

سامية محمد مصطفى



شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم



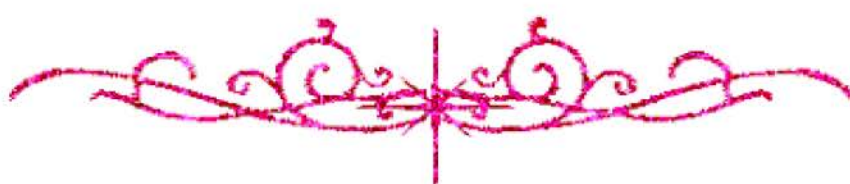
سامية محمد مصطفى



شبكة المعلومات الجامعية



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



سامية محمد مصطفى



شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

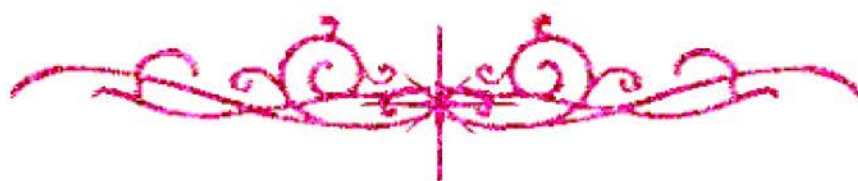
قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



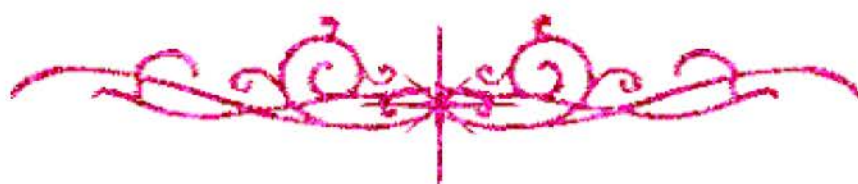
سامية محمد مصطفى



شبكة المعلومات الجامعية



بعض الوثائق الأصلية تالفة



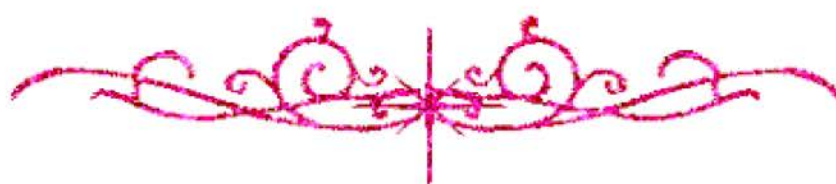
سامية محمد مصطفى



شبكة المعلومات الجامعية



بالرسالة صفحات لم ترد بالأصل





" NEW TREND FOR GAS PIPELINE NETWORKS DESIGN"

A Thesis Submitted to
Department of Chemical & Petroleum Refining Engineering.

in Partial Fulfillment of the Requirements
for the Award of the Doctor of Philosophy Degree
in

" Chemical & Petroleum Refining Engineering "

By
Nasser Ahmed Zoghaib
B. Sc. (Eng.), 1985
M. Sc. (Eng.), 1996

Supervised by

Prof. Dr.
Fatma Khalifa Gad
Head of Chemical & Petroleum Refining Eng. Dept
Faculty of Pet. & Min. Eng.
Suez Canal University

Ass. Prof.
Mostafa El-Sayed Awad
Dept of Chemical & Petroleum Refining Eng.
Faculty of Pet. & Min. Eng.
Suez Canal University

Dr. M. AWAD

Prof. Dr.
Nour Ahmed El-Emam
Head of Mining & Petroleum Eng. Dept
Faculty of Engineering
Al-Azhar University

Ass. Prof.
Said Mohamed Abdalla
Dept of Chemical & Petroleum Refining Eng.
Faculty of Pet. & Min. Eng.
Suez Canal University

S. M. ABDALLA

2004

B

13131

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

179

Suez Canal University .
Faculty of Petroleum & Mining Engineering .
Department of Chemical & Petroleum Refining Engineering .



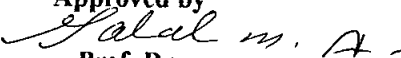
" NEW TREND FOR GAS PIPELINE NETWORKS DESIGN"

A Thesis Submitted to
Department of Chemical & Petroleum Refining Engineering.

in Partial Fulfillment of the Requirements
for the Award of the Doctor of Philosophy Degree
in

" Chemical & Petroleum Refining Engineering "

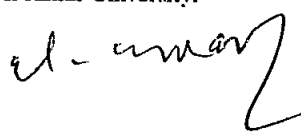
By
Nasser Ahmed Zoghaib
B. Sc. (Eng.), 1985
M. Sc. (Eng.), 1996

Approved by

Prof. Dr.
Galal Abdel-Alim
Dept. of Chemical & Petroleum Refining Eng.
Faculty of Pet. & Min. Eng.
Suez Canal University

Prof. Dr.
Salah Ahmed Khalil
Head of Process Design and Development Dept.
Egyptian Petroleum Research Institute (EPRI)



Prof. Dr.
Nour Ahmed El-Emam
Head of Mining & Petroleum Eng. Dept.
Faculty of Engineering,
Al-Azhar University.



Author	Nasser Ahmed Ahmed Zoghaib
Title	"New Trend For Gas Pipeline Networks Design"
Faculty	Faculty of Petroleum & Mining Engineering
Department	Chemical & Petroleum Refining Engineering
Location	Suez
Degree	Doctor of Philosophy "Ph.D."
Date	/ /
Language	English
Supervision Committee	Pro.Dr. Fatma Khalifa - Pro.Dr. Nour A. El-Emam - Dr. Mostafa Awad Dr. Said M. Abdalla

English Abstract

This work deals with the optimization application in the design and operation of gas pipeline systems through two common pipeline problems. The first is how to maximize the gas sales and the second is how to minimize the gas transport cost. A hypothetical gas network was used as an example of the first problem. In addition, three actual networks were used as examples of the second problem. Applying a new proposed procedure to reduce the possible combinations of gas fields and consumers, the obtained number of effective combinations constitutes about 35% of the number of possible combinations in most cases.

Key words

Natural Gas - Pipeline - Optimization - Combinations Reduction

ACKNOWLEDGEMENT

The sincere co-operation of many esteemed persons made this thesis possible. Unfortunately, it is not feasible to mention all those participants but the author would like to recognize the under-mentioned names.

First of all, the author would like to express his deep appreciation to Prof. Dr. FATMA KHALIFA GAD. Head of Chemical Engineering & Petroleum Refining Department, Faculty of Petroleum & Mining Engineering, Suez Canal University, and Prof. Dr. NOUR EL-EMAM , Head of Petroleum Engineering Department , Faculty of Engineering, Al-Azhar University for their invaluable guidance, close supervision and patient encouragement during all periods of this work.

He also expresses his cordial thanks to Ass. Prof. MOSTAFA AWAD and Ass. Prof. SAID MOHAMED ABDALLA, Department of Chemical Engineering & Petroleum Refining, Faculty of Petroleum & Mining Engineering, Suez Canal University , for their invaluable discussion, comments and suggestions throughout this work .

In addition ,the author expresses his thanks to all his colleagues at The Egyptian Natural Gas Co. (GASCO) who helped him collecting the required data. Special thanks to Eng. Hany Soliman, Chairman and managing Director, Eng. Al-Sayed Talaat, Chairman Assistant and Supervisor on Network Gen. Dept. , Eng. Abdel-Wahid El-Sayed, Gen. Manager of Gas Networks Planning and Analysis & Eng. Rizkallah Shenouda, Gen. Manager of Gas National Control Center. Also, I feel lucky to have wonderful officemates Eng. Abdel-Sattar El-Demerdash and Eng. Moatz Atef for their sincere help in the preparation of this thesis.

Last, but certainly not least , the author expresses his best thanks to everyone who directly or indirectly offered a hand in this work .

Nomenclature .

Letter	Description
A	pipe cross sectional area , m ² .
C	gas consumer.
Cs	transport cost, L.E.
Cst	total transport cost, L.E.
d	internal diameter of pipe , m.
D	Day
Dc	Consumer Deviation from optimum conditions, %
Ds	Supply Deviation from optimum conditions, %
E	pipeline efficiency factor (fraction) .
f	Fanning friction factor .
1/f	transmission factor.
g	acceleration due to gravity , 9.81 m/s ² .
G	specific gravity of flowing gas (for air =1) .
h	change in elevation , m.
L	length of pipeline , m.
m	mass flow , kg / hr .
M	thousand .
MM	million .
MW	molecular weight .
n	number of moles .
N	pipe node
P	pressure , k Pa.
P ₁	inlet pressure , k Pa.
P ₂	outlet pressure , k Pa .
P _{2act}	actual outlet pressure , k Pa.
P _{2c}	end pressure by consumer, k Pa .
PF	Field outlet pressure pressure, k Pa
P _o	operating pressure , k Pa .
P _m	mean pressure , k Pa .
PN	pressure at node, k Pa
P _{pc}	pseudocritical pressure , k Pa.
P _{sc}	pressure of standard conditions , k Pa.
Q	flow rate of gas , cubic metre per day.
Q _{act}	Actual or measured value of flow rate of gas , MMscm/D .
QC	Consumer flow rate, MMscm/D
Q _{opt}	Optimum value of gas flow rate from, MMscm/D.

Letter	Description
QF	Field flow rate, MMscm/D
Q_{sc}	flow rate at T_{sc} , P_{sc} , MMscm/D
Q_t	total flow rate of gas, MMscm/D
Q_{tx}	maximum total flow rate of gas, MMscm/D
Q_{tn}	minimum total flow rate of gas, MMscm/D
R	sales revenue, L.E.
R_i	individual sales revenue, L.E.
R_t	total sales revenue, L.E.
Re	Reynolds number , dimensionless .
S	pipe segment, m.
t	wall thickness of pipe, mm
T	absolute temperature of flowing gas , K .
T_1	gas inlet absolute temperature , K .
T_2	gas outlet absolute temperature , K .
T_m	arithmetic mean temperature , K , $T_m = \frac{1}{2} (T_1 + T_2)$.
T_{PC}	pseudocritical temperature , K.
T_{Pr}	pseudoreduced temperature , K .
T_{sc}	temperature of standard conditions , K .
v	fluid velocity , m/s.
w	work , kJ .
Z_m	gas mean compressibility factor .

Greek Letters

Letter	Description
α	pipe angle to horizontal , degrees .
Δ	difference .
ϵ	absolute roughness , m.
μ	fluid viscosity , Pa.s .
π	ratio of circumference to diameter in circle , 3.14
ρ	fluid density , kg / m ³ .
Σ	sum