# ANAEROBIC TREATMENT OF THE WASTEWATER IN THE FOOD INDUSTRY

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***Abstract***

*Anaerobic biodigestia can be an option for biological wastewater treatment, being configured as an important energy carrier able to provide both heat and / or electricity and efficient removal of organic pollutants.*

*The system type adopted for wastewater treatment depends on the influent characteristics. During the anaerobic process a part of the organic matter changes into methane, and the other part is digested and reflected in the effluent.*

*This paper keeps up the efficiency of anaerobic biological process carried out in a UASB reactor by processing the collected wastewater from a brewery, a juice factory and a distillery. Taking into account only the step of anaerobic biological treatment can not be obtained the effluent by the conditions imposed by NTPA 001/2005, so it is best combined anaerobic-aerobic treatment of wastewater from food industry.*

**Keywords:** anaerobic treatment , biogas, wastewater of food industry, UASB reactor

## INTRODUCTION

Anaerobic treatment in recent years, taking into account the advantages and disadvantages of the process, turned into biological pre-treatment step.

Anaerobic digestion processes provide organic chemicals because of the biochemical reactions and leads to the formation, of an effluent which cuts pollution also to obtain a new source of green energy: biogas.

About 3% of the organic mass is converted into cellular mass during the anaerobe systems, the rest of 97% being transformed through catabolism in $CH_4$ and $CO_2$ (Hobson, P.N., Wheatley, A.D., 1993), (Kalyuzhnyi, S.V. et al., 1991) .

This process can provide 70-90% reduction of organic substances, mainly dissolved organic substances, which for organic wastewater with medium and high loads provides a significant reduction in the aerobic treatment step.

The following organic waste products can be processed through anaerobe digestion: industrial waste products, slaughter houses, fruit,

vegetables, agricultural biomass (Palmai A., 2000; Minovscky J., Svatopluk C., 2002).

UASB process was developed as an anaerobic treatment system with a high degree of efficiency based on the immobilization of biomass in the form of sludge granules with good settling ability. UASB reactors are completely devoided of support materials.

The influent is distributed through a sophisticated system at the reactor inlet. Production of biogas sludge layer induces a good mixture of sludge with the influent (Sayed, S.K.Y.et al, 1987; Seghezo, L., et al., Review, 1998).

## MATERIAL AND METHODS

A mixture of wastewater from the brewery, juice factory and a distillery after preliminary processing are subjected to the anaerobic biological tratment into a UASB reactor with a volume of 1700 $m^3$.

The distribution system of the influent ensures optimum contact between the biomass and wastewater throughout the whole reactor.

In the reactor the wastewater is subjected of anaerobic biological treatment obtained and biogas. Separators installed at the top of the reactor, separating the treated water and the biogas. The biogas is sent to treatment.

The biogas production will be around 395 $m^3/h$, and the quality of biogas is 20-35% $CO_2$, 65-80% $CH_4$ and other gases.

To determine the efficiency of the UASB reactor was monitored of the influent and effluent quality by determining the following parameters: pH, $CCO_{Cr}$, total nitrogen, total phosphorus.

Determination of pH was performed using a portable pH meter, Hanna Instruments, HI 98127.

Chemical oxygen demand of wastewater was determined by the potassium dichromate method (can be considered as an approximate measure of the theoretical oxygen consumption), which is the amount of total oxygen consumed by the chemical oxidation of organic compounds to inorganic products.

## RESULTS AND DISCUSSION

Monitoring of anaerobic digestion of waste water in the UASB reactor was conducted from January to April 2010.

The characteristics of the wastewater supplied to the anaerobic UASB reactor are presented in Table 1.

*Table 1*

The average values of the main features of the influent the UASB reactor

| Month | pH | COD mg/l | $BOD_5$ mg/l | $N_t$ mg/l | $P_t$ mg/l |
|---|---|---|---|---|---|
| **January** | 4.9 | 4207.2 | 928 | 10.2 | 8.63 |
| **February** | 4.3 | 3121.2 | 790 | 19.8 | 6.46 |
| **March** | 4.89 | 4407.5 | 1017 | 11.08 | 5.20 |
| **April** | 4.65 | 4033.3 | 880 | 9,07 | 4,23 |

The average values of the main parameters in wastewater treatment plant after anaerobic treatment (anaerobic effluent) are shown in the next table.

*Table 2*

The average values of the main features of the efluent the UASB reactor

| Month | pH | COD mg/l | $N_t$ mg/l | $P_t$ mg/l |
|---|---|---|---|---|
| **January** | 6.96 | 810.7 | 3.86 | 3.79 |
| **February** | 7.05 | 649.5 | 9.67 | 4,52 |
| **March** | 7.004 | 967 | 4,63 | 2.24 |
| **April** | 6.92 | 943.3 | 5.56 | 2.75 |

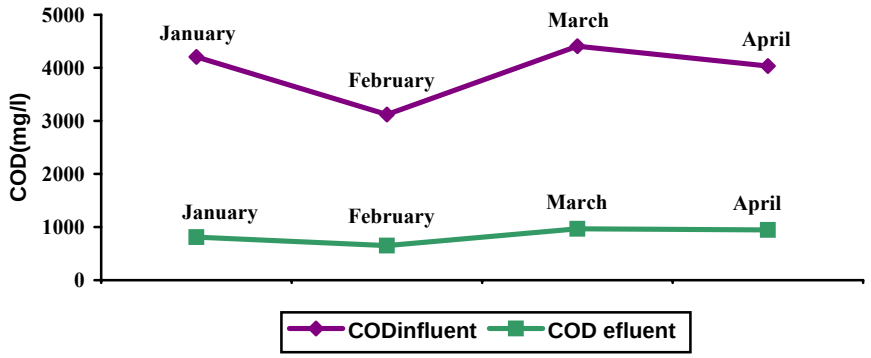


Fig. 1. Average values monthly influent and effluent COD in the UASB reactor

As seen from the chart above the organic pollutant concentration expressed by parameter COD values decreased from: 4207.2 mg/l to 810.7 mg/l, in January; 3121.2 mg/l to 649.5 mg/l, in February; 4407.5 mg/l to 967 mg/l, in March; 4033.3 mg/l to 943.3 mg/l, in April.

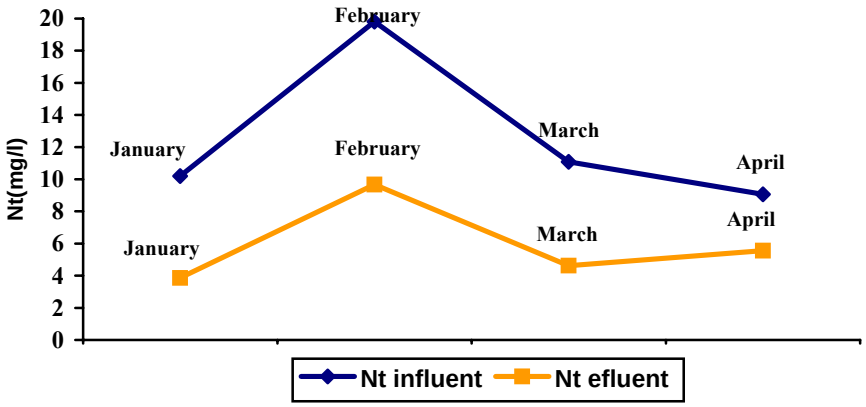


Fig. 2. Average values monthly influent and effluent Ntotal in UASB reactor

Using the anaerobic digestion process has been reduced the total nitrogen concentration, its values falling within the limits imposed by local law, but for large values of the influent total nitrogen concentration was found that this process will ensure a considerable reduction so that this parameter to fall below 10 mg/l.

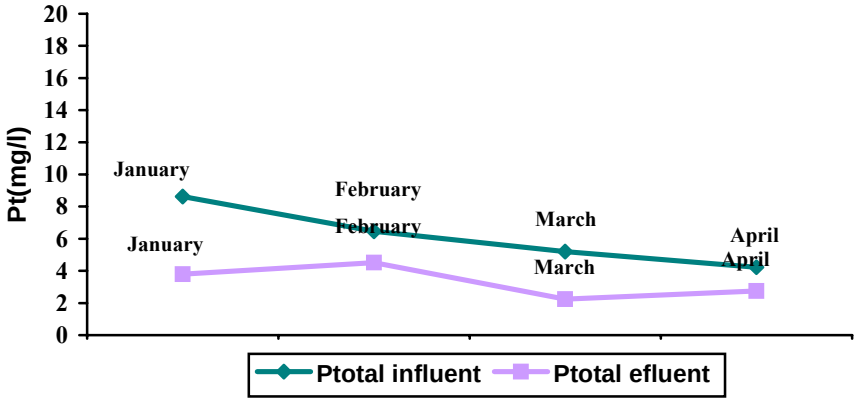


Fig. 3. Average values monthly influent and effluent Ptotal in UASB reactor

By reducing parameter $P_{total}$ through anaerobic digestion in the UASB reactor was not sufficient for the effluent to be discharged directly into the environment while respecting the local laws. It is required a post-stage aerobic biological treatment.

The anaerobic treatment ensures a higher rate to reduce the main pollutants in the wastewater, as shown in Table 3.

*Table 3*

Efficiency of anaerobic process

| Month | COD % | Nt % | Ft % |
|---|---|---|---|
| **January** | 80.23 | 62.35 | 56.58 |
| **February** | 79.71 | 54.98 | 56.75 |
| **March** | 78.18 | 56.60 | 58,43 |
| **April** | 76,03 | 39.18 | 40.95 |

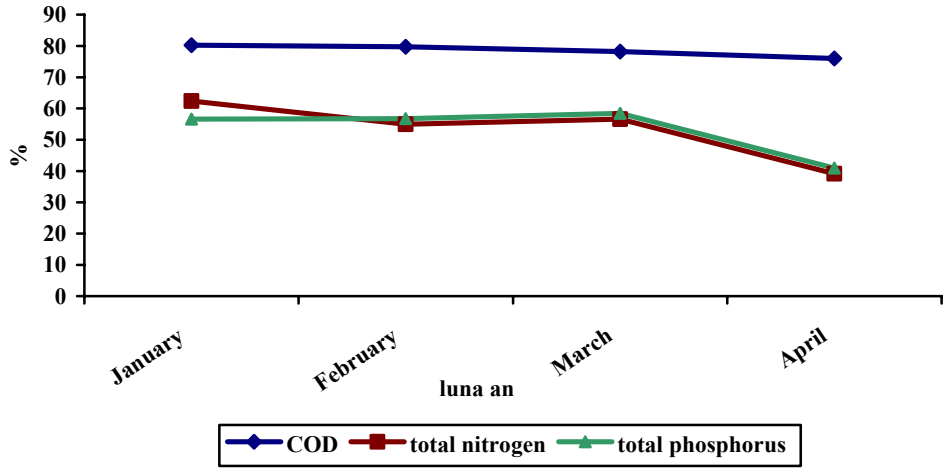


Fig. 4. The efficiency of removal of the main parameters in anaerobic reactor

**CONCLUSIONS**

The monitorisation of parameters, COD, total nitrogen, total phosphorus, lead to the following conclusions:

- concentration of organic substance in influent of the UASB reactor, expressed COD ranged from 3121.2 to 4407.5 mg/l and the effluent from 649.5 to 967 mg/l;
- the efficiency of anaerobic biological treatment reported the parameter COD ranged from 76.03 to 80.23%;
- the removal efficiency ranged from 39.18 to 62.35% for nitrogen, respectively, from 40.95 to 58, 43, for phosphorus;
- this process enables a significant reduction of organic pollutants, expressed by parameter COD, but not sufficient in terms of total phosphorus;
- to achieve the limits imposed by current legislation and this parameters need a post-aerobic biological treatment;

- the amount of biogas obtained is 395 m³ /h containing 80% $CH_4$.(is one of the most important benefits of anaerobic treatment).

If an industrial wastewater generators decide to install a system of anaerobic or aerobic biological treatment, it must take into account:

- anaerobic treatment, not usually lead to low levels of environmental pollution of the legislation, the COD, that can be achieved with aerobic systems;
- anaerobic treatment of waste and wastewater must be considered a pre-treatment process to minimize oxygen consumption and excess sludge formation, followed by aerobic post-treatment. wastewater with high concentrations of organic pollutants is shown to be anaerobically treated as a source of green energy, biogas; Currently, the food industry, is considered to be the most advantageous application of combined treatment of anaerobic - aerobic sewage flow generated by of the technological flow.

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