MODELING OF AN HERBIVOROUS DIGESTIVE SYSTEM AS A 3-CONTINUOUS STIRRED TANK REACTOR (CSTR) -1-PLUG FLOW REACTOR (PER) ARRANGEMENT WITH PARTICULAR REFERENCE TO *HIPPOPOTAMUS AMPHIBIOUS*

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ABSTRACT

Hippopotamus Amphibious has three stomach compartments together with small and large intestines all required in digesting lignocellulosics. It is desirable to model the performance of such a natural (in - vivo) system with the view to designing a physical (in-vitro) system for efficient digestion of lignocellulosics.

Each stomach compartment in *Hippopotamus Amphibious* was modeled as a continuously stirred Tank Reactor (CSTR) and the small and large intestines as Plug Flow Reactor (PFR) arrangement in series in order to determine the performance of the digestive system. Monod Kinetics and Michaelis-Menten equations were used to develop the design equation ($-r_{AM} = f(X)$) used for the sizing of the reactor, where $-r_{AM}$ is the rate of disappearance of substrate from the reactor(s) and X is the conversion. The equation was at steady state. The solutions from the design equation above are obtained graphically using Levenspiel plot and numerically, using Simpson's Rule to solve the Integrals, in order to determine the efficiency of each reactor at converting the substrates (lignocellulosics) into the final products.

The result showed that 3CSTR – 1PFR arrangement in series has reactor volume of $0.5863m^3$, while ICSTR — 1PFR has $0.6120m^3$. The model of the whole

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system as 1PFR has reactor volume of $0.6030m^3$,The 3CSTR —1PFR which has the lowest value of $0.5863m^3$ is the best reactor arrangement to achieve efficient digestion of lignocellulosics.

It could be concluded that, the *Hippopotamus Amphibious* digestive system is best modeled, in –vitro as a 3CSTR – 1PFR arrangement in series.