Working Parameters Optimization of Hydrolysis-acidogenesis reactor in two stage anaerobic digestion of slaughterhouse Wastewater for Biogas Production

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Abstract
Background: Wastewater from agro-industries such as slaughterhouse is typical organic wastewater with high value of biochemical oxygen demand, chemical oxygen demand, biological organic nutrients (Nitrogen and phosphate) which are insoluble, slowly biodegradable solids, pathogenic and non-pathogenic bacteria and viruses, parasite eggs. Moreover it contains high protein and putrefies fast leading to environmental pollution problem. This indicates that slaughterhouses are among the most environmental polluting agro-industries. Anaerobic digestion is a sequence of metabolic steps involving consortia of several microbial populations to form a complex metabolic interaction network resulting in the conversation of organic matter into methane (CH₄), carbon dioxide (CO₂) and other trace compounds. Separation of the phase permits the optimization of the organic loading rate and HRT based on the requirements of the microbial consortia of each phase. The purpose of this study was to optimize the working conditions for the hydrolytic - acidogenic stage in two step/phase anaerobic digestion of slaughterhouse wastewater. The setup of the laboratory scale reactor was established at Center for Environmental Science, College of Natural Science with a total volume of 40 liter (36 liter working volume and 4 liter gas space). The working parameters for hydrolytic - acidogenic stage were optimized for six hydraulic retention time 1-6 days and equivalent organic loading rate of 5366.43 – 894.41 mg COD/L day to evaluate the effect of the working parameters on the performance of hydrolytic - acidogenic reactor.

Result: The finding revealed that hydraulic retention time of 3 day with organic loading rate of 1,788.81 mg COD/L day was a as an optimal working conditions for the parameters under study for the hydrolytic - acidogenic stage. The degree of hydrolysis and acidification were mainly influenced by lower hydraulic retention time (higher organic loading rate) and highest values recorded were 63.92 % at hydraulic retention time of 3 day and 53.26% at hydraulic retention time of 2 day respectively.

Conclusion: The finding of the present study indicated that at steady state the concentration of soluble chemical oxygen demand and total volatile fatty acids increase as hydraulic retention time decreased or organic loading rate increased from 1 day hydraulic retention time to 3 day hydraulic
retention time and decreases as hydraulic retention time increase from 4 to 6 day. The lowest concentration of NH\textsubscript{4}+ -N and highest degree of acidification was also achieved at hydraulic retention time of 3 day. Therefore, it can be concluded that hydraulic retention time of 3 day/organic loading rate of 1,788.81 mg COD/L \textit{day} was selected as an optimal working condition for the high performance and stability during the two stage anaerobic digestion of slaughterhouse wastewater for the hydrolytic-acidogenic stage under mesophilic temperature range selected (37.5°C).

Keywords: Slaughterhouse Wastewater, Hydrolytic – Acidogenic, Two Phase Anaerobic Digestion, Optimal Condition, Agro-processing wastewater

Full Text
Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

![Photo of Laboratory Experiment setup](image)

**Figure 1**
Photo of Laboratory Experiment setup
Figure 2

Schematic diagram of the laboratory scale hydrolytic-acidogenic reactor experimental setup.

Figure 3

Variation in TDS, Salinity and EC during the two stage anaerobic digestion of SHWW of hydrolytic-acidogenic reactor at different Hydraulic retention times
Figure 4
Change in pH and ORP at hydrolytic-acidogenic step at different HRT

Figure 5
Variation of Resistivity, NH4+-N and TVFA at hydrolytic-acidogenic step with different HRT
Figure 6
Variation trends of TCOD and SCOD during at hydrolytic-acidogenic step during two stage anaerobic digestion of SHWW at different HRT

Figure 7
DH and DA of the Hydrolytic-acidogenic digester at different HRT