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# IMPROVED SEPTIC TANK, A PROMISING DECENTRALIZED WASTEWATER TREATMENT ALTERNATIVE IN VIETNAM

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## Abstract

The septic tank is the most frequent wastewater pre-treatment mean applied in Vietnam, as well as in most South-East Asian countries. Unfortunately, in practice, the septic tanks installed in Vietnam show low treatment efficiencies and thus don't contribute as expected to the protection of the urban environment. The goal of this study was to examine possibilities to upgrade conventional septic tanks for the treatment of toilet wastewater (blackwater), modifying their configuration by introducing vertical in-tank baffles. The improved septic tank is also called "baffled septic tank" – BAST. Stable average removal efficiencies of 58...76%, 47...61%, and 61...78% in terms of COD<sub>t</sub>, COD<sub>f</sub> and SS, respectively, could be reached, depending on the HRT in the BAST. Reference experimental conventional septic tank had much lower average removal efficiencies of 48-65%, 33-54%, and 44-69% in terms of COD<sub>t</sub>, COD<sub>f</sub> and SS, respectively. Decentralized wastewater management opens up opportunities for greater flexibility and innovation in technological options and service provision. In our case, the baffled septic tank (BAST) proved to be a promising solution. A HRT of 2 days is recommended for design of BAST systems consisting of an equalizing/settling chamber, followed by 2 - 3 up-flow chambers in series. Average removal efficiency of 70 – 80% for BOD, COD and SS can be achieved.

**Key words:** Anaerobic, baffled septic tank, COD, removal efficiency, SS, Vietnam, wastewater.

## 1. Introduction

### *Septic tank in Vietnam – an institutionally well accepted technology with low treatment efficiency*

The septic tank is the most frequent wastewater pre-treatment mean applied in Vietnam, as well as in most South-East Asian countries. The septic tank is a watertight, covered receptacle designed and constructed to receive domestic wastewater in which two processes take place: settling of the solids, and the digestion of some of the accumulated solids by anaerobic action. Unfortunately, in practice, the septic tanks installed in Vietnam show low treatment efficiencies and thus don't contribute as expected to the protection of the urban environment.

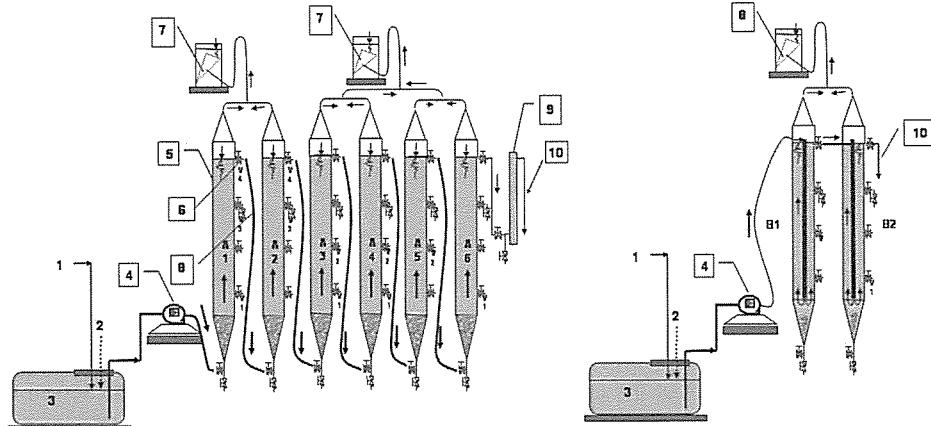
### *Research on baffled septic tank*

The goal of this study was to examine possibilities to upgrade conventional septic tanks for the treatment of toilet wastewater (blackwater), modifying their configuration by introducing vertical in-tank baffles.

## 2. Materials and methods

Two laboratory-scale treatment units were installed, using 6 plastic cylinders to simulate up-flow chambers of the baffled septic tank (BAST, reactor A), and 2 plastic up-flow cylinders to simulate 2 settling columns as in the conventional septic tank (reactor B) as illustrated in Figure 1. The baffles in

the baffled reactor ensure optimum contact of wastewater and sludge in the bottom of the reactor. The reactor columns, with a height of 1.5 m and a 20-cm diameter ensured appropriate hydraulic patterns of the up-flowing wastewater, where especially short-circuits of the wastewater could be avoided. The units were fed continuously at the same flow rate throughout the day using peristaltic pumps. 3 units of gas volume digital counter were used for measuring the biogas volume generated.

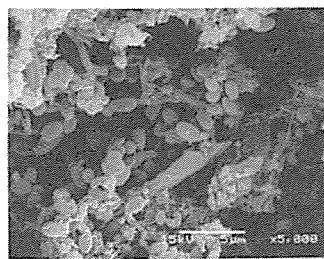


**Figure 1.** Baffled septic tank A and reference conventional septic tank B.

This paper presents results from Nov. 2004 – Apr. 2005, whereas the hydraulic retention time (HRT, 12 - 72 hours) and the number of baffles (up to 6 baffles) were varied. Toilet wastewater was used as wastewater source for this study. Total COD in raw wastewater was kept at approximately 500 mg/l. SS values in the feeding wastewater were in a range of 151 – 618 mg/L.

### 3. Main findings and discussion

Sludge samples from column A1 were taken for Scanning Electro Microscope (SEM) analysis. Figure shows clear presence of methanogenic bacteria, mostly *Methanococcus* and *Methanosaerina* spp.



**Figure 2.** SEM of BAST sludge, x 5,000 enlargement.

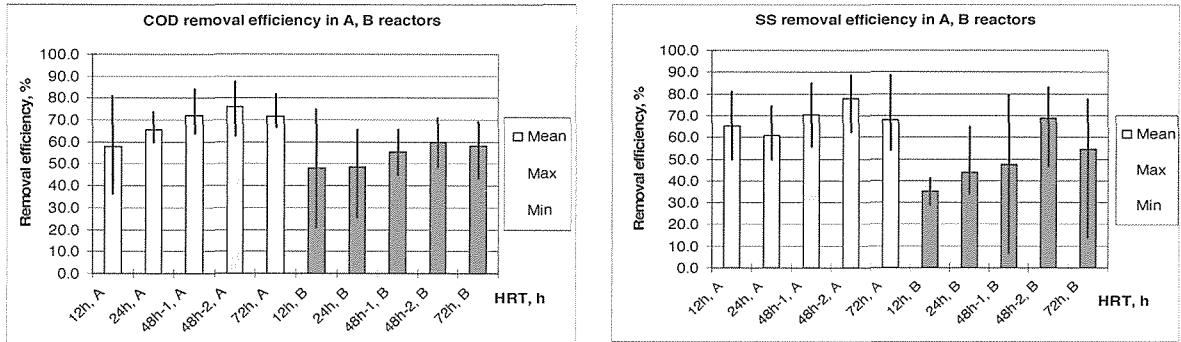
#### Removal efficiencies

Stable average removal efficiencies of 58...76%, 47...61%, and 61...78% in terms of COD<sub>t</sub>, COD<sub>f</sub> and SS, respectively, could be reached, depending on the HRT in the BAST. Septic tank B had much lower average removal efficiencies of 48-65%, 33-54%, and 44-69% in terms of COD<sub>t</sub>, COD<sub>f</sub> and SS, respectively.

#### Impact of HRT

The experiments revealed that in the range of 12...48h, an increase of the HRT led to an increase of the removal rates (in terms of COD, COD<sub>f</sub> and SS). Additional increase of HRT above 48 hours did not significantly increase the removal efficiency, neither in terms of COD, COD<sub>f</sub> nor in terms of solids

removal. Increase of HRT also seems to enable stabilization of the treatment process, as the standard deviations of the COD, COD<sub>f</sub> and SS removal rates indicate.

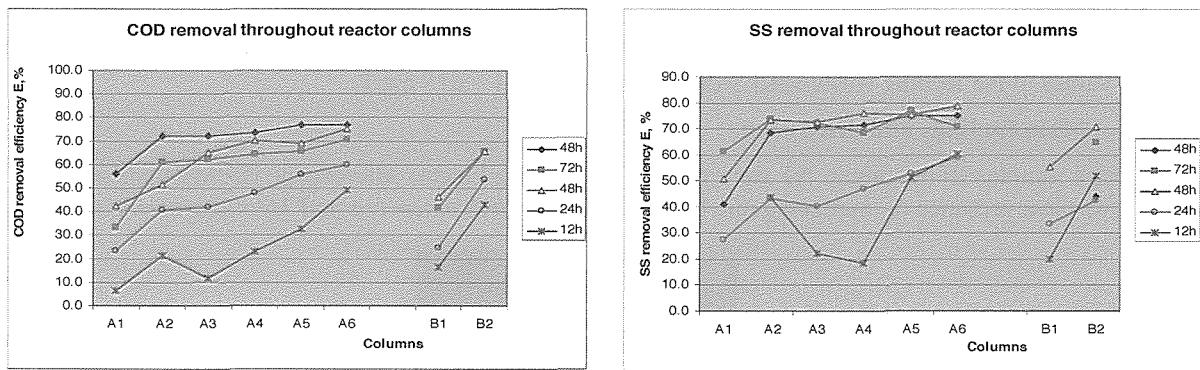


**Figure 3.** (a) COD and (b) SS removal efficiencies in reactor A and B

Based on these findings, an effective HRT of 48h is recommended. This value is identical with the worldwide recommended HRT for conventional septic tanks. This means the baffled reactor can give higher removal efficiencies than the conventional septic tank with the same construction volume.

#### *Impact of number of chambers*

An increase to more than 4 up-flow chambers at the optimal HRT = 48h did not lead to any significant increase of removal efficiencies, as figure 4 is illustrating. Taking economical and O&M considerations into account, 2 - 4 chambers are recommended for baffled septic tank configuration.



**Figure 4.** Cumulative (a) COD and (b) SS removal efficiency along the reactor's length

## 4. Conclusions

Decentralized wastewater management opens up opportunities for greater flexibility and innovation in technological options and service provision. In our case, the baffled septic tank (BAST) proved to be a promising solution. A HRT of 2 days is recommended for design of BAST systems consisting of an equalizing/settling chamber, followed by 2 - 3 up-flow chambers in series. Average removal efficiency of 70 – 80% for BOD, COD and SS can be achieved.

*(Contact DESA team for update information on BAST experiments in 2005 – 2006 period).*

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