



**TREATMENT  
TECHNOLOGIES®**

NATURAL TREATMENT SYSTEMS

By: **Lloyd Rozema, M.Sc.**

**104-155 Main Street East, Suite # 227, Grimsby, Ontario L3M 1P2**

**phone: 905-327-4571**

**Fax: 905-563-4025**

**email: lrozema@aqua-tt.com**

---

### **Introduction**

In September of 2002 a single cell Wetland Biofilter System (WBS) for treatment of high strength winery processing water was installed at EastDell Estates Winery (Certificate of Approval # 2295-4ZSKZJ). EastDell Estates is a mid-size commercial estate winery and restaurant that produces both red and white wines.

The purpose of this trial was to determine if a single cell Wetland Biofilter System, operated as a recirculating Anaerobic Stationary Fixed Film (ASFF) reactor, can provide sufficient pre-treatment of high strength winery process water prior to its discharge into a three cell WBS for final polishing and re-use or discharge. Previous installations of the Wetland Biofilter System in Ontario have demonstrated the ability of the systems do effectively and consistently reduce BOD<sub>5</sub> from as high as 1200 mg/L to near laboratory detection limits (appendix 4). The original Letter to the MOE (Stefanos Habtom, Senior Water Engineer, Ministry of the Environment Approvals Branch, Dated November 7, 2001, appendix 2) predicted that if the ASFF reactor can reduce BOD<sub>5</sub> to 350 mg/L it would be suitable for further treatment, to tertiary quality, within the 3 cell Wetland Biofilter already in use for treatment of sanitary sewage at the winery.

Thus the criteria for determining success of this trial is an average BOD<sub>5</sub> effluent concentration of 350 mg/L or below, as defined in the above letter and referenced to in Certificate of Approval # 2295- 4ZSKZJ.

**AQUA Treatment Technologies Inc.**

**104-155 Main Street East, Suite # 227, Grimsby, Ontario L3M 1P2**

**phone: 905-327-4571**

**Fax: 905-563-4025**

**email: lrozema@aqua-tt.com**

## **Section 1.0 - Materials and methods**

### **System design**

The system consists of a new, two-chamber concrete septic tank that provides pre-treatment of winery effluent before application to the ASFF reactor. The ASFF reactor measures 5m X 5m and is 1.2 m in depth. In an effort to maximize treatment efficiency the ASFF reactor was operated as a *re-circulating* Anaerobic Stationary Fixed Film Reactor. The trial began operation on September 24, 2002 at the when grape crushing commenced, and ended November 15, at the end of crush season.

### **Sampling protocol**

Water samples were collected by a third party (Marielle Klijn of ESG International Ltd., St. Catharines, Ontario) twice weekly from three locations: 1) winery effluent i.e. before entering the septic tank; 2) septic effluent and 3) ASFF reactor effluent. The water samples were sent to an accredited laboratory to be analyzed for BOD<sub>5</sub>, suspended solids and total phosphorus; temperature and pH were measured on-site.

## **Section 2.0 - Results and discussion**

### ***Water flow***

Water flow from the winery was measured directly by using an inline flow meter located at the discharge point of the ASFF reactor. The total flow to the system during this trial was 25,560 litres over 50 days. From these data the average flow to the system was calculated to be about 500 L/day. As the data were collected at the height of the winery's crush season this flow represents the average maximum daily flow that can be expected to be generated from this facility. During the course of this trial 3,500 cases of wine were processed. Thus approximately 8 litres of water is required to process one case of wine. The water flow, in litres per day, is shown on the right y-axis of figures 1 - 5.

### ***BOD<sub>5</sub> reduction***

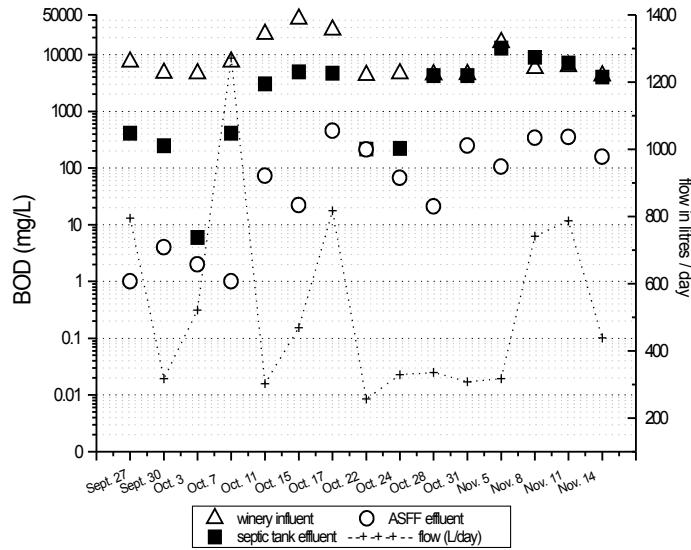
The data show that a 99% reduction of BOD<sub>5</sub> from winery wastewater can be achieved within an ASFF reactor when using a septic tank for pre-treatment. The average winery effluent BOD<sub>5</sub> concentration was 11,112 mg/L. The septic tank reduced the BOD<sub>5</sub> by 65%, to an average of 3,720 mg/L. Treatment within the ASFF reduced the BOD<sub>5</sub> to 136.87 mg/L (Table 1), well within the direct discharge requirements to a leaching bed as outlined in Part 8 of the Ontario Building Code, appendix to Part 8, A-8.13.1 (3).

**Table 1.** Mean and Standard Deviation of various parameters in the winery effluent, septic tank effluent and ASFF effluent from September 26 to November 14 at EastDell Estates Winery, n= 25.

| <b>Parameter</b>        |                      | <b>average concentration</b> |
|-------------------------|----------------------|------------------------------|
| <b>BOD<sub>5</sub></b>  | Winery effluent      | 11,112.0 mg/L                |
|                         | Septic tank effluent | 3,720.27 mg/L                |
|                         | ASFF effluent        | 136.87 mg/L                  |
| <b>suspended solids</b> | Winery effluent      | 1,936.80 mg/L                |
|                         | Septic tank effluent | 412.73 mg/L                  |
|                         | ASFF effluent        | 17.33 mg/L                   |
| <b>Total phosphorus</b> | Winery effluent      | 18.63 mg/L                   |
|                         | Septic tank effluent | 9.21 mg/L                    |
|                         | ASFF effluent        | 0.14 mg/L                    |
| <b>pH</b>               | Winery effluent      | 5.03                         |
|                         | Septic tank effluent | 5.73                         |
|                         | ASFF effluent        | 6.81                         |
| <b>Temperature (C)</b>  | Winery effluent      | 15.74                        |
|                         | Septic tank effluent | 14.18                        |
|                         | ASFF effluent        | 13.91                        |

Figure 1 shows that BOD<sub>5</sub> reduction is relatively intolerant to fluctuating influent concentrations. For instance, in spite of very large fluctuations of BOD<sub>5</sub> winery influent concentrations (from 42,000 to 4,200 mg/L) ASFF reactor effluent concentrations exceeded 350 mg/L only once (see appendix 3).

**Figure 1.** Reduction of BOD<sub>5</sub> from winery effluent by a re-circulating Wetland Biofilter System (operated as an Anaerobic Stationary Fixed Film Reactor) during the 2002 grape crush season at EastDell Estates Winery, Beamsville, Ontario, Canada.

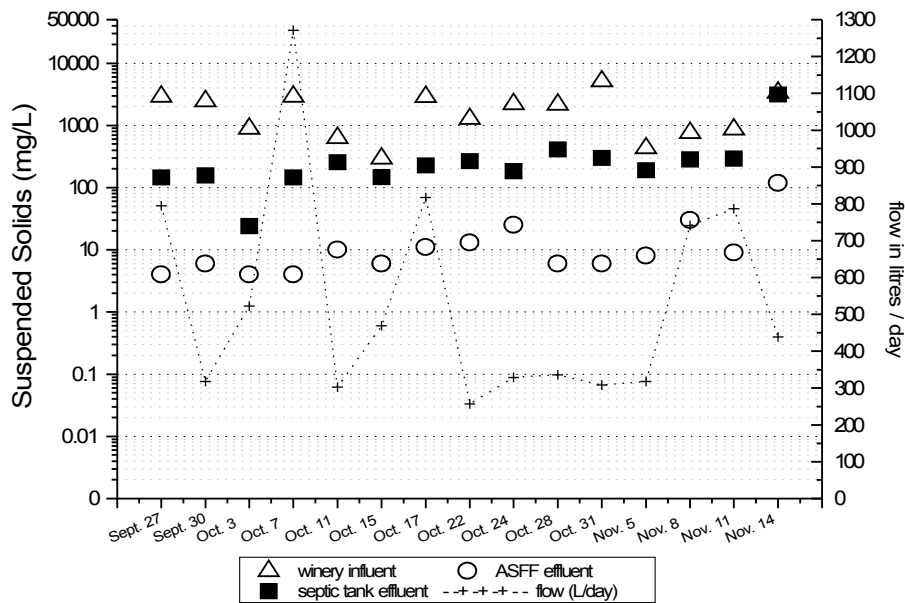


### ***Suspended solids reduction***

Greater than 99% reduction of suspended solids can also be achieved from winery wastewater within an ASFF when using a septic tank for pre-treatment. The average winery effluent suspended solids concentration was 1,936.8 mg/L. The septic tank reduced the suspended solids by 75%, to an average of 412.73 mg/L. Treatment within the ASFF reactor further reduced suspended solids to 17.33 mg/L (Table 1), well within the direct discharge requirements to a leaching bed as outlined in Part 8 of the Ontario Building Code, appendix to Part 8, A-8.13.1 (3).

ASFF reactor suspended solids effluent concentrations (figure 2) are very intolerant to fluctuating influent concentrations. Even though the winery effluent suspended solids concentration ranged from about 300 to 5,000 mg/L, ASFF reactor concentration exceeded 100 mg/L only once (see appendix 3) and was generally below 25 mg/L.

**Figure 2.** Reduction of Suspended Solids from winery effluent by a re-circulating Wetland Biofilter System (operated as an Anaerobic Stationary Fixed Film Reactor) during the 2002 grape crush season at EastDell Estates Winery, Beamsville, Ontario, Canada.

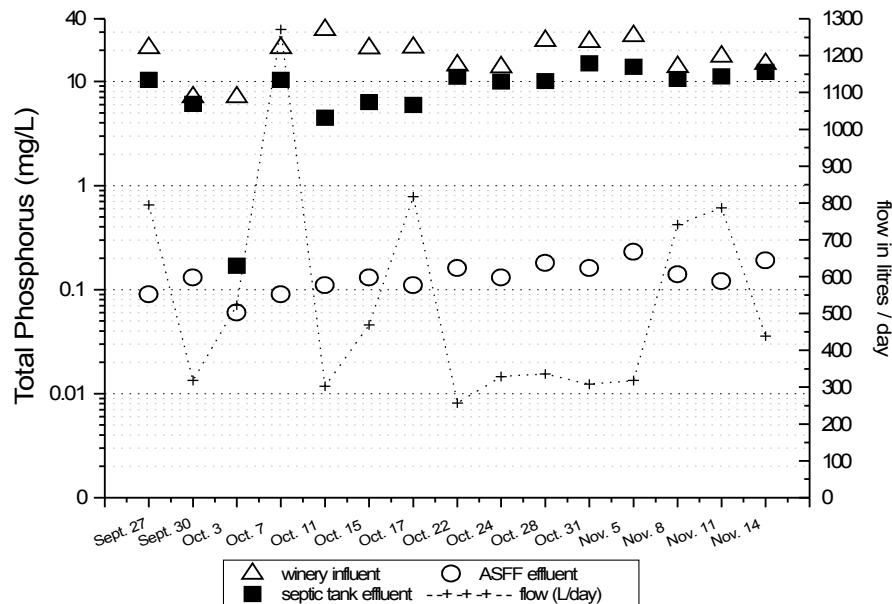


### ***Total phosphorus reduction***

Reduction of total phosphorus by the septic tank/ASFF reactor system was greater than 99%. The average winery effluent total phosphorus was 18.63 mg/L and septic tank concentration was 9.21 mg/L; ASFF effluent concentration was 0.14 mg/L (Table 1). The Ontario Building Code does not impose any phosphorus discharge requirements.

ASFF total phosphorus effluent concentrations remained very stable over the course of this trial, never exceeding 0.23 mg/L ( Figure 3 and appendix 3) in spite of relatively high influent concentrations.

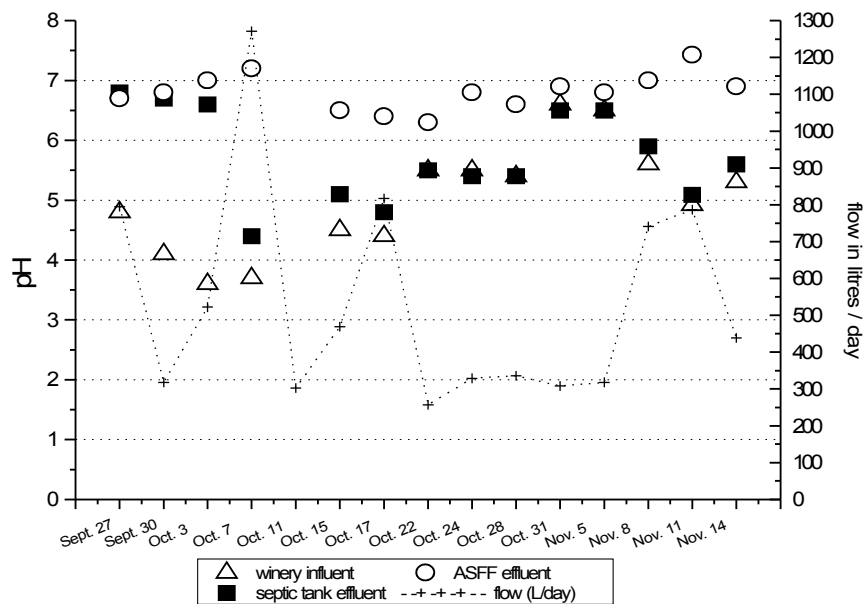
**Figure 3.** Reduction of Total Phosphorus from winery effluent by a re-circulating Wetland Biofilter System (operated as an Anaerobic Stationary Fixed Film Reactor) during the 2002 grape crush season at EastDell Estates Winery, Beamsville, Ontario, Canada.



## pH

The ASFF reactor significantly neutralized the pH of the winery effluent. Average winery influent pH was 5.03, average septic tank effluent pH was 5.73 and average ASFF effluent pH was 6.81 (Table 1). Figure 4 shows that the ASFF effluent pH never went below 6.3 or above 7.5. This phenomenon is likely due to the high calcium and magnesium content of the manufactured sand used in the construction of the ASFF reactor, which acts as a very efficient pH buffering system.

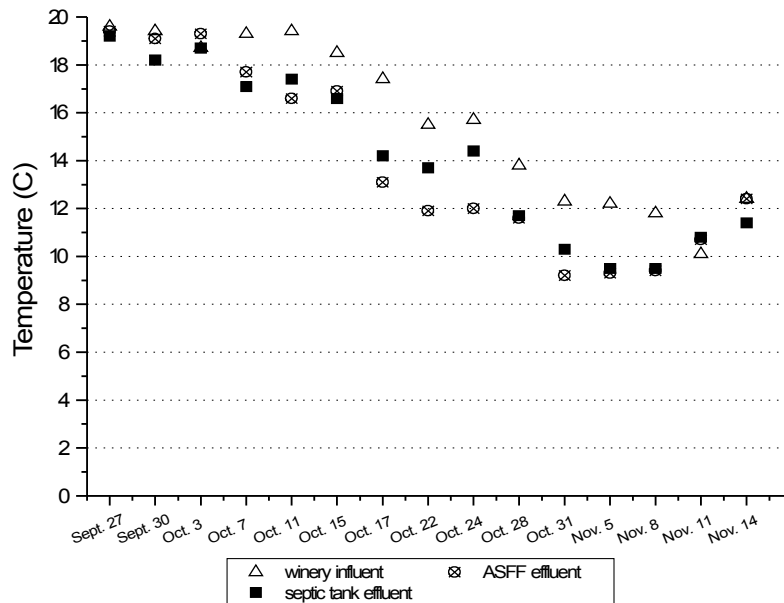
**Figure 4.** Modification of the pH of winery effluent by a re-circulating Wetland Biofilter System (operated as an Anaerobic Stationary Fixed Film Reactor) during the 2002 grape crush season at EastDell Estates Winery, Beamsville, Ontario, Canada.



### Temperature

Previous work done by us on the Wetland Biofilter System has shown that air temperature has little impact on the system performance and that the ASFF reactor cell temperature (= Wetland Biofilter) closely follows that of septic tank effluent temperature. This has also been confirmed in this trial. At the beginning of this trial the water temperature of the winery effluent, septic tank effluent and ASFF were approaching 20 C and at the end of the trial they were between 9-10 C (Figure 5). In spite of this, no real impact on the treatment efficiency of the system can be detected, figures 1-4. Figure 5 also clearly demonstrates the dependence of Wetland Biofilter System (or ASFF) temperature on influent water temperature.

**Figure 5.** Temperature of winery effluent within a re-circulating Wetland Biofilter System (operated as an Anaerobic Stationary Fixed Film Reactor) during the 2002 grape crush season at EastDell Estates Winery, Beamsville, Ontario, Canada.





### **Section 3.0 - Design considerations**

In order to facilitate design of future systems the following design equation, based on actual organic loading data and expressed as **Kg BOD<sub>5</sub>/ m<sup>2</sup> /day** is proposed:

|   |                   |
|---|-------------------|
| actual ASFF reactor size at EastDell Estates: | 25 m <sup>2</sup> |
| average BOD <sub>5</sub> concentration:       | 11,112 mg/L       |
| total measured flow:                          | 25,560 L          |

#### **observed organic loading:**

$$11,112 \text{ mg/L} \times 25,560 \text{ L} = 284 \text{ kilograms of BOD}_5$$

$$284 \text{ Kg BOD}_5 / 50 \text{ days} = 5.68 \text{ kg BOD}_5 / \text{day}$$

$$5.68 \text{ kg BOD}_5 / \text{day} / 25 \text{ square metres}$$

$$= \mathbf{0.23 \text{ kg BOD}_5 / \text{m}^2 / \text{day}}$$

### **Section 4.0 - Conclusions**

1) A single cell Wetland Biofilter System, operated as a re-circulating Anaerobic Stationary Fixed Film Reactor, in conjunction with a two chambered septic tank, can easily provide a level of treatment to winery process water that meets the requirements of the Ontario Building Code for direct discharge into a gravel leaching bed.

2) A single cell Wetland Biofilter System, operated as a re-circulating Anaerobic Stationary Fixed Film Reactor, in conjunction with a two chambered septic tank can be designed to treat winery process to a level suitable for discharge into a conventional 3 cell Wetland Biofilter for additional treatment to tertiary quality and re-use within the winery for toilet and urinal flushing.

3) A single cell Wetland Biofilter System, operated as a re-circulating Anaerobic Stationary Fixed Film Reactor, performed better than predicted in the letter proposal to Stefanos Habtom, Senior Water Engineer, Ministry of the Environment Approvals Branch, Dated November 7, 2001 (appendix 2).