



Cairo University

OPTIMIZATION OF PHOTOBIOREACTOR DESIGN FOR MICROALGAE TO PRODUCE BIODIESEL

By

Samar Abdullah Gouda El-Mekkawi

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
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in
Chemical Engineering

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Dedication

*To my father
To the memory of my mother*

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List of Abbreviation

A	Irradiance as coded variable
AAD	Absolute Average Deviation
Adj. R ²	Adjusted residual squared – Statistics
ANOVA	Analysis of variance – Statistics
B	Initial inoculum concentration as coded variable
BG11	Blue-Green Algae medium
c	Speed of light
C	Initial inoculum concentration as actual variable
CI	Confidence interval – Statistics
C.V.	Coefficient of variation – Statistics
dCO ₂	Dissolved carbon dioxide
df	degrees of freedom - statistics
DNA	Deoxyribonucleic acid, the primary carrier of genetic information found in the chromosomes of almost all organisms.
DO	Dissolved Oxygen
E	Irradiance
E _p	Energy of photon
EPA	Environmental Production Agency
FFD	Flux Flow Density
f	Frequency
GC	Gas chromatography analysis
GHG	Greenhouse Gas
h	Blank's constant
I	Irradiance as actual variable
K _I	Monod constant
LCA	Life cycle assessment
LED	Light emitting diode
lm	luminous
N _A	Avogadro's Number
NO _x	Nitrogen oxides
N _p	Number of photon
OD	Optical density
OPEC	Organization of the Petroleum Exporting Countries
P	growth rate
PAH	Polycyclic aromatic hydrocarbon
PAR	Photosynthetic Active Radiation
PBR	Photobioreactor
PFD	Photon Flux Density
PI	Prediction interval – Statistics

P-I curve	Photosynthetic light response curve
PPD	Photosynthetic photon density
Pred. R^2	Predicted residual squared – Statistics
PRESS	Predicted residual error sum of squares – Statistics
PUFA	Poly unsaturated fatty acids
PVC	Poly vinyl chloride
R^2	Residual squared – Statistics
RSM	Response surface methodology
ROI	Return on investment
S/V	illuminated surface to volume ratio
SFA	Saturated fatty acids
TAG	Triacylglyceride
vvm	volume of air per volume of liquid per minute (unit of air flow rate)
μ	Specific growth rate
α	Hyperbolic tangent model's constant
σ	Standard deviation – Statistics
λ	Light wave length
η_{photon}	Photon efficiency