process, for instance: Upflow Anaerobic Filter-UAF, Downflow Stationary Fixed Film-DSFF, Upflow Anaerobic Sludge Bed-UASB, Anaerobic Fluidized Bed-AFB, etc. UASB is the selected treatment process for the WWTP of Kirin Acecook Co.

After the anaerobic biological process, the remains of pollutants in wastewater of Kirin Acecook are then treated by the aerobic biological process by Aerotank. All steps of investigation and operation of Kirin Acecook Co. are described and summarized in this paper.

2. MATERIAL AND METHODS

2.1 Material

Activated sludge used in hospital WWTP was taken from stable aerotanks in other WWTPs which have the similar characteristics.

Wastewater described in this paper is textile wastewater from Beverage Kirin Acecook Co. (My Phuoc 2 Industrial Park, Ben Cat, Binh Duong, Vietnam).

2.2 Methods

2.2.1 Treatment process

Wastewater from drainage system of company flows to Pump sum (Ø 800mm) with installed Coarse screen in order to remove all coarse grits. Another Ø 90mm pipeline is used to pump concentrated water to Concentrated water tank. Wastewater from the pump sum and the concentrated water tank is pumped to Communitor to remove all garbage larger than 2 mm.

Wastewater then flows to Equalization tank with submersible mixers in order to adjust capacity as well as pollutants concentrations. After going to the equalization tank, wastewater is pumped to pH adjustment tank to keep the constant pH of wastewater before biological treatment process.

In Anaerobic tank (UASB), dissolved organic matters are discomposed by anaerobic microorganisms. They are converted to biogas (approximately 70 – 80% of CH₄, 20 – 30% of CO₂). Bubles from anaerobic process attach to sludge and rise to the surface of mixed liquor, making the partial circulation inside the sludge. The BOD and COD removal performance might reach to 70 – 90%.

After going to the UASB, wastewater goes to Aerotank. In the aerotank, dissolved and undissolved organic matters are converted to sludge flocs – aerobic microorganisms community – which are settleable under gravity.

The mixed liquor including activated sludge and wastewater flows to Clarifier, which has function to separate sludge and wastewater. SS concentration of sludge after settled is 8000 – 12000 mg/L. A part of activated sludge is returned to the biological tank (25 – 75% of capacity) in order to maintain the biological concentration and MLSS.
Wastewater after biological treatment process contains a lot of bacteria. Therefore, wastewater is disinfected by sodium hypochlorite (NaOCl) in Disinfection tank. Wastewater after disinfection treatment meets the outlet standard A level, TCVN 5945-2005.

Sludge from the bottom of the UASB tank and the clarifier is pumped to Thickening tank and treated by Sludge filter press. Sludge after pressed can be discarded in landfill.

Figure 1: Diagram of the beverage WWTP

2.2.2 Investigated parameters and sample collection methods

To find the treatment performance of each system, these factors were investigated: COD, BOD₅, TSS, total Nitrogen and total Phosphor. Here is the way to collect samples: 500 ml glass bottles were used to collect effluent sample from each stage of treatment. Duplicate samples were collected and stored in a refrigerator. After collection, all the samples were processed in Environmental Engineering Laboratory – Institute of Environment and Resources, Vietnam National University-Ho Chi Minh city.

3. RESULT AND DISCUSSION

The analyzed results of wastewater from the WWTP of Beverage Kirin Acecook Co. were described in Table 1.

Table 1: The characteristics of the influent and the effluent of the WWTP of Beverage Kirin Acecook Co.
Source: Green Tech Co., 05/08/2009
### COD and BOD removal performance

Figure 2 shows the COD removal performance of the beverage WWTP. The results express that the COD removal performance of UASB reached to 93.9%. This result is so high and it is over than normal UASB performance. However, because the organic matters concentrations of beverage wastewater are also high, it is necessary to treat wastewater by aerobic treatment process – Aerotank before emitted to the receiving water. The COD removal performance of Aerotank proves that the chosen technology with activated sludge treatment and the coagulation-flocculation treatment is an effectively process (77.6%).

![COD removal performance](image)

**Figure 2: COD removal performance of the beverage WWTP**

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\% \text{COD}_{\text{treated}} = \frac{\text{COD}_{\text{influent}} - \text{COD}_{\text{effluent}}}{\text{COD}_{\text{influent}}} \times 100\%
\]
The BOD removal performance is shown in Figure 3, with that of UASB is 96.0%, and that of Aerotank is 80.5%. After going to UASB and Aerotank, BOD concentration in the outlet meets the standard A level, TCVN 5945:2005.

![BOD removal performance](image)

**Figure 3: BOD removal performance of the beverage WWTP**

### 3.2 Suspended solids removal performance

![SS removal performance](image)

**Figure 4: SS removal performance of the beverage WWTP**

Figure 4 shows the suspended solids removal performance of the beverage WWTP of Kirin Acecook Co. is very high (91.6% in UASB and 76.2% in Aerotank). The SS concentration in outlet wastewater is lower 10 times than SS concentration in the required standard (5 mg/L comparing to 50 mg/L).
3.3 Phosphor removal performance

![Phosphor removal performance](chart)

*Figure 5: N-NH₃ of the beverage WWTP*

The performance of total P removal is 40% in UASB and 91.7% in Aerotank. The P concentration of outlet wastewater is 0.5 mg/l, meets the standard A level, TCVN 5945:2005.

4. CONCLUSION

- The beverage WWTP of Kirin Acecook Co. with capacity 380 m³/day designed and constructed by Green Tech Co. has shown the effective efficiency in beverage wastewater treatment. All investigated parameters have been treated to meet the standard A level, TCVN 5945:2005.

- The WWTP of Kirin Acecook Co. also expresses the operation effectiveness of UASB, with all pollutants removal performances are higher 90%.

REFERENCE
