



شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم



شبكة المعلومات الجامعية
@ ASUNET



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

قسم

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



يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of
15-25- c and relative humidity 20-40%

بعض الوثائق الأصلية تالفة

بالرسالة صفحات لم ترد بالاصل



CONTAMINATION OF NEW DESERT LANDS NEAR PETROLEUM WELLS AT RAS-SUDR

BY

Sayed Ahmed Saleh Ismail

B.Sc. in Agriculture (Soil Science),

Cairo University (1982)

Thesis

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Master of Science

in

Soil Science

To the Post graduate Division

Soils Department

Faculty of Agriculture

Cairo University

2000

APPROVAL SHEET

TITLE : Contamination of new desert lands near petroleum wells at Ras-Sudr

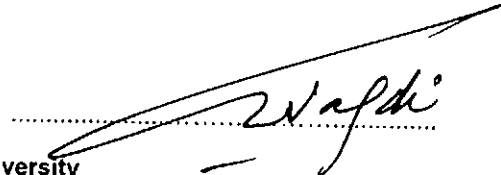
Degree : Master of Soil Science

Name : Sayed Ahmed Saleh Ismail

This Thesis has been approved by:

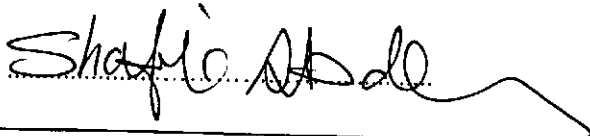
Prof. Dr. Mohamed Wagdi Abdel Hamid

Institute of Efficient productivity, Zagazig University



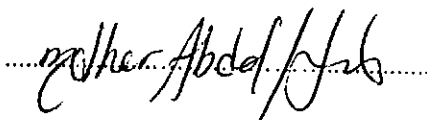
Prof. Dr. Shafik Ibrahim Abdel-Aal

Soil Sci. Dept. Fac. of Agric., Cairo University



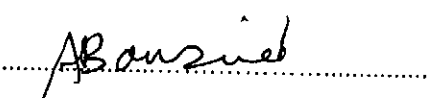
Prof. Dr. Maher A. Abdel-Hamid

Soil Sci. Dept. Fac. of Agric., Cairo University



Dr. Moustafa M.A. Abu-Zied

Soil Sci. Dept. Fac. of Agric., Cairo University



Date: /6 / 12 / 2000

Supervising Committee

Prof. Dr. Maher A. Abdel-Hamid

Professor of Soil Science, Soils Department,
Faculty of Agric., Cairo University, Giza, Egypt.

Prof. Dr. Nadia El-Asar

Professor of Soil Science, Soil Conservation
Department, Desert Res. Center

Dr. Moustafa M.A. Abu-Zied

Lecturer of Soil Science, Soils Department,
Faculty of Agric., Cairo University, Giza, Egypt.

2000

Name of Candidate: Sayed Ahmed Saleh Ismail

Degree: M.Sc.

Title of Thesis: Contamination of New Desert Lands Near Petroleum Wells at Ras-Sudr

Supervisors: Prof. Dr. Maher A. Abdel-Hamid

Dr. Moustafa M.A. Abu-Zied

Prof. Dr. Nadia El-Asar

Department: Soil Science

Branch : Soil Science

Approval: 16 /12 /2000 .

ABSTRACT

Sandy soil samples from Ras-Sudr area (South Sinai), Egypt were collected at 50, 200, and 800 meters from petroleum well site to investigate the hazardous effects of petroleum constituents. Pot experiment was conducted using wheat and corn plants as bioindicators in oil polluted soils at rates of 1.5, 3.0 and 4.5%. Two different remedies, agrolic and bentonite, were used at the rate of 6% to reduce the risk to toxic petroleum products in soils.

Crude oil represents a complex mixture of both inorganic and organic components. Total petroleum hydrocarbons (TPH) represent 82.82 % of the crude oil. Fe and Mn are present in largest concentrations while Cd and Cu are found in low concentrations.

Heavy metals concentrations and TPH showed a horizontal distribution with tendency to decrease with increasing the distance from oil well. Cd showed the largest variation with distance while Mn and Fe showed the smallest variation. With regard to TPH content soils located in the vicinity of oil well (50 and 200 m distance) are heavily polluted ($> 200 \mu\text{g g}^{-1}$) and soils at 800 m from oil well are moderately polluted ($50\text{-}200 \mu\text{g g}^{-1}$).

Contamination of oil significantly reduced plant growth parameters, i.e. germination, seedlings shoot length and dry matter biomass of both wheat and corn. The reduction was more pronounced when plants grown at zero time of contamination compared with that grown 30 days after contamination. Heavy metals concentrations in oil polluted soils increased with increasing level of pollution. The concentrations of heavy metals in soil as well as in corn and wheat plants significantly increased with increasing oil pollution after contamination.

Application of bentonite or agrolic at rate of 6% significantly decreased Cd, Pb, Cu, Zn, Mn and Fe concentrations in the oil polluted soils. The decrease was about 13-27 % with agrolic and 23-32% with bentonite. TPH decreased by about 40-44 % and 18-22 % in oil polluted soil supplemented with bentonite and agrolic, respectively.

Application of bentonite or agrolic as reclamative remedies significantly increase the growth parameters, i.e. germination percentage, plant height and dry matter of both corn and wheat. On the other hand they significantly decrease the concentrations of heavy metals in both plants. Bentonite showed a relatively higher effect compared to agrolic.

Key words:

Sandy soil-crude oil – oil polluted soils – pollution-heavy metals - petroleum hydrocarbons-remediation – Agrolic-bentonite – bioindicators – wheat- corn.

Thanks to GOD.

ACKNOWLEDGEMENT

The author wishes to express his appreciation, deep thanks and sincere gratitude to **Prof. Dr. Maher A. Abdel-Hamid**, professor of Soil Science, Faculty of Agriculture, Cairo University, for suggesting the problem, supervision, advices, guidance and continuous valuable help in all phases of study which made completion of this work possible.

Sincere thanks are also expressed to **Prof. Dr. Nadia El-Asar**, Prof. of Soil Science, Soil Conservation Department, Desert Res. Center and to **Dr. Moustafa M. A. Abo-Zied**, lecturer of Soil Science, Faculty of Agriculture, Cairo University for, supervision, help and constructive criticism throughout this work.

Thanks are extended to all Staff members of the Soil Conservation Department, Desert Res. Center for supplying all facilities needed.

Thanks are also extended to all Staff member of the Soils Department, Faculty of Agriculture, Cairo University, for their interest and help.

CONTENTS

	Page
1- INTRODUCTION	1
2- REVIEW OF LITERATURE	3
2.1. Characteristics and composition of crude oil	3
2.2. Crude oil as a source of pollutants	5
2.2.1. Hydrocarbons	5
2.2.2. Heavy metals	7
2.3. Impact of crude oil on some soil properties	9
2.4. Effect of petroleum on plants	12
2.5. Remediation of oil polluted soil	13
3. MATERIALS AND METHODS	17
3.1. Materials	17
3.1.1. Soil samples	17
3.1.2. Crude oil	17
3.1.3. Remedies	17
3.2. Green house experiment	23
3.3. Methods of analysis	25
3.3.1. Soil analysis	25
3.3.2. Plant analysis	26
3.3.3. Crude oil analysis	27
4. RESULTS AND DISCUSSION	28
4.1. Properties of the crude oil	28
4.2. Soil pollution by crude oil	28
4.2.1. Heavy metals	31
4.2.2. Hydrocarbons	36

	Page
4.3. Green house experiment	44
4.3.1. Corn and wheat as bioindicators of soil pollution	44
4.3.1.1. Growth parameters	44
4.3.1.2. Heavy metals contents in plants	48
4.3.1.3. Heavy metals concentrations in soil	48
4.3.2. Remediation of oil polluted soil	51
4.3.2.1. Heavy metals concentrations in soils	51
4.3.2.2. Hydrocarbon concentrations in soils	51
4.3.2.3. Growth parameters	56
4.3.2.4. Heavy metals concentration in plants	61
5- SUMMARY	64
6- REFERENCES	67
7- Appendices	76
8- ARABIC SUMMARY	

LIST OF TABLES

Table No.		Page
1	Some chemical and physical properties of the investigated soils (50 meters from oil well	19
2	Some chemical and physical properties of the investigated soils (200 meters from oil well	20
3	Some chemical and physical properties of the investigated soils (800 meters from oil well	21
4	Some chemical properties of the used agrolite	22
5	Some physical and chemical properties of the used bentonite	22
6	Some chemical properties of the crude oil of the petroleum well at Ras-Sudr	29
7	Total heavy metals ($\mu\text{g.g}^{-1}$) in the surface soil samples (0-15 cm) at different distance from oil well	32
8	Total heavy metals ($\mu\text{g.g}^{-1}$) in the sub surface soil samples (15-40 cm) at different distance from oil well	33
9	Total heavy metals ($\mu\text{g.g}^{-1}$) in the subsurface soil samples (40-60 cm) at different distance from oil well	34
10	Least significant difference for heavy metals at different distances	39
11	Concentration of petroleum hydrocarbons ($\mu\text{g.g}^{-1}$) of surface soil samples (0-15 cm) at different distances from oil well	39
12	Growth response of corn and wheat seedlings to crude oil concentrations at different time of sowing	46
13	Concentration of heavy metals ($\mu\text{g.g}^{-1}$) in corn and wheat plants grown in oil contaminated soil	49
14	Total concentrations of heavy metals ($\mu\text{g.g}^{-1}$) in the soil polluted by different levels of crude oil	52
15	Total concentration ($\mu\text{g.g}^{-1}$) of Cd, Pb, Cu, Zn, Mn and Fe in oil polluted soil supplemented with agrolite and bentonite remedies	54
16	Total concentration ($\mu\text{g.g}^{-1}$) of hydrocarbon in oil polluted soils supplemented with agrolite and bentonite remedies	57
17	Growth response of corn and wheat seedlings grown in oil polluted soil supplemented with agrolite and bentonite remedies	59
18	Concentration ($\mu\text{g.g}^{-1}$) of Cd, Pb, Cu, Zn, Mn and Fe in corn and wheat plants grown in oil polluted soil supplemented with agrolite and bentonite remedies	62

LIST OF FIGURES

Figure No.		Page
1	Location of the studied area	18
2	Sketch diagram of treatments used in pot experiment	24
3	Gas chromatogram of crude oil from petroleum well at Ras-Sudr	30
4	Average total concentrations of Cd, Cu, Pb, Zn, Mn and Fe in soil samples at different distances from oil well	35
5	Heavy metals concentration as affected by soil depth at different distances from oil well	37
6	Concentrations ($\mu\text{g.g}^{-1}$) of total hydrocarbons in surface soil samples (0-15 cm) at different distances from oil well	40
07	Gas chromatogram of petroleum hydrocarbons in soil samples at 50 m (D_1) from oil well	41
8	Gas chromatogram of petroleum hydrocarbons in soil samples at 200 m (D_2) from oil well	42
9	Gas chromatogram of petroleum hydrocarbons in soil samples at 800 m (D_3) from oil well	43
10	Growth response of corn and wheat seedlings to crude oil concentrations at different time of sowing	47
11	Concentration of heavy metals ($\mu\text{g.g}^{-1}$) in corn and wheat plants grown in soil polluted by different levels of crude oil at different times of seedling	50
12	Total heavy metals ($\mu\text{g.g}^{-1}$) in the soil polluted by different levels of crude oil	53
13	Total concentration of heavy metals ($\mu\text{g.g}^{-1}$) in oil polluted soil supplemented with agrolic and bentonite remedies	55
14	Total concentration ($\mu\text{g.g}^{-1}$) of hydrocarbons in oil polluted soils supplemented with agrolic and bentonite remedies	58
15	Growth response of corn and wheat seedlings grown in oil polluted soil supplemented with agrolic and bentonite remedies	60
16	Concentration of heavy metals ($\mu\text{g.g}^{-1}$) in corn and wheat plants grown in oil polluted soil supplemented with agrolic and bentonite remedies ..	63

1- Introduction