Dedication.

To my wife, Son, and Daughters.

To all whom I love.

Researcher

Aknowledgements

Thank Allah who gave me the strength and hope to finish what I started and for giving me such a wonderful wife who brightened my way with her love, support, and great expectations that she and our sons gave to me.

If I want to thank some one else I would give it to my father professor Sabir Mohammed Salih who gave me the opportunity to rise up after disappointment. In addition to all of that my thanks to professor Sabir for good advise and leadership of this project.. My great thanks to Professor William Ibrahim Asaad the co-supervisor of this project for his great care, effort and guidance to the right track to execute and complete this research.

My great thanks to Professor Ahmed Eltyeb the Vice-chancellor of Sudan University for his support to this project finically and emotionally. He always reminded me that life is running fast and I have to catch up with my goals. Thanks to Dr. Sharf eldeen Bannega for his good financial support. And my great thanks to all whom I forgot and who gave me the support to complete this mission.

Allah bless you all
Hassan,

التجريدة

يقوم هذا المشروع على تصميم انموذج هندسي متكامل للمعالجة اللاهوائية لمياه الصرف الصحي. تصميم المشروع اعتمد على المعلومات التي تم الحصول عليها من تحليل عينات اخذت من بئر تجميع مياه الصرف الصحي لمباني الجناح الجنوبي بكلية الهندسة- جامعة السودان للعلوم والتكنولوجيا. وقد تم اختيار مواد التصميم وبناء المنظومة لاجراء اسهل وانجع السبل البديلة للمعالجة التقليدية المستحدمة حاليا دون الاعتماد على اي مواد او اجزاء مستوردة من الخارج.

الاعتماد المتزايد على الطاقة قاد الي بحوث من اجل اكتشاف المزيد من اشكال الطاقة عبر الحقب التاريخية وربما سيكتشف المزيد بمرور الوقت. فمنذ ان خلقت البشرية ادرك الانسان اهمية الطاقة للبقاء على قيد الحياة. فلذلك استخدم الانسان العناصر المتوفرة في بيئته في سبيل البقاء بعد مشيئة الخالق واستمر الانسان في تطوير حياته باستخدام الاشكال المختلفة للطاقة.

هذا الجهد الانساني لاكتشاف وتطوير المزيد من مصادر الطاقة كان دافعا لاجراء هذا البحث الذى يشمل احد مصادر الطاقة المتجددة ويطلق عليها البيوغاز)الغاز الحيوي(كمنتج ثانوى من محطة المعالجة الاهوائية لمياه الصرف الصحى.

مشروع البحث تطرق الي انتاج الغاز الحيوي من زاوية البيئة ومن التحليل الاقتصادي من حيث الاستفادة منها في جعل بيئة نظيفة خالية من التلوث البيئي وفي نفس الوقت ذا فائدة اقتصادية.

هذا المشروع هو البديل الناجع للنظام المعمول به حالياًوهى المعالجة التقليدية المكلفة اقتصاديا وبيئيا وذلك باقامة المعالجة اللاهوائية واللامركزية للاستفادة من نواتج تلك المحطات اقتصاديا وبيئيا وصحيا فى احياء ولاية الخرطوم. .

Abstract

This research is intended to design an integrated

engineering model for anaerobic sewage treatment. The design of

the model is based on the data provided by sampling analysis which are taken from the collection well of wastewater in southern campus of college of Engineering and it came out with the selection of material used as well as the construction of the system as the easiest and best substitute of conventional type of sewage treatment applied now.

Ever since the creation of humanity, the human being realized the importance of energy for his survival so he used the elements available to produce energy, in order to do so he kept developing his life by using the different forms of energy.

The increasing demand on energy leads to continuous researches on alternative and renewable energy source. The time has changed and many energy sources have been discovered throughout the history and more may be discovered in future time.

This human effort for developing and discovering the renewable energy sources was taken into consideration in this research. The biogas produced from the anaerobic sewage treatment as a by product may be used as by product.

The final goal is to establish the project in Khartoum State to any big settlement squares.

The project is evaluated in terms of environment and cost-benefit effects. And will be fit well in a decentralized treatment and recycling of the by-products.

Abbreviations and Symbols

Symbols	Description	Unit
PE	Population equivalent	gal /day
F_D	Drag force	Newton

F_b	Buoyancy force	Newton
F_g	Gravity force	Newton
ρ_s	Density of particle	Kg /m^3
V	Volume	m^3
g	Gravitational acceleration	m /s^2
A	Area	m^2
C_D	Drag coefficient	dimensionless
v	Velocity	m /s
R_e	Reynolds number	dimensionless
μ	Dynamic viscosity	N.s
v_s	Velocity of particle	m /s
H	Height	m
L	Length	m
t	Time	second
Q	Rate of discharge	m^3 /s
UASB	Up flow anaerobic sludge blanket	mg /l
S.S	Suspended solids	mg/l
B.O.D	Biochemical oxygen demand	mg /l
O.P.E.C	Oil producing export countries	
F.A.O	Food and agricultural organization	
L.P.G.	Liquidified petroleum gas	
T	Temperature	^{0} C
J.C.U	Jackson candle unit	
N.T.U	Nephelometric turbidity unit	

T.C.U	True colour unit	
R	Electric resistance	Ohm
D.S	Dissolved solid	mg /l
V.S	Volatile solid	mg /l
F.S	Fixed solid	mg /l
S.G.	Specific gravity	Dimensionless
τ	Shear stress	N/m^2
PH	Hydrogen ion concentration	
D.O	Dissolved oxygen	mg /l
CH_4	Methane	
C.O.D	Chemical oxygen demand	mg /l
AWWA	American water workers association	
r_H	Hydraulic radius	m
D	Diameter	m
W_p	Wetted perimeter	m
h_f	Friction head	m
C_f	Friction coefficient of Chezy	$m^{0,5}/s$
J	Slope of bed	m
n	Manning coefficient	dimensionless
$(W_p)_f$	Wetted perimeter full = πD	m
P	Pressure	N/m^2
υ	Kinmatic viscosity	dimensionless
φ	Angle	Degree
v_{sc}	Self cleansing velocity	m /s

b	Constant	
∑	Summation	
F	Force	Newton
D.W.F	Dry weather flow	Gallons/ day
r_i	Total rain fall	mm
AP_i	Impervious area	hectare
P_i	Power	KW
R.M.P	Revolution per minute	
Z	Potential head	m
h_L	Head loss	m
N.P.S.H	Net positive suction head	m
H.R.T	Hydraulic retention time	hours
W_p	Mass flow rate of sludge	Kg/day
M.L.S.S	Mixed liquor suspended solid	mg /l
F / M	Food to microorganism ratio	dimensionless
γ	Yield coefficient	
K_1 k_2	Constant as function of suspended solids	
hp	Horse power	
S.V.I	Sludge volume index	ml / g
S.D.I	Sludge density index	g / ml
$K^{/}$	Constant of reaction rate	
T.S.S	Total suspended solids	mg / l
T.V.S	Total volatile solids	mg / l
P.P.M	Parts per million	

C.S T_w	Cost of wastewater treatment	Sudanese dinnar
PC	Plant capacity	%
B.C.R	Benefit cost ratio	SD
η	Efficiency	%

List of figures and tables

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