

## The effect of Incomplete Combustion Outcomes of Fuel Oil on the Internal Environment of Al-Dora Electricity Power Station

Dr. Kassim Mahdi Wadi/Physical Lectural  
Electrical Power Engineering Techniques  
Department  
Al-Ma'moun University College

### Abstract:

The aim of this study is to assess and evaluate the impact of air pollution of incomplete combustion outcomes on the workers' health in the Dora power station. The study included the following:-

Reviewing the occupational safety records in the station and determining the abnormal states due to the effect of gases resulted from incomplete combustion of fuel oil used to operate the station. Assessing the program of environmental measures and control of pollutants on which the station relied. Surveying the abnormal cases among workers through distributing a questionnaire and answering the questions posed in it by them. And examining 60 workers at national center for occupational health and safety lung function hemoglobin test allegoric skin and allergic eyes.

Discussing the above results and analyzing them statistically, it was shown that there was a marked effect on the workers' health and the preventive and cautions procedures were taken by making the required periodic tests and measures and laying a program to decrease the gases ( $\text{NO}_x$ ,  $\text{So}_x$ ,  $\text{CO}_x$ ). (nitrogen oxides seilver dioxides carbon mono oxides

We recommend the establishment of a control program to reduce the air pollution by  $\text{NO}_x$ ,  $\text{So}_x$ ,  $\text{CO}_x$ . according to Iraqi national ambint air quality standards.

تأثير نواتج الاحتراق غير التام للوقود على البيئة الداخلية في محطة الدورة الكهربائية

د.قاسم مهدي وادي

### المستخلص:

إن هدف هذه الدراسة هو قياس مدى أثر الغازات المنبعثة من محطة الدورة دون مستوى الاحتراق التام للوقود المستخدم للتشغيل على صحة العاملين فيها من خلال:- دراسة سجلات السلامة في المحطة وتحديد الحالات غير الاعتيادية نتيجة أثر انبعاث الغازات الناتجة عن احتراق النفط الأسود المستعمل لتشغيل المحطة. تقييم برنامج القياسات البيئية والسيطرة على الملوثات المعتمد في المحطة. استقراء الحالات غير الاعتيادية لدى العاملين من خلال توزيع استمارة استبانة على العاملين والإجابة عن الأسئلة الموجودة فيها من قبلهم.

وارسال ٦٠ عاملى الى المركز الوطنى للصحة والسلامة واءراء فحوصات كفاءة الرئة وفحص هيموكلوبين الدم وحساسية الجلد . من خلال مناقشة النتائج أعلاه وتحليلها إحصائياً، ظهر وجود أثر بسيط ملحوظ على صحة العاملين، وتم التوجيه باتخاذ الإجراءات الوقائية والاحترازية بأجراء الفحوصات والقياسات الدورية ووضع برنامج لتقليل انبعاث غازات  $NO_x$ ،  $SO_x$ ،  $CO_x$  . (اكاسيد الكربون ، اكاسيد الكبريت ، اكاسيد النتروجين).

## Introduction:

Air pollution is mean pollution of the ambient air by products of combustion and industrial wastes rather than the contamination of the atmospheres in factories and other places of works. Air pollution may cause a wide variety of substances and processes under normal and abnormal circumstances pollution. From natural phenomena, the traditional problem is pollution by the products of combustion complete and incomplete of fuel oil[1].

The internal environment of electrical thermal power stations is polluted by the combustion of large quantities of fuel used in operation,during365 days of continues operation especially at non-commitment with the environment conditions and requirements and the safety defined for the cycle of operating and executing the supportive works. Of these invasions is the increase in the percentage of air pollution more than the permitted limits and with quantities and periods affect negatively on the workers' health and the production process as a result of the presence of any type of impurities resulted from the unordinary operation of the station or the aging of its systems and its non-convoying the international developments and improvements for these stations[2].

These impurities (pollutants) are particles, gases and vapors represented by:

Particulate matters with grey, black or brown color according to combustion degree and the efficiency of the burner loaded with hydro-carbonic compounds which are sometimes called ashes or black carbon transferred to the human through the respiratory system[3]. Volatile organic compounds including the vapors resulted from the breaking of black oil (fuel) particles during its combustion which soon ascend to high sky layers reacting with other pollutants forming what is known as toxic compounds[4]. Carbon-Monoxide resulted from the incomplete combustion of black oil (fuel) during burning which affects the nervous behavior and the complication of heart and blood vessels problems when absorbed by lungs and interacted with blood protein, especially

hemoglobin and converted to hemoglobin carboxyl which if exceeds 10%, it will cause pains in the head, fatigue, non-concentrating and hard breathing among the workers which affect their health and productive efficiency[5]. Nitrogen oxide  $\text{NO}_x$  resulted from incomplete combustion of black oil (fuel) which contains percentages of nitrogen or from high temperature of boiler which forms a group of nitrogen oxides like ( $\text{NO}$ ,  $\text{NO}_2$ ,  $\text{N}_2\text{O}_4$ )[6]. Sulfur dioxide  $\text{SO}_x$  resulted from the combustion of sulfur that exists in black oil used as fuel to operate the station forming Sulfur dioxide[7, 8]. All these kind of pollution effected on the health of workers

## **Methods and Apparatuses:**

### **Methods:**

The methods used by the teams to measure and assess the air pollution exposure to the workers in Dora power station. According to Iraqi national ambient air quality standard for eight hours daily as following gas type

	limit
No	$\text{No} < 250(\text{mg} / \text{m})$
$\text{No}_x$	$\text{No}_x < 300\text{mg}/\text{m}$
$\text{So}_2$	$\text{so}_2 < 1000\text{mg}/\text{m}$
$\text{So}_3$	$\text{so}_3 < 50\text{mg}/\text{m}$

### **Control Program:**

Evaluation of the environment air pollution control program (air quality and practical standard) which to control and prevent harmful effects and protect the workers' health from record data and investigation with the safety and environment section.

### **Clinical test:**

Examine 60 workers at national center for occupational health and safety, chest x-ray, clinical text and lung function by spirometer is used to measure airflow and records it on graph of volume versus time.

### **Health situation of workers:**

A list of questions were asked of the workers about some abnormal health situations that were felt by them due to air pollution.  
No.1

### **Auditing safety records:**

Assessment the past occupational accidents, ills and monitoring of air pollution limitation of exposure to pinpoint the hazards and ills the workers were exposed to specially in high air pollution areas.

**Apparatus:**

- **Spirometer:** is used to measure various quantities of pulmonary function the airflow in and out of the length and connecting to a computer to recorded it consist co counter weight pen rotating chart weight less, drum noise clamp ,pulley ,computer .
- **X-ray unit :** is used to produced x-ray images for the chest and the main components of x-ray unit are .
- **Cathode ,anode ,High voltage source and tube current.**

وزارة الكهرباء  
المديرية العامة لإنتاج الطاقة الكهربائية  
الطبية

استمارة استبيان تأثير التلوث الغازي على العاملين في محطة الدورة / رقم ١

الاسم / الجنس / العمر / مكان العمل / تاريخ التعيين / تاريخ المباشرة بالعمل / المهنة / مهندس - فني - اداري

ت	الحالة	نعم	كلا	تاريخ بدء الحالة	درجة التأثير	المعالجة	الملاحظات
١	الصداع المزمن						
٢	التوتر والرعب						
٣	الانفعالات غير السوية						
٤	الحساسية :-						
	الجلد						
	الصدر						
	العين						
	التهاب المفاصل						
٥	اضطراب القلب						
٦	الارهاق						

مسؤول الطبابة  
الاسم :  
التاريخ :  
التوقيع :

**Results:**

Table (1) represented the data collected from the examine 60 workers:

No.	Age years	Occupation	Period of service yeras	Lung function	Allergic eyes	Allergic skin	hemoglobin test(Hb) g/dl
1	42	Operators	24	1	0	0	1
2	32	=	12	1	1	0	1
3	39	=	2	0	0	0	0
4	37	=	6	0	0	1	0
5	32	=	6	0	0	0	0
6	55	=	34	0	1	1	0
7	47	=	27	1	0	0	0
8	35	=	23	0	0	0	0
9	19	=	23	0	0	0	0
10	37	=	18	0	0	0	0
1	38	=	10	0	0	0	0
2	56	=	34	0	0	0	0
3	38	=	20	0	0	0	0
4	36	=	14	0	1	0	0
5	30	=	12	0	0	0	0
6	42	=	11	0	0	0	0
7	55	=	34	0	0	0	0
8	48	=	9	0	0	0	0
9	45	=	22	0	0	0	0
10	58	maintenance	22	0	0	1	0
11	39	=	15	0	0	1	0
12	35	=	17	0	0	1	0
13	49	=	12	0	0	1	0
14	33	=	31	0	0	0	0
15	48	=	13	0	0	0	0
16	36	=	10	0	0	0	0
17	21	=	9	0	0	0	0
18	30	=	4	0	0	0	0
19	47	=	19	1	0	0	0
20	41	=	24	1	0	0	0
21	41	=	21	1	0	0	0
22	44	=	22	1	0	1	0
23	35	=	20	0	0	0	0
24	40	=	15	0	0	0	0
25	38	=	18	1	0	1	0
26	40	=	20	0	0	1	0
27	38	=	24	0	0	0	0
28	29	=	15	0	1	0	0
29	35	=	10	0	0	1	0
30	28	=	8	0	0	0	0
31	36	=	7	0	0	0	0
32	39	Inspectors	7	1	0	0	0
33	42	=	6	0	1	0	1
34	30	=	8	0	0	0	0
35	25	=	9	0	0	0	0
36	44	=	7	1	0	0	0

No.	Age years	Occupation	Period of service yeras	Lung function	Allergic eyes	Allergic skin	hemoglobin test(Hb) g/dl
37	25	=	6	0	0	0	1
38	33	=	8	0	1	0	0
39	39	=	7	0	0	0	1
40	42	=	6	0	1	0	0
41	46	=	6	0	0	1	0
42	30	=	6	0	0	0	0
43	22	=	7	1	0	0	0
44	29	=	8	0	0	1	0
45	30	=	7	0	0	0	0
46	44	=	6	0	0	1	0
47	45	=	8	0	0	0	1
48	32	=	7	0	0	0	0
49	29	=	6	1	0	0	0

0-no effect

1-effect

**Table ( 2 ) : Causal Correlation along Age Groups and different Score respondents of Lung function defected**

Factor	Groups	Freq.'s %	Lung function		Total	C.S. P-value
			Healthy	Disease		
Age Groups	< 20 yrs	Count	1		1	$\chi^2=10.070$ P = 0.039 S  CC = 0.379 P = 0.039 S
		% of Total	1.7%		1.7%	
	20 -29 yrs	Count	6	2	8	
		% of Total	10.0%	3.3%	13.3%	
	30 -39 yrs	Count	26	2	28	
		% of Total	43.3%	3.3%	46.7%	
	40 -49 yrs	Count	11	8	19	
		% of Total	18.3%	13.3%	31.7%	
	50 > yrs	Count	4		4	
		% of Total	6.7%		6.7%	
Total		Count	48	12	60	
		% of Total	80.0%	20.0%	100.0%	

S : Sig. at P&lt;0.05

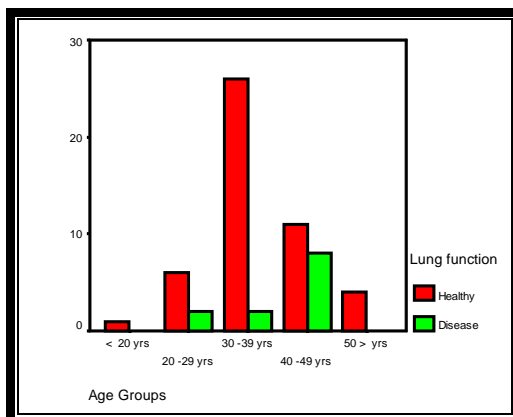


Figure ( 1 ) : Cluster Bar – Chart along Periods of work Groups and different Score respondents of Lung function defected

Table ( 3 ) : Causal Correlation along Age Groups and different Score respondents of Allergies defected

Factor	Groups	Freq.'s %	Allergic		Total	C.S. P-value
			Healthy	Disease		
Allergic eyes	< 20 yrs	Count	1	0	1	$\chi^2=0.876$ $P = 0.928$ NS  $CC = 0.120$ $P = 0.928$ NS
		% of Total	1.7%	0.0%	1.7%	
	20 -29 yrs	Count	7	1	8	
		% of Total	11.7%	1.7%	13.3%	
	30 -39 yrs	Count	25	3	28	
		% of Total	41.7%	5.0%	46.7%	
	40 -49 yrs	Count	17	2	19	
% of Total		28.3%	3.3%	31.7%		
50 > yrs	Count	3	1	4		
	% of Total	5.0%	1.7%	6.7%		
Total	Count	53	7	60		
	% of Total	88.3%	11.7%	100.0%		
Allergic skin	< 20 yrs	Count	1	0	1	$\chi^2=3.486$ $P = 0.480$ NS  $CC = 0.234$ $P = 0.480$ NS
		% of Total	1.7%	0.0%	1.7%	
	20 -29 yrs	Count	7	1	8	
		% of Total	11.7%	1.7%	13.3%	
	30 -39 yrs	Count	24	4	28	
		% of Total	40.0%	6.7%	46.7%	
	40 -49 yrs	Count	15	4	19	
% of Total		25.0%	6.7%	31.7%		
50 > yrs	Count	2	2	4		
	% of Total	3.3%	3.3%	6.7%		
Total	Count	49	11	60		
	% of Total	81.7%	18.3%	100.0%		

NS : Sig. at P>0.05

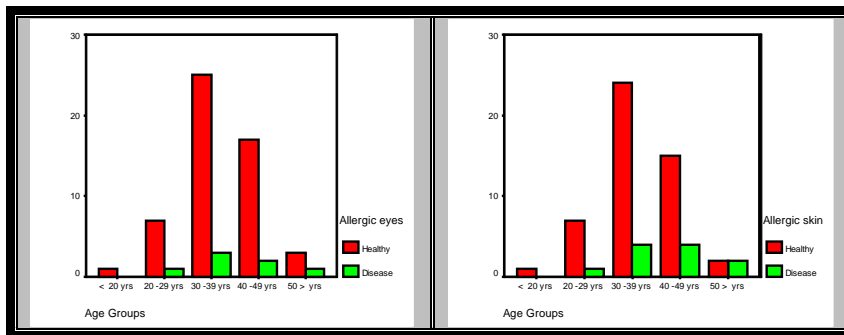


Figure ( 2 ) : Cluster Bar – Chart along Age Groups and different Score respondents of Allergies defected

Table ( 4 ) : Causal Correlation along Age Groups and different Score respondents of Hemoglobin - Hb defected

Factor	Groups	Freq.'s %	Hemoglobin - Hb		Total	C.S. P-value
			Healthy	Disease		
Age Groups	< 20 yrs	Count	1	0	1	$\chi^2=1.573$ $P = 0.814$ NS  CC = 0.160 $P = 0.814$ NS
		% of Total	1.7%	0.0%	1.7%	
	20 -29 yrs	Count	7	1	8	
		% of Total	11.7%	1.7%	13.3%	
	30 -39 yrs	Count	26	2	28	
		% of Total	43.3%	3.3%	46.7%	
	40 -49 yrs	Count	16	3	19	
		% of Total	26.7%	5.0%	31.7%	
	50 > yrs	Count	4	0	4	
		% of Total	6.7%	0.0%	6.7%	
Total	Count	54	6	60		
	% of Total	90.0%	10.0%	100.0%		

NS : Sig. at P>0.05

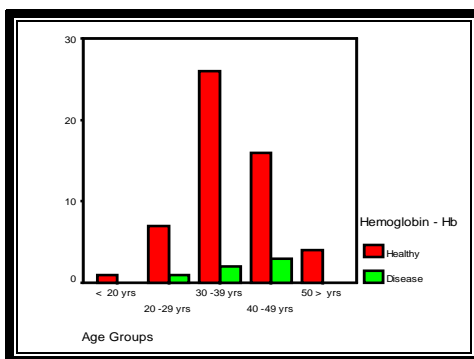


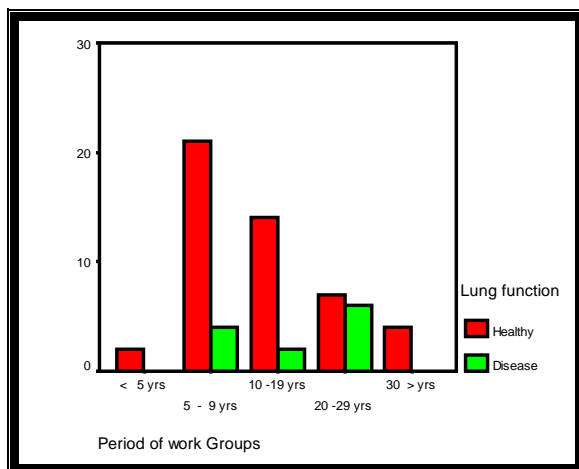
Figure ( 3 ) : Cluster Bar – Chart along Age Groups and different Score respondents of of Hemoglobin - Hb defected



**Table ( 5 ) : Causal Correlation along Period of work Groups and different Score respondents Lung function defected**

Factor	Groups	Freq.'s %	Lung function		Total	C.S. P-value
			Healthy	Disease		
Period of Service	< 5 yrs	Count	2	0	2	$\chi^2=7.870$ P = 0.096 NS  CC= 0.341 P = 0.096 NS
		% of Total	3.3%	0.0%	3.3%	
	5 - 9 yrs	Count	21	4	25	
		% of Total	35.0%	6.7%	41.7%	
	10 -19 yrs	Count	14	2	16	
		% of Total	23.3%	3.3%	26.7%	
	20 -29 yrs	Count	7	6	13	
		% of Total	11.7%	10.0%	21.7%	
	30 > yrs	Count	4	0	4	
		% of Total	6.7%	0.0%	6.7%	
Total	Count	48	12	60		
	% of Total	80.0%	20.0%	100.0%		

NS : Sig. at P>0.05



**Figure ( 4 ) : Cluster Bar – Chart along Periods of work Groups and different Score respondents of Lung function defected**

Table ( 6 ) : Causal Correlation along Periods of work Groups and different Score respondents of Allergies defected

Factor	Groups	Freq.'s %	Healthy	Disease	Total	C.S. P-value
Allergic eyes	< 5 yrs	Count	2		2	$\chi^2=3.453$ P = 0.485 NS  CC= 0.233 P = 0.485 NS
		% of Total	3.3%		3.3%	
	5 - 9 yrs	Count	22	3	25	
		% of Total	36.7%	5.0%	41.7%	
	10 -19 yrs	Count	13	3	16	
		% of Total	21.7%	5.0%	26.7%	
	20 -29 yrs	Count	13		13	
		% of Total	21.7%		21.7%	
	30 > yrs	Count	3	1	4	
		% of Total	5.0%	1.7%	6.7%	
Total	Count	53	7	60		
	% of Total	88.3%	11.7%	100.0%		
Allergic skin	< 5 yrs	Count	2		2	$\chi^2=1.209$ P = 0.877 NS  CC= 0.141 P = 0.877 NS
		% of Total	3.3%		3.3%	
	5 - 9 yrs	Count	21	4	25	
		% of Total	35.0%	6.7%	41.7%	
	10 -19 yrs	Count	12	4	16	
		% of Total	20.0%	6.7%	26.7%	
	20 -29 yrs	Count	11	2	13	
		% of Total	18.3%	3.3%	21.7%	
	30 > yrs	Count	3	1	4	
		% of Total	5.0%	1.7%	6.7%	
Total	Count	49	11	60		
	% of Total	81.7%	18.3%	100.0%		

NS : Sig. at P&gt;0.05

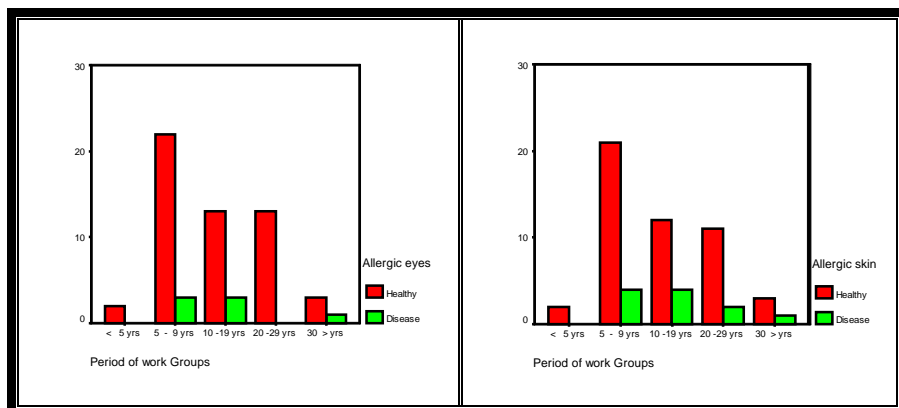


Figure ( 5 ) : Cluster Bar – Chart along periods of work Groups and different Score respondents of Allergies detected

Table ( 7 ) : Causal Correlation along Period of work Groups and different Score respondents of Hemoglobin - Hb detected

Factor	Groups	Freq.'s %	Hemoglobin - Hb		Total	C.S. P-value
			Healthy	Disease		
Period of Service	< 5 yrs	Count	2		2	$\chi^2=1.994$ P = 0.737 NS  CC= 0.179 P = 0.737 NS
		% of Total	3.3%		3.3%	
	5 - 9 yrs	Count	21	4	25	
		% of Total	35.0%	6.7%	41.7%	
	10 -19 yrs	Count	15	1	16	
		% of Total	25.0%	1.7%	26.7%	
	20 -29 yrs	Count	12	1	13	
		% of Total	20.0%	1.7%	21.7%	
	30 > yrs	Count	4		4	
		% of Total	6.7%		6.7%	
Total	Count	54	6	60		
	% of Total	90.0%	10.0%	100.0%		

NS : Sig. at P>0.05

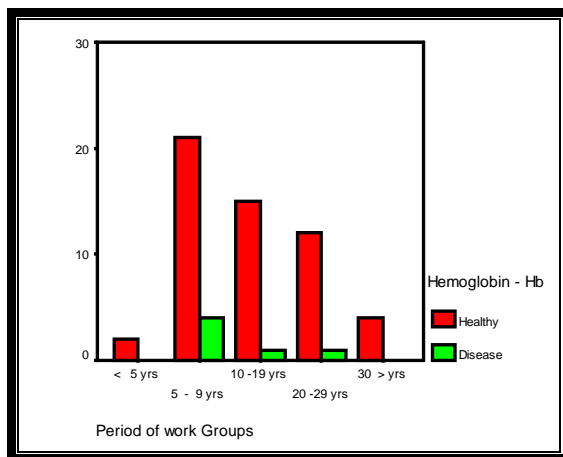


Figure ( 6 ) : Cluster Bar – Chart along Period of work Groups and different Score respondents of Hemoglobin - Hb defected

Table ( 8 ) : Causal Correlation along Place of work and respondents of Hemoglobin - Hb defected

Factor	Groups	Freq.'s %	Hemoglobin – Hb		Total	C.S. P-value	
			Healthy	Disease			
Occupation	Operators	Count	19	2	21	$\chi^2=5.326$ P = 0.070 (S)	
		% of Total	31.7%	3.3%	35.0%		
	Maintenance	Count	21	0	21		
		% of Total	35.0%	0.0%	35.0%		
	Inspectors	Count	14	4	18		CC= 0.286 P = 0.070 (S)
		% of Total	23.3%	6.7%	30.0%		
Total		Count	54	6	60		
		% of Total	90.0%	10.0%	100.0%		

(S) : Sig. at P<0.10

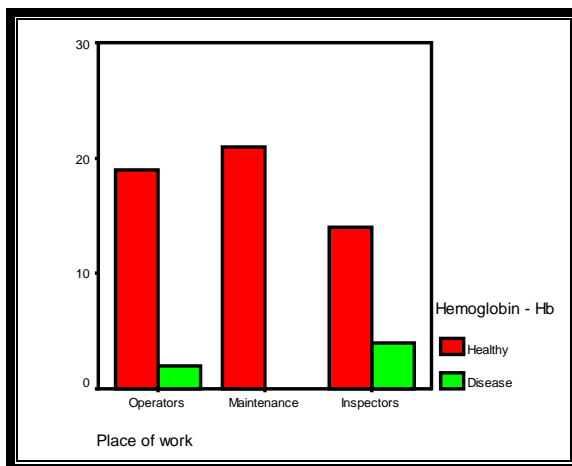


Figure ( 7 ) : Cluster Bar – Chart for place of work Groups and respondents of Hemoglobin - Hb defected

Table ( 9 ) : Causal Correlation along Place of work and respondents of at least one defected

Factor	Groups	Freq.'s %	At least one defected		Total	C.S. P-value
			Healthy	Disease		
Occupation	Operators	Count	14	7	21	$\chi^2=5.937$ P = 0.051 (S)
		% of Total	23.3%	11.7%	35.0%	
	Maintenance	Count	11	10	21	
		% of Total	18.3%	16.7%	35.0%	
	Inspectors	Count	5	13	18	
		% of Total	8.3%	21.7%	30.0%	
Total		Count	30	30	60	CC= 0.300 P = 0.051 (S)
		% of Total	50.0%	50.0%	100.0%	

(S) : Sig. at P<0.10

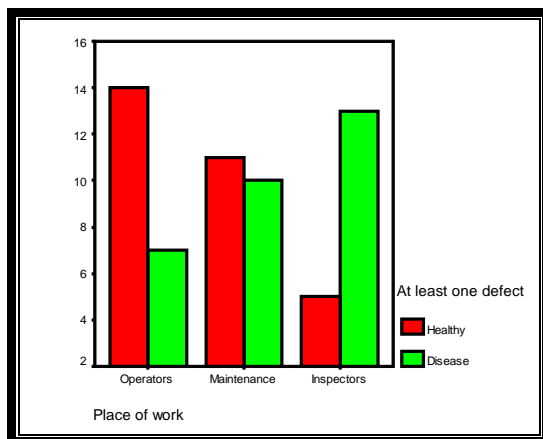
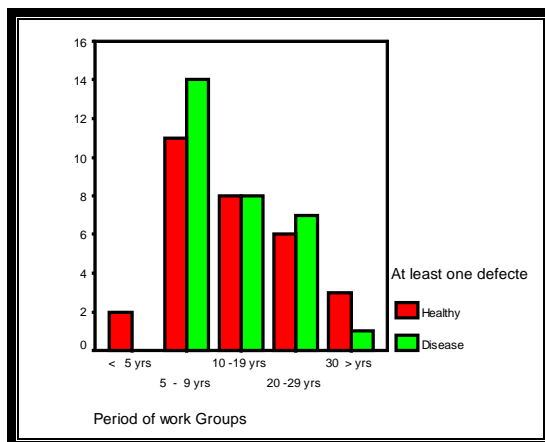


Figure ( 8 ) : Cluster Bar – Chart for place of work Groups and respondents of at Least one defected

Table ( 10 ) : Causal Correlation along Periods of work Groups and different Score respondents in At least one defected

Factor	Groups	Freq.'s %	At least one defected		Total	C.S. P-value
			Healthy	Disease		
Period of Service	< 5 yrs	Count	2	0	2	$\chi^2=3.437$ P = 0.488 NS  CC =0.233 P = 0.488 NS
		% of Total	3.30%	0.0%	3.30%	
	5 - 9 yrs	Count	11	14	25	
		% of Total	18.3%	23.3%	41.7%	
	10 - 19 yrs	Count	8	8	16	
		% of Total	13.3%	13.3%	26.7%	
	20 -29 yrs	Count	6	7	13	
		% of Total	10.0%	11.7%	21.7%	
	30 > yrs	Count	3	1	4	
		% of Total	5.0%	1.7%	6.7%	
Total	Count	30	30	60		
	% of Total	50.0%	50.0%	100.0%		



**Figure ( 9 ) : Cluster Bar – Chart along Periods of work Groups and different Score respondents in At least one defected**

### Discussion:

According to the examination results of 60 workers on table (1), the evaluation of health situation of workers and auditing the safety records and statistical analysis by chi-square and p-value with significant level  $P < 0.05$  to assess the causal correlations along age groups, occupation and period of service of the workers in different scores represent the effect of air pollution on lung function defected, allergic eyes defected, allergic skin defected and blood hemoglobin (H.b) defected which were taken as a sensor to check the effect of air pollution in the Dora workers as shown in the following:

Table (2) and figure (1) showed the causal relationship between the factor of age groups and different score respondents of lung function defected by the air pollutions resulted from incomplete combustion outcomes of fuel oil used to operate the internal environment of Al-Dora electricity power station. It was shown that the age groups (40-49) years old were more affected than others groups because they work as operators who had direct contact with air pollution sources.

Table (3) and figure (2) showed the causal relationship between the factor of age groups and different score respondents of allergies defected (allergic eyes and allergic skin). It was shown that the age groups (30-39) years old were affect more than others by allergic eyes

and age groups (30-39) years old and (40-49) years old were more affected by allergic skin than other because they were operators.

Table (4) and figure (3) showed the causal relationship between age groups factor and the effect of workers' blood hemoglobin. It was shown that age groups (40-49) years old were affected more than others because they were operators.

Table (5) and figure (4) showed the causal relationship between period of service factor and the effect of workers' lung function. It was shown that age groups (20-29) years old were affected more than others because their period of service was more than the others.

Table (6) and figure (5) showed the causal relationship between period of service factor and allergic of eyes and skin. It was shown that age groups (5-9) years old and (10-19) years old are affected more in allergic of eyes than others and the groups (5-9) years old and (10-19) years old were affected more in allergic of skin than others because they were newly appointed and their bodies are susceptible to these effects.

Table (7) and figure (6) showed the causal relationship between period of service factor and the effect of workers' blood hemoglobin with gaseous pollutions. It was shown that workers' blood hemoglobin for the period of service (5-9) years were affected more as being operators.

Table (8) and figure (7) represented the causal relationship between occupation factor, and the effect of workers' blood hemoglobin. It was shown that the inspectors were affected more than others because their work included most pollution sources at the station.

Table (9) and figure (8) represented the causal relationship between occupation factor and the effects resulted from gaseous pollutions on the basis that the appearance of any effect on any worker was considered a measure for effect. It was shown that the operators' effect was more than others.

Table (10) and figure (9) represented the causal relationship between period of service and the effects resulted from gaseous pollutions on the basis that the appearance of any effect on any worker was considered a measure for effect. It was shown that the groups (10-19) years were more than other categories for the operators fell within these groups.

The above discussion showed that there were small effects of air pollution on Dora workers' health .



## Conclusions:

Establishment a schedule time and air quality index to measure air pollution levels to reduce air emissions by: modification the operation process, and environment system during five years[9, 10]. Good program for maintenance the control system of environment. Periodically flow up the testing the workers and monitory the environment factor[11]. To collect environmental data periodically which combined with monitoring of health and other effects (bank data). Adequate storage for chemical materials and disposal waste.

## References:

- 1- Luiji,P. Encyclopedia of Occupation Health Safety, 1985, P.96.
- 2- De Koning, H.W., Air Pollution and Human Health Changing Disease Patterns and Human Behavior, London, Academic Press, 1980, P.436-445.
- ٣ - محمد أحمد نجم، التجمعات السكنية العشوائية (مدن الصفيح)، رؤية من الناحية البيئية والصحية، مجلة البيئة والحياة، وزارة البيئة، العدد 14، 2007، ص44-46.
- 4- United States and New York Reach Agreement with Electric Utility to Reduce Air Pollution Accor Marks, A Major Step in National Enforcement Initiative, 2000.
- 5- Lee Jae- Joon, A study on the development of the planning indicators Korean style eco-city, Journal of the Korean Planners Association, 2005, Vol.40, No.3, 9-25.
- 6- Lisa Magnino, Dana Topousis, New Report Bench Marks Air Pollution from Top 100 Electric Company Wide Disparities among Competitors, Public Service Enterprise Group Incorporated, 2002.
- 7- Michel O'Neill, Paule Simara, Choosing Indicators to Evaluate Healthy Cities Projects, Health Promotion International, 2006, Vol.21, No.2.
- 8- Beron KJ, Murdoch JC, Thayer MA, The Benefits of Visibility Improvement: New Evidence from the Los Angeles Metropolitan Area, Journal of Real Estate Finance and Economic, March 2001: 22(2-3) 319-337.
- ٩ - محمد أحمد نجم الدين، إعلان المدن الخضراء Green Cities Declarations، مجلة البيئة والحياة، وزارة البيئة، العدد 9، 2008، ص28
- ١٠ - أحمد حنون جاسم، المركبات وتلوث الهواء Cares and Air Pollution، مجلة البيئة والحياة، وزارة البيئة، العدد 14، 2007، ص38-39.
- 11- Beron KJ, Murdoch JC, Thayer MA, Hierarchical Linear Models with Application to Air Pollution in South Coast Air Basin, American Journal of Agriculture Economics, 1999, 81(5), 1123-1127.