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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.

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Allah bless you all
Hassan,

التجريدة

يقوم هذا المشروع على تصميم نموذج 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 المستخدمة 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 الذي يشمل احد مصادر الطاقة المتجددة ويطلق عليها البيوغاز (الغاز الحيوي) كمنتج ثانوي من محطة المعالجة اللاهوائية لمياه الصرف الصحي. 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 حالياً وهي 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	$^{\circ}\text{C}$
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
ν	Kinematic viscosity	dimensionless
ϕ	Angle	Degree
v _{sc}	Self cleansing velocity	m /s

b	Constant	
Σ	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	%

CONTENTS

		Contents	Page
Chapter 1		Preliminary remarks	1
	1-1	Scope of present work	3
	1-2	Sludge disposal	5
	1-3	Objectives	6
		References	10

Chapter 2		SEWAGE SYSTEMS	
	2-1	Introduction	11
	2-2	Liquid wastes	12
	2-3	Choice of site	14
	2-4	Methods of sewage treatment	15
	2-4-1	Conventional system used today	20
	2-4-2	Anaerobic technology	25
	2-4-3	Anaerobic sewage treatment	30
	2-5	Types of tanks	35
	2-5-1	Circular mechanically raked tanks	35
	2-5-2	Rectangular tanks	35
	2-5-3	Scum removal	36
	2-5-4	Sedimentation tank details	36
	2-5-5	Secondary sedimentation tanks	39
	2-6	Domestic sewage treatment	39
	2-6-1	The wastewater treatment plant	40
	2-6-2	Processes and systems	41
	2-7	History of biogas	44
	2-7-1	Definition of biogas	45
	2-7-2	Around the world	45
	2-7-3	In Sudan	46
	2-7-4	Utilization of biogas	47
	2-7-5	Benefits of using biogas in developing countries	48
	2-8	Types of models	50
	2-8-1	KVIC model	53
	2-8-2	Chinese models	55
	2-8-3	Janata model	57
	2-8-4	RMP model	58
	2-8-5	Neoprene model	60
	2-8-6	Taiwanese models	61
	2-9	Geographical	61
	2-10	Climate	62
		References	73
Chapter 3		The designed engineering model in relation to man and environment	
	3-1	Agricultural waste pollution	76
	3-2	Animal waste pollution	77
	3-3	Wastes and human health	77

	3-4	Climatic conditions	79
	3-5	Environment degradation by man	80
	3-6	Solutions	81
	3-7	Global environmental benefits of biogas technology	84
	3-8	The impact on the greenhouse effect	85
	3-9	The reduction potential of nitrous oxide emission from agriculture	86
	3-10	Sludge treatment and handling	87
	3-11	Wastewater borne diseases	88
	3-12	Processes and problems phasing the treatment plant	89
		References	92
Chapter 4		Preliminary design work	
	4-1	The wastewater characteristics	93
	4-2	Physical characteristics	93
	4-3	Chemical characteristics	99
	4-4	Biological and bacteriological characteristics	101
	4-5	Experimental work	104
		References	108
Chapter 5		Design and construction of anaerobic sewage treatment plant	
	5-1	Introduction	109
	5-2	Domestic sewage and model design	109
	5-3	Hydraulics of sewers	111
	5-4	Imperial formulas for friction flow	111
	5-5	Self cleansing velocities	118
	5-6	Domestic sewage treatment	119
	5-7	The wastewater treatment plant	121
	5-8	Sewage treatment and disposal	121
	5-9	Rates of flow	121
	5-10	Chemistry of sewage	123
	5-11	Design of anaerobic sewage treatment model constraints and parameters	124
	5-12	Calculation of methane gas production	132
	5-13	Experimental tests	134
		References	147
Chapter 6		The economic analysis of the plant	
	6-1	Introduction	149

	6-2	Cost estimates of wastewater projects	149
	6-2-1	Direct costs	149
	6-2-2	Material and subcontracts	149
	6-2-3	Other direct costs	150
	6-2-4	Indirect costs	150
	6-2-5	Material burdens	150
	6-2-6	Amortization	150
	6-2-7	Other indirect costs	150
	6-3	Estimating reclaimed wastewater and reuse systems costs	150
	6-4	Wastewater as an economic resources	151
	6-5	Public benefits	152
	6-6	Treatment and disposal of sewage sludge	152
	6-7	Calculating of primary sludge	153
	6-8	Sludge disposal	154
	6-9	Area of sludge drying bed	154
	6-10	Digestion	154
	6-10-1	Types of sludge digestion	155
	6-10-2	Forms of sludge digestion	156
	6-11	Economics of wastewater treatment	156
	6-11-1	Screening phase	157
	6-11-2	The final detailed evaluation	157
	6-12	Technological options	158
	6-12-1	Points of observation for pre-investment planning processes	159
	6-13	Economics and feasibility study of the project	159
	6-14	Cost estimates of wastewater projects	160
	6-14-1	Benefits as monetary value	161
	6-15	Costs of sewage works	162
		References	166
Chapter 7		Results and discussions	
	7-1	Results	167
	7-2	Discussions	168
	7-3	Some limitations faced during the course of research.	169
	7-4	Expected contribution of the digestion	170
	7-5	Perspectives of wastewater treatment in Sudan	171
		References	175
Chapter 8		Conclusions and Recommendations	
	8-1	Conclusions	176
	8-2	Recommendations	176
		Appendix	

List of figures and tables

Figures and or tables	Titles	Pages
Figure 1-1	Wastewater collection system of college Of engineering south campus	4
Figure 1-2	Plant flow diagram	7
Figure 1-3	Facultative pond of Soba sewage treatment plant	8

Figure 1-4	Conventional sewage layout	8
Figure 1-5	Basic flow diagram for conventional sewage plant	9
Figure 2-1	Composition of sewage	19
Figure 2-2	The benefits of biogas technology	24
Figure 2-3	Rectangular sedimentation tank	38
Figure 2-4	Components of El-Remaila sewage plant	63
Figure 2-5	Components of designed treatment model	66
Table 2-1	Applications of biogas	49
Figure 2-6	The KVIC biogas digester model	55
Figure 2-7	The Chinese biogas digester model	57
Figure 2-8	The Janata biogas digester model	58
Figure 2-9	The RMP biogas digester model	59
Figure 2-10	The Neprene biogas digester model	60
Figure 3-1	The biogas conductive temperature zone	80
Table 3-1	Principle human diseases and their causative agents	88
Figure 4-1	Flow diagram relating basic science areas to water and wastewater technology and pollution control.	94
Figure 4-2	Food to bacteria growth and decay relationship	102
Table 4-1	Tests of wastewater from collection well	106
Figure 4-3	A chart of total solid concentration v.s biogas production	107
Figure 5-1	Variation of domestic sewage quantities with time	110
Figure 5-2	Cross-section of a pipe partially full	117
Figure 5-3	Diagram of $(t/ B.O.D)^{1/3}$ v.s time	134
Table 5-1	Results of calculations	136
Table 5-2	Results of sample tests	137
Table 5-3	Test of supernatant liquid	138
Table 5-4	Tests of liquid wastewater effluent from Secondary sedimentation tank	139
Figure 5-4	Flow diagram between suction pipe in the well And inlet to pump	140
Figure 5-5	Flow diagram between pump discharge and Inlet to primary sedimentation tank	141

Figure 5-6	Plan view of secondary sedimentation tank	142
Figure 5-7	Sludge pump and vertical section of digestion tank	143
Figure 5-8	Sludge collection system	144
Figure 5-9	An elevation view of integrated engineering Sewage treatment model	145
Figure 5-10	A plan view of an integrated engineering sewage model	146
Figure 6-1	Moisture content of sludge	153
Figure 6-2	Flow diagram of economical investigation Of sewage treatment analysis	156
Table 6-1	Material and manufacturing costs	161
Table 6-2	Running costs	161
Table 6-3	Comparison of application of anaerobic Digestion for sectors	164

		Contents	Page
Chapter 1		Preliminary remarks	1
	1-1	Scope of present work	3
	1-2	Sludge disposal	5
	1-3	Objectives	6
		References	10
Chapter 2		SEWAGE SYSTEMS	
	2-1	Introduction	11
	2-2	Liquid wastes	12
	2-3	Choice of site	14
	2-4	Methods of sewage treatment	15
	2-4-1	Conventional system used today	20
	2-4-2	Anaerobic technology	25
	2-4-3	Anaerobic sewage treatment	30
	2-5	Types of tanks	35
	2-5-1	Circular mechanically raked tanks	35
	2-5-2	Rectangular tanks	35
	2-5-3	Scum removal	36
	2-5-4	Sedimentation tank details	36
	2-5-5	Secondary sedimentation tanks	39
	2-6	Domestic sewage treatment	39
	2-6-1	The wastewater treatment plant	40
	2-6-2	Processes and systems	41
	2-7	History of biogas	44
	2-7-1	Definition of biogas	45
	2-7-2	Around the world	45
	2-7-3	In Sudan	46
	2-7-4	Utilization of biogas	47
	2-7-5	Benefits of using biogas in developing countries	48
	2-8	Types of models	50
	2-8-1	KVIC model	53
	2-8-2	Chinese models	55
	2-8-3	Janata model	57
	2-8-4	RMP model	58
	2-8-5	Neoprene model	60
	2-8-6	Taiwanese models	61
	2-9	Geographical	61
	2-10	Climate	62