THE EFFECT OF THE HYDRAULIC RETENTION TIME IN THE ANAEROBIC DIGESTION

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Abstract
This research emphasizes on the most adequate technology for the removal of the polluted factors from the wastewater which comes from the food industry and its purpose is to identify the main techniques and to obtain significant performances as regarding the quality of the effluents. thus reducing the negative effects an inefficient treatment could have upon the environment. The process of anaerobic degradation takes place in two reactors. Each of the two reactors has a total volume of 5 liters. During the process the two reactors were loaded with material which comes from an industrial complex which collected the wastewater from a beer factory. a distillery and a juice factory. The wastewater with an organic charge of 3150 mg/l is loading the reactor. initially at a ratio of 1.5 l/day. then the transit was increased with 1.5l /day.

Key words: wastewater. hydraulic retention time. anaerobic treatment. food industry

INTRODUCTION

The treatment of the residual water in the food industry must be realised so that to ensure the environment protection. That is why it is necessary to introduce some measures and methods which ensure a minimum consume and a maximum recirculation. realized through integrated systems such as: the treatment of the wastewater with the recovery and reuse of the water and of the resulted products (Carawan. Roz E.. 1996).
The treatment of the wastewater from the food industry can be realised through methods based on physical. chemical and biological phenomena. The chosen treatment type depends on the kind of the processed product. on the procession technique. on the nature and concentration of the organic substances. on the necessary degree of treatment. on the climate and sole conditions of the nearby areas etc (Negulescu M. et. al..1987).
The worldwide actual tendency is to adopt procedures of biological anaerobe treatment which. even if consuming energy. are more compact. take into consideration the environment protection and the length of the process is much shorter due to the biological anaerobe techniques.
The biological anaerobic treatment. which was considered at the beginning as a unique biological treatment step. in the last years. due to its advantages and disadvantages. was transformed into a pre-treatment step (Driessen W.. Vereijken T.. 2003). The level of hydraulic charge applied to an anaerobic system influences the stability and performances of the process. being one of its key factors. The necessary contact time in order to realize the biochemical decomposition depends on the complexity of the substratum which has to be treated (Banks. C.J.. Wang. Z.. 1999; Bjornsson. L..et. al.. 2000).

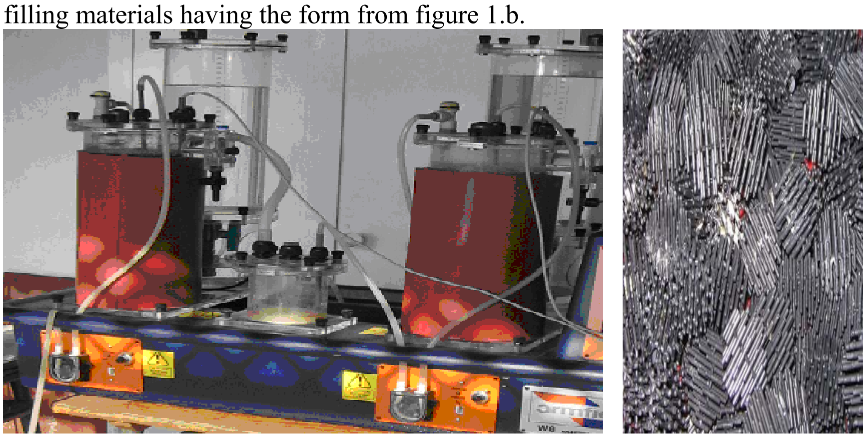
MATERIAL AND METHODS

The specific aims of this research are:

- the supervising of the anaerobic digestion parameters in reactors which are placed in series working with different hydraulic charging rates and different hydraulic retention times;
- the efficiency of the removal of the organic loading expressed by CCO_{Cr} from the wastewater in the food industry.

The process of anaerobe degradation takes place in two reactors (figure 1. a). The laboratory installation is formed of two anaerobe reactors placed in series. each of them having a volume of 5 liters. The use of the anaerobe reactors where the two phases of the anaerobe degradation are separated. where the bacteria develop on inert supports. forming the bio-film. allow a larger period of time to maintain the biomass in the reactor. thus increasing the efficiency of the process. It also increases the stability of the process through the control of the acid phase.

The first filter works as a metabolic blotter. preventing the pH shocks. the high ratios of organic charging (Sachs. J.. et.al.. 2003). A more intense contact between the material which is subjected to the anaerobe process and the anaerobe microorganisms is done by the filling materials having the form from figure 1.b.



a) b)

Fig.1. The working installation (a) and the materials which ensure the support for the development of the biomass (b)

During the process the two reactors were charged with material which comes from an industrial complex which collected the wastewater from a beer factory. a distillery and a juice factory. The wastewater with an organic loading of 3150 mg/l charges the reactor. first at a ratio of 1.5 l/day. then the transit was increased with 1.5 l/day. The working temperature was maintained in the thermofilic working domain (55^{o}C).

RESULTS AND DISCUSSION

During this period. the main indicators of the process were supervised by analysing the tests of the wastewater. The obtained performances in the reduction of the organic charging expressed through CCO_{Cr} (medium values) in anaerobe reactors placed in series and used for the treatment of the wastewater from an industrial complex which produces beer. juice and alcohol and are presented in table 1.

Table 1

The removal ratio of CCOcr according to the ratio of the charging flow of the anaerobe system and the retention hydraulic time.

The ratio of the charging flow (l/day)	HRT (days)	CCO_{Cr} mg/l	CCOcr removed (%)
1.5	3.3	337.05	89.3
2.0	2.5	393.25	87.5
2.5	2.0	466.2	85.2
3.0	1.6	507.15	83.9
3.5	1.4	626.95	80.1
4.0	1.2	667.8	78.8
4.5	1.1	730.8	76.8
5.0	1.0	837.9	73.4
5.5	0.90	926.1	70.6
6.0	0.83	1266.3	59.8

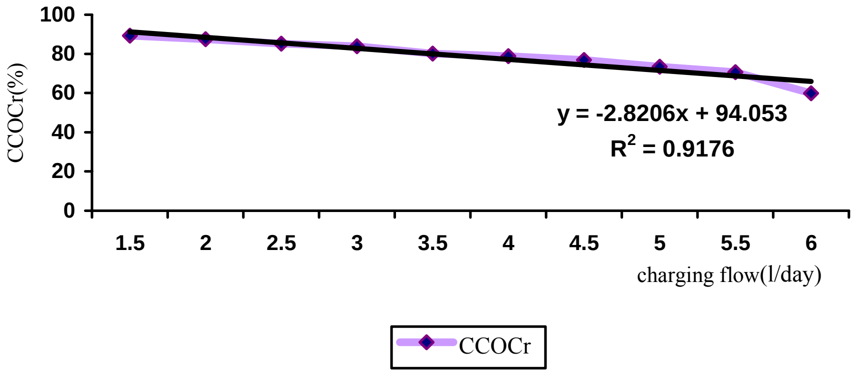


Fig. 3. The ratio of the removed CCOcr according to the ratio of the charging flow

From figure 3 there can be noticed that an increase of the charging flow of the reactors leads to a decrease of the efficiency of the process. even if the two important steps: the acidogenesis and methanogenesis were separated. taking place in two different reactors.

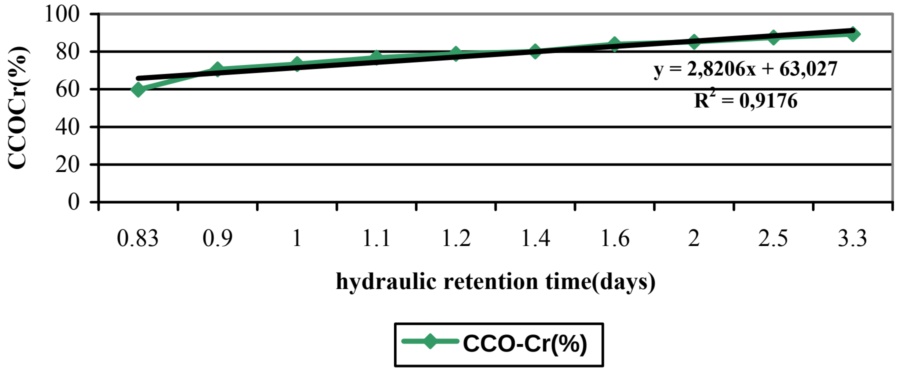


Fig. 4. The evolution of the organic charge for different hydraulic retention times

Together with the decrease of the hydraulic retention time and with the increase of the charging flow there can be seen that for a ratio of the charging flow of 1.5 l/day and a hydraulic retention time of 3.3 days the highest efficiency of the anaerobic digestion is obtained. compared to the CCO_{Cr} parameter. The increase of the ratio of the charging flow associated to the decrease of the hydraulic retention time leads to the decrease of the value of the removed CCO_{Cr}.

CONCLUSIONS

The ratio of the hydraulic charging (transit) applied to an anaerobe system influences directly the stability and performances of the process. The hydraulic retention time is directly related to the hydraulic transit. being one of the key factors of the anaerobic process. The fraction of degraded organic matter increases together with the increase of the hydraulic retention time and decreases together with the increase of the charging flow. There was noticed that the degradation of the CCO_{Cr} was of 89.3% at a retention time of 3.3 days and a ratio of the charging flow of 1.5 l /h and 59.8% at a retention time of 0.83 days and a ratio of the charging flow of 6.0 l/h.

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