

Evaluation Of The Environmental Awareness In The Different Types Of Metal Finishing In Alexandria

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Abstract: The metal finishing process involves the consumption and utilization of different raw materials which are highly toxic and dangerous to working labour. The aim of the present work is to provide the basic information needed about the environmental awareness of the metal finishing activity. The highest number of metal finishing industries [107] has been found in the central district. Painting enterprises represented the highest percentage [68%]. Most of the surveyed industries [97.8%] belonged to the private sector. The highest percentage [87.8%] represented the small size. All the metal finishing factories discharge its wastewater effluents into Alexandria combined sewer system. The results of analysis reports available indicated that 95% of electroplating and 62% of galvanizing were in compliance with regulation. The surveyed anodizing shop was renegade firm while no analysis has been done by painters. Most of the factories [all electroplating, all painting, and 75% of galvanizing] did not install any treatment unit. However, the factories which apply treated units generate hazardous sludge that handled as domestic refuse or disposed into the nearest dumping area. The evaluation of the existing environmental situation in metal finishing enterprises in Alexandria shows that hazardous effects are not considered. The study gave some recommendations which can be followed to overcome the hazards generated by metal finishing industries.

INTRODUCTION

Metal finishing processes can be defined as the final operation applied to the surface of a metal article in order to alter its surface properties to achieve various goals. Metal finishing provided both protection and decoration.¹ Its applications include engineering², ornamental electroplating, economic³, and many industrial products.⁴ These industries are varied in the used

technology to include electroplating, galvanizing, anodizing and painting.^{5,6,7,8} Metal finishing operations have three basic steps: surface cleaning or preparation; surface modification; and rinsing.⁹ The metal finishing process involves the consumption and utilization of different raw materials which are highly toxic and dangerous to working labour. Releases of pollutants are not only to water but also to air. Releases to water

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include acids¹⁰, phosphate-containing detergents¹¹, electroplating solutions¹⁰, organic finishing.^{12,13} Releases to air includes acids¹⁴, solvents¹⁵, electroplating solutions¹⁶, and organic finishing.^{17,18} Exposure pathways for these chemicals are inhalation, absorption, or ingestion. Metal finishing wastes discharged to sewers may be harmful to sewer structure and toxic to treatment plant organisms.

Over the past two decades, metal finishing industries were grown and developed to cope with the vast and various extension of the general industry in Egypt. In Alexandria, There is a lack of information about the environmental awareness in metal finishing industry. Therefore, the aim of the present work is to provide the basic information needed about the environmental awareness of the metal finishing activity in Alexandria.

MATERIAL AND METHODS

Surveying the metal finishing industries in Alexandria has been carried out through two ways: records of governmental offices and using a designed questionnaire. The aim was

to collect information about the environmental awareness in the activity under investigation. The obtained results have been tabulated and presented in figures.

RESULTS AND DISCUSSION

3.1. Metal finishing industries survey in Alexandria

3.1.1. The records of governmental offices survey

The results of the survey through the records of governmental offices are presented in table [I]. It is clear from the table that there were 322 metal finishing enterprises distributed along the six districts.

The highest number of metal finishing industries [107] has been found in the central district followed by El-Gomrouk [73]. The reasons could be attributed to that they are the oldest districts, located in the city center and the enterprises owners preferred to practice their work in the areas accessible to the customers, and they were considered the industrialized areas of the city. This has been changed later due to the expansion of the city where most of the new enterprises are concentrated in the new industrial areas

Table 1 : Distribution Of Metal Finishing Industries Types Along Different Six Districts In Alexandria, 2000.

Type Of Finishing	Electroplating		Galvanizing		Anodizing		Painting		Total		
	Total	Visited	Total	Visited	Total	Visited	Total	Visited	Total	Visited	
El-Montazah	3	3	-	-	-	-	60	20	-	63	23
East	3	2	-	-	1	1	-	-	-	4	3
Center	19	15	1	1	-	-	87	36	20	107	52
West	4	4	3	2	-	-	45	30	-	52	36
El-Gomrouk	57	43	2	2	-	-	14	10	-	73	55
El-Amreya	5	3	2	4	4	4	-	5	-	23	12
Total	91	70	2	10	9	1	220	101	20	322	181

[Amreya free zone and Borg El-Arab]. This was clear from the high number in El-Amreya district[23].

The table also illustrated that painting enterprises represented the highest percentage [68%] while anodizing has represented the lowest percentage [0.3%]. The reason of the highest percentage of painting enterprises was due to that activity is used for different kinds of articles under extensive usage nowadays.

It has been found during the survey through the records that there was a lack of

information which necessitated a field survey.

3.1.2. Metal finishing industries survey using a questionnaire

Table [II] represents the results of sector and size of the surveyed enterprises. It is illustrated from the table that 97.8% of the surveyed industries belonged to the private sector. This is attributed to that this kind of activity includes many hazards and the government facing many problems to continue practicing it. This helps the private owners to find a market of their products, and

Table 2 : Distribution of metal finishing industries in Alexandria according to sector and size of enterprise, 2000

Type of finishing	Sector			Size of enterprises visited		
	Private	Public	Free	Small < 5 employees	Medium 5-50 employees	Large > 50 employees
Electroplating	89	2	-	59	10	1
Galvanizing	10	-	-	5	3	1
Anodizing	1	-	-	-	1	-
Painting	215	2	3	96	5	-
Total	315	4	3	160	19	2

to expand their number and activity.

The table showed that 87.8% of the field surveyed industries represented small size industry [employees <5] and 1.6% represented the large size industry [employees >50]. The highest percentage of small size may be due to this kind of activity can be carried out in a small space and each worker can do more than one job at the same time. The highest percentage of small size enterprises was in compliance with UNEP et al.¹⁹ study which surveyed ASEAN electroplating enterprises and showed that more than 72% of them are small shops.

Table [III] shows the raw materials, water, and electric consumption of the field surveyed metal finishing industries. It is shown from the table that anodizing represented the lowest rate of water consumption/amount of raw material [0.036 m³/kg]. On the other hand, painting represented the highest rate [26.2 m³/kg] due to that the articles plated by this kind of activity are too big to be immersed in tanks and surface preparation depends on washing by water hoses.

As regards the rate of electric consumption/amount of raw material, anodizing recorded the lowest rate [3.67 kw/kg]. Galvanizing recorded the highest [147.3 kw/kg] followed by electroplating because the operation conditions of both of them depend on large current density and voltage. Painting recorded 60.6 kw/kg because solvent spray methods of application depend on automated guns which require a big amount of electricity.

The results also showed that there has been direct inversely proportional relationship between F ratio [electric consumption/water consumption] and the quantity of monthly-added raw material or the number of workers. The more the F ratio, the lower the number of workers with a very strong inverse correlation coefficient $R^2 = 0.6995$. The more the consumption of raw materials, the lower the F ratio with a strong inverse correlation coefficient $R^2 = 0.7825$, figures [1&2].

3.2. Wastewater monitoring

The results showed that all the galvanizers and anodizers, and 78% of electroplaters have analyzed their

Table 3 :Raw material, water, and electric consumption of the field surveyed metal finishing industries in Alexandria, 2000

Type of finishing	Number of shops	Amount of raw material/month (kg)	Water consumption / month (m3)	Rate of water consumption amo unt of raw material	Electric consumption kw/hr	Rate of electric consumption/raw material (kw/kg)			
	Total	For one shop	Total	For one shop	Total	For one shop			
Electroplating	70	1176	16.8	5530	79	4.7	143943	2056.3	122.4
Galvanizing	9	106.3	11.8	670	74	6.3	15659	1739.9	147.3
Anodizing	1	3500	3500	125	125	0.036	12860	12860.0	3.67
Painting	101	229.2	2.3	6000	59	26.2	13900	137.6	60.6

wastewater effluents. However, painters have not done. The results of wastewater analysis reports available showed that 95% of electroplating shops were in compliance with environmental requirements and 62% of galvanizing shops were seeking to comply with the regulations. The surveyed anodizing shop was renegade firm. The results showed that no wastewater treatments were installed for any of the electroplating and painting enterprises. This was not agreed with UNEP et al.¹⁹ study, which mentioned that 22.2% of electroplaters had no treatment of their wastewater. In galvanizing shops, only 25% installed some sorts of wastewater treatment units using neutralization and precipitation process. The anodizing shop had a wastewater treatment unit using neutralization process.

The present treatment processes in 25% of galvanizing and in the only studied anodizing enterprises generate hazardous sludge that disposed off in combination with domestic solid waste or in the nearest vacant areas. These unsafe disposal methods did

not agree with the followed methods in the UK where the end product has conventionally been co-disposed of by land filling with domestic waste. It is also not in compliance with an alternative technique, used extensively in North America, Japan and some parts of Europe, named chemical fixation or stabilization/solidification.²⁰

Residual metals in wastewater that discharged by metal finishing shops to the municipal sewer systems were not removed by the available primary treatment in Alexandria. This agreed with Osmond and Bentley²¹ who studied wastewater treatment and disposal in U.K. metal finishing industry, they recorded that primary treatment was not sufficient to remove metals.

3.3. Problems of metal finishing industry operation

It has been found that 60% of workers suffered from noise; 90% exposed to machines and tools which may lead to injuries; 10% suffered from exposure to dust of poisonous metals; 60% suffered from exposure to liquids which are toxic-irritative

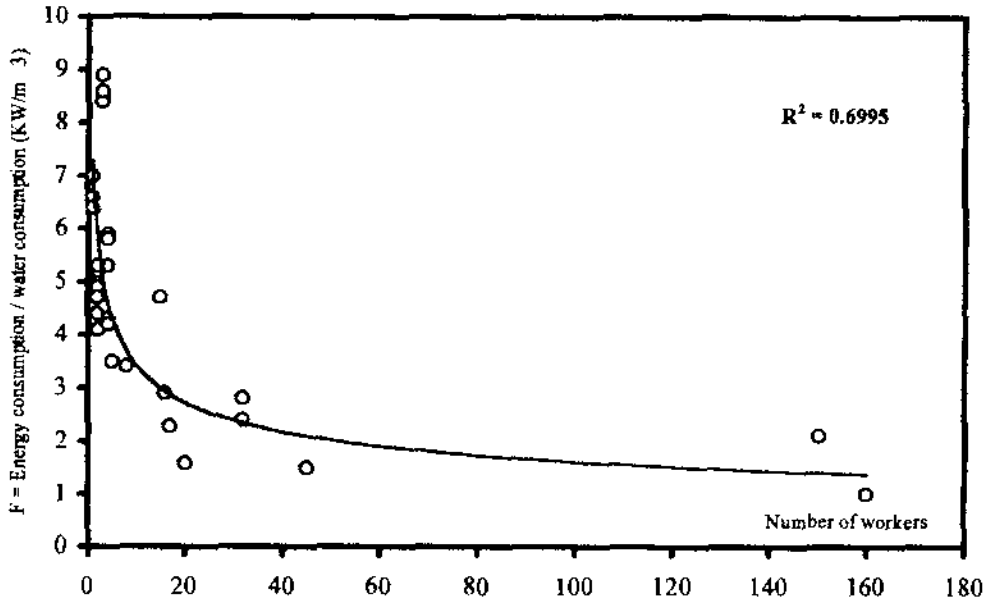


Figure 1: Number of workers in relation to F-ratio in metal finishing shops

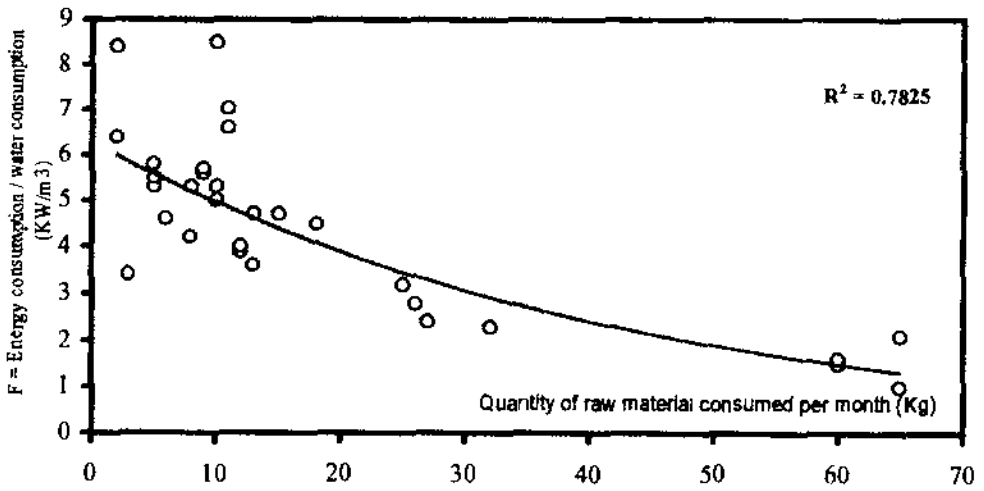


Figure 2: Raw material consumption per month in relation to F-ratio in metal finishing shops

or allergic, corrosives, explosives and oxidizers that may cause heart and lung diseases; and 30% suffered from exposure to gases and vapors [solvents and chromium anodizing].

It has been noticed also that 10% of workers suffered from exposure to electrical shock; 5% suffered during degreasing operation from acute poisoning through inspiration of vapors, skin contact, oral intake and/or primary narcotic effects that in the final stage lead to respiratory paralysis; and 1% suffered from chronic poisoning, central nervous system effects and injuries to the liver were in the foreground.

There was no available measurement about the noise level in the surveyed shops, a lack of information about the recorded injuries from exposure to machines, and no medical records on the hazards of working environment.

3.4. Prevention and control of hazards evaluation

The results indicated that 33% only of the surveyed shops have been controlling

hazards as follow: 20% used local exhaust ventilation; 10% replaced the noisy process by non or less noisy one; 2% isolated noisy process in a separate room; and 1% used enclosure against noise. It has been found that 17% only of surveyed shops used rooms with high ceilings and general ventilation. There was a safety zone of 80 to 100 cm between the breaking region of the worker and the edge of the bath. This was in compliance with Zober⁵ study which mentioned that the safety zone should be between 80 to 100 cm. It has been also found that the owners of the 50% of the surveyed shops have made periodic medical examination of workers and used personal protective equipment. This was in compliance with Zober⁵ study which mentioned that in metal finishing activities, acid-proof clothes and safety shoes should be used to protect workers against hazards of working environment.

Conclusion and Recommendations

The following has been concluded based on the obtained results:

- 1- Painting represented the highest percentage [68%] of metal finishing enterprises while anodizing represented the lowest percentage [0.3%].
 - 2- Most of the surveyed industries [97.8%] belonged to the private sector.
 - 3- The highest percentage [87.8%] of the surveyed industries represented the small size while large size represented the lowest [1.6%].
 - 4- The results of wastewater analysis of the electroplating shops showed that the highest percentage [95%] were in compliance with environmental requirements.
 - 5- In galvanizing shops, only 62% were seeking to comply with the environmental regulation.
 - 6- There was no wastewater treatments installed for any of the electroplating and painting enterprises.
 - 7- In galvanizing shops, only 25% installed some sorts of wastewater treatment units using neutralization and precipitation process.
 - 8- Employees with different percentages suffered from exposure to noise; machines and tools which may lead to injuries; dust of poisonous metals; toxic, allergic, corrosives, and explosives liquids; gases and vapors; and electrical shock.
- Based on the aforementioned conclusion, the following are recommended:
- 1- Organizing a training program for the enterprises representatives regarding the hazards associated with their operation, the precautions, the importance of raw materials conservation, and importance of wastewater treatment,
 - 2- Encourage keeping environmental registers.
 - 3- Establishing an integrated environmental management through:
 - a- Movement of these activities to the nearest industrial area,
 - b- establishing a centralized treatment plant,
 - c- substituting the toxic raw materials with non-toxic substances, and

d- substituting their old technologies with the clean technology.

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