

SOLID WASTE MANAGEMNET FOR QUWEISNA INDUSTRIAL ZONE

El Nadi M. H.¹, Nasr N. A. H.², Badawy N. M.³ and Hassan H. A. H.*⁴

¹Prof. of Sanitary and Environmental Engineering, Faculty of Engineering, Ain Shams University.

²Associate Prof. of Sanitary and Environmental Engineering, Faculty of Engineering, Ain Shams University.

³Assistant Prof. of Chemistry, Faculty of Engineering, Ain Shams University.

⁴M.Sc. Environmental Engineering Sciences Department, Institute of Environmental Studies and Research, Ain Shams University.

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*Corresponding Author

Hassan H. A. H.

M.Sc. Environmental Engineering Sciences Department, Institute of Environmental Studies and Research, Ain Shams University.

ABSTRACT

Solid Waste Management is one of most important pillars for achieving sustainability, along with wastewater and energy management. Solid waste management is a major issue not only at nation and government levels but also at any facility level. One of the important facilities to consider is the industrial zones. As most of the industrial zones in Egypt, Quweisna industrial zone is one of the important industrial zone as it contents important industries such as,

engineering, ceramic, textiles, food, and chemical and pharmaceutical industries. A detailed study about Quweisna industrial zone's waste generation, composition and characteristics, existing good and bad practices was conducted. The objective of the study was to provide a baseline data related to solid waste in the zone to suggest 4Rs strategy for achieving a clean and green industrial zone. Quweisna Industrial Zone generates every year 170.446 ton, almost 138.15 ton of the total wastes that reaches the final stage of disposal, and only 32.39 ton are recovered, which mean that nearly 81% of the total waste generated in industrial zone is sent-off for disposal to local municipality. Trading of dry recyclables like plastic and glass bottles, metal cans and office paper happens at individual level by the facility owner in Cash-

for-Trash event, or as a group by cleaning staffs collectively selling them. At the end, the waste audit (composition, characteristics) results show a great scope for many waste recovery and recycling opportunities in Quweisna Industrial Zone, to transform into a Green industrial zone.

KEYWORDS: Solid waste – Industrial zone – Solid waste management – 4Rs.

BACKGROUND

With increasing population, industry and the economic growth the management of solid waste in the country has emerged as a severe problem not only because of the environmental and aesthetic concerns but also because of the quantities generated every day. Segregation at source, collection, transportation, treatment and final disposal of waste was largely insufficient leading to degradation of environment and poor quality of life.

The status of solid waste management is considered as a development indicator as it has direct link to issues like sanitation and public health. Thus, management of solid waste generated in a country must be one of the priorities while forming policies at national level.

However, the situation of solid waste in Egypt has always been questionable. The major reasons, particularly in urban areas, are economic growth, unplanned land use and, most importantly, the lack of proper legislations on solid waste management. According to the National Solid Waste Management program, 60 million tons of solid wastes are generated every year in Egypt. Of the total waste generated, approximately 30-60 % of wastes are collected and many wastes are scattering throughout towns and streets without being treated.

Egyptian industries produce between 3 and 6 million tons per year of waste. Hazardous industrial waste is estimated to be between 150 and 175 thousand tons per year. This broad range demonstrates the general lack of information available on the actual amount of industrial waste generated in Egypt. Most industrial waste in Egypt comes from important industries such as cement, metallurgical, petrochemicals, textiles, food, and chemical and pharmaceutical industries. Although these and other industries are major contributors to Egypt's economy, they are also a major contributor to the country's solid waste problem. Any contract established for an integrated solid waste management service must attempt to incorporate as much of this industrial solid waste as possible.

Industrial wastes are generated from approximately 24,500 manufacturing facilities located throughout Egypt. Some estimates have indicated that close to 50 percent of all industrial activity is concentrated in the Greater Cairo area and approximately 40 percent in Alexandria. The rest is in the Delta and Upper Egypt, and new cities such as 10th of Ramadan. Industrial hazardous waste generation in the Greater Cairo Metropolitan area is estimated to be between 77,000 and 84,000 tons per year.

In Quweisna industrial zone, waste management system is inefficient, if it is compared with other zones that can be appear in many practices like:

- No special compartment for collecting solid waste.
- 81% of industries kept their wastes in dumping site.
- Only 19% of industrial solid wastes are recycled.

All these examples and more are appear at the Quweisna industrial zone because the weakness of the management of solid waste office at the industrial zone, the unfollow of the solid waste rules from the factories side, and the absent of the Government role of implementing and enforcing the regulations act at the industrial zone. This paper primarily focuses on the issues related to the management of solid waste in industrial zones.

STUDY OBJECTIVE

The objectives of the study are indicated as follows:

- To perform waste audit, composition analysis and characteristics of solid waste generated in Quweisna Industrial Zone.
- To evaluate existing waste management systems and identify both good and unsustainable practices of waste handling in Quweisna Industrial Zone.
- To perform a technical study on the solid waste management of the Quweisna Industrial Zone.
- To study the options for solid waste reduction, reuse, recycling and recovery in the Quweisna Industrial Zone.

Study Location

Quweisna Industrial Zone (formerly Mubarak Industrial Zone), lies in the East of city of Quweisna, two kilometers away from Cairo-Alexandria agricultural highway. It has a strategic location –in the middle of the Nile Delta- it's only 60 km away from Cairo, 25 km from Tanta city, 13 km from Benha city, 130 km from Alexandria, and 90 km from Sadat

City. Being near from all these cities, it gets its strategic importance appears in marketing goods easily in Lower Egypt which is full of highly populated areas, besides providing a lot of opportunities on integration with industrial zones and establishments in other neighboring governorates and making good use of Damietta (Dumyat) and Alexandria.

Pilot description (lab scale experiment description)

The foundation of a successful strategy for the management of solid industrial waste in Quweisna Industrial Zone, is to identify the components of the waste thoroughly and then put the best way to deal with it, and through studying the tables of data, it has been founded that the study area got seven types of major industries, and it was clear how each type of waste was varying in characteristics and components of solid wastes, these industries are food industry, plastic industry, carton industry, engineering industry, ceramic industry, chemical industry and leather industry.

Waste auditing is one of the best methods for quantifying the waste generated and understanding the flows. Waste Audit consisted of measuring the waste generation rate, as well as find the physical components of various waste types. Waste Auditing was conducted once a week for a period of 12 months from January 2016 to December 2016, Quweisna Industrial Zone factories generating different types of waste, thus for waste sampling the wastes was divided into seven various types.

Data Collection (Sampling)

This part of the study shows details of the existing waste quantity in the industrial zone this involved careful and regular observation of the waste handling practices and review of past data and information carried out in Quweisna Industrial Zone, during January 2016 to December 2016.

EXPERIMENTAL SAMPLE OF THE STUDY

This part used in data collection was experimental, in which segregation and separation of solid waste components at different facilities of the industrial zone were done for several times. Seven types of major industries within Quweisna Industrial Zone were found, a (solid waste of food industry factories, solid waste of engineering industry factories, solid waste of carton industry factories, solid waste of plastic industry factories, solid waste of ceramic industry factories, solid waste leather industry factories and solid waste of chemical industries factories).

In this study it has been able to determine the size, type of laboratory samples and the quantity of the different industrial solid waste types founded in Quweisna Industrial Zone in 2016.

Measurement Analysis

Solid waste generation in Quweisna Industrial Zone was measured by manually weighing the waste from entire zone for a day at the weekend, as well as by weighing the solid waste collection truck that transports and disposes industrial zone's waste. To get the representative result, 48 times of waste measurement were done. Such measurements were carried once in every weekend of the experiment period.

After collection the data from the zone and use manual sorting, a Microsoft Excel software was used in data entry and processing. Certain statistical variables were calculated for data analysis. These variables include averages, standard deviations, and percentages. SPSS was used for statistical analysis, and relations between certain variables were also analyzed, descriptive statistics such as means and ranges were computed. Appropriate tests of significance were performed to determine practice regarding management of solid waste.

Both primary and secondary data collection tools and techniques were used in the study. The results founded summarize the data collection and analysis method to achieve the set objectives of this study.

RESULTS AND DISCUSSION

Since this study was carried out in Quweisna Industrial Zone, the generation rate of solid waste is calculated based on the records of the total waste generated every week while solid waste reach containers for disposal. The Quweisna Industrial Zone is producing about 170.446 tons of waste yearly as per the record maintained.

RESULTS VERIFICATIONS

The results indicated that the experiment of amount of solid waste in the study area as follows:

- The amount of total industrial solid waste of Quweisna Industrial Zone is (170.446) Tons/year.
- The amount of food waste from the zone is 6.1703.
- The amount of metal waste from the zone is 11.70663.

- The amount of wood waste from the zone is 8.7049.
- The amount of the carton waste from the zone is 51.86.
- The amount of the plastic waste from the zone is 2.34.
- The amount of the ceramic waste from the zone is 1.9411.
- The amount of the leather waste from the zone is 22.64.
- The amount of recyclable from the zone is (30,908) Tons / year.
- The amount of exhaust from the zone is (16.57) Tons / year.
- Non-hazardous wastes are: organic - metal - wood - plastic - glass - textiles - paper - cardboard - nylon (and the industrial city collected and carried over).
- The hazardous wastes are: waste paints laboratories - waste mineral oil refineries - waste grinding sulfur - the chemical sludge processing units within the Plant / laboratory are assembled and carried over by the owner of the facility, which uses a temporary landfill in Northern polluting industries area of the city Industrial solid waste disposal, where it is cached until landfilled. Figure (1) shows the different components of the wastes and quantity of each solid waste generated in the industrial zone for a year.

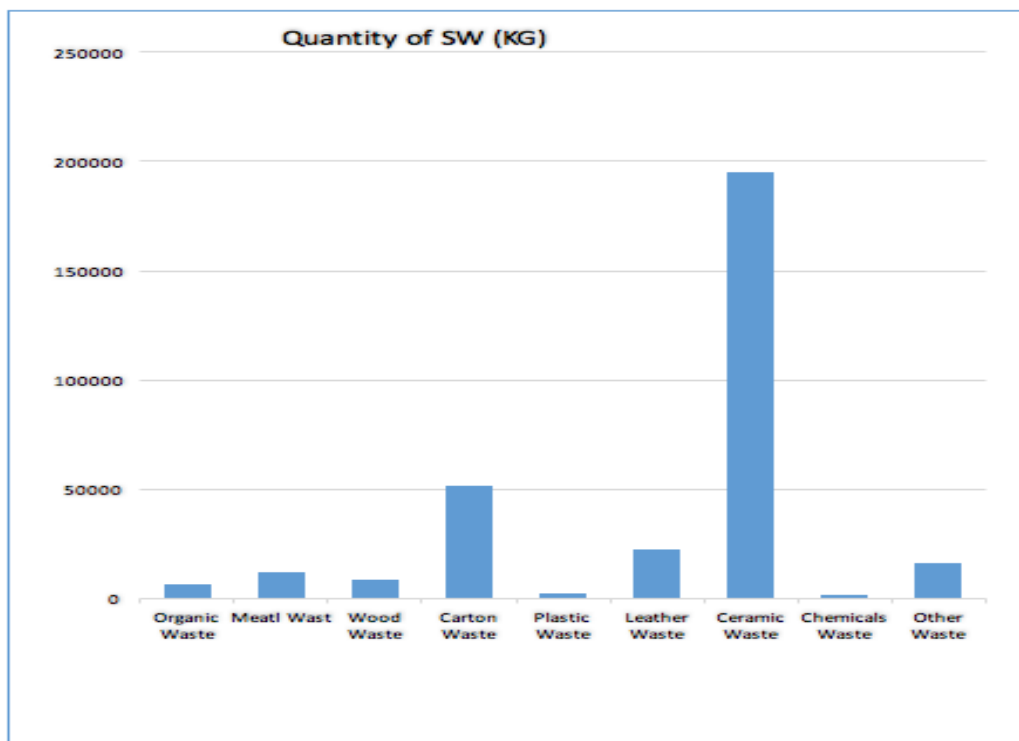


Figure 1: Quantity of each Solid Waste Generated in 2016.

Quweisna Industrial Zone has its own waste handling activities up to intermediary stage. Even though, majority of waste is send off for disposal without source segregation and

recovery through the local municipality, but there are some good practices of waste recovery inside the industrial zone. These good practices include recyclable waste recovery (Cash-for-Trash) for recycling. Such activity is scattered at individual capacity, and does not cover the entire industrial zone. Few companies expend significant amount of money on waste disposal. Even though the company responded the expense as waste treatment cost of, upon verification it is mostly collection and transport expense upon disposal. The rest of the companies do allow any form of waste pickers.

DISCUSSION OF RESULTS AND ITS USE

Quweisna Industrial Zone has, to some extent, improved its solid waste management. With the right solid waste management and good sustainability plan action, Quweisna Industrial Zone is leading towards becoming a Green zone. However, there needs a lot of careful planning, policies and participation from the Industrial Zone administration and the companies' owners towards attaining a sustainable solid waste management. Waste flow shows the waste generation, recycling, and disposal in a simple graphical form. Figure (2) captures Quweisna Industrial Zone's waste flow. This waste flow is based on the actual waste being recovered in 2016, and average monthly value is used to calculate the annual waste flow.

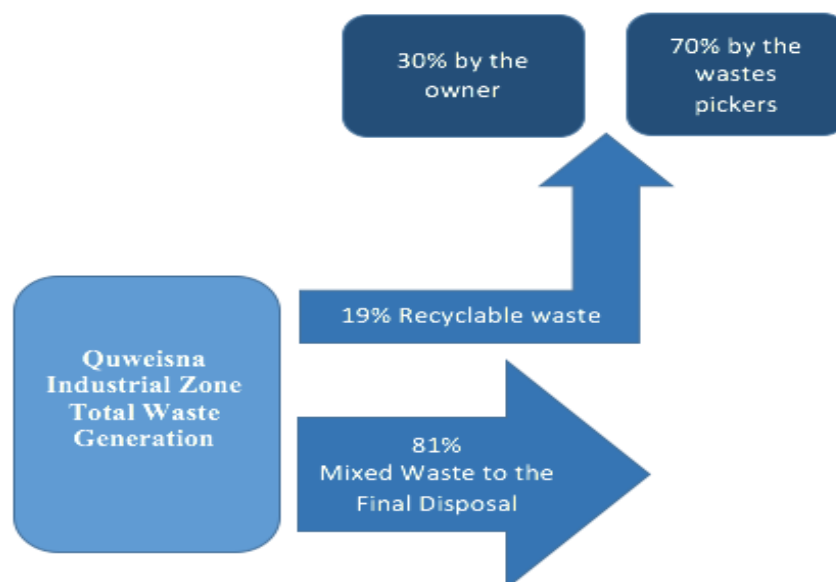


Figure 2: Quweisna Industrial Zone's waste generation flow.

On an annual basis, Quweisna Industrial Zone generates 170.446 ton, almost 138.15 ton of the total wastes that reaches the final stage of disposal, and another 32.39 ton are recovered for various recycling activities, even before reaching the dump site. Out of these wastes,

roughly 19% of waste is recovered. Remaining nearly 81% of the total waste generated in industrial zone is sent-off for disposal to local municipality.

Trading of dry recyclables like plastic and glass bottles, metal cans and office paper happens at individual level by the facility owner in Cash-for-Trash event, or as a group by cleaning staffs collectively selling them, and also at the final stage when waste collection staffs partly sort recyclables at the transfer station before sending wastes to local municipal service.

To conclude, as mentioned above, some good practices of waste management has been attempted (and some still in continuation) in Quweisna Industrial Zone, however, discontinuation and lack of participation from the zone administration is of the concern. The waste audit (composition, characteristics) results show a great scope for many waste recovery and recycling opportunities in Quweisna Industrial Zone, to transform into a Green industrial zone.

Performance of the solid waste management system

Solving the waste problem is a difficult task, even more in developing countries where there is a chronic lack of funds and environmental issues are still poorly recognized by the population. It is a broad definition of having a holistic view on the waste problem, by taking in account the overall picture. That's mean not only taking in account economic but also social and environmental aspect of waste management. The reason to apply such concepts is to lower the environmental and social impact of waste at an acceptable cost for the society. Planning involves all aspects of waste issues, from the generation through the collection, treatment and finally till the disposal.

An important aspect of integrated waste management is the use combination of methods that are suitable to each type of waste fraction, in order to have the lower environmental impact with the highest economic benefits. In other word creates a situation of "win-win-win" between social benefit, economic profitability and environmental protection. Nevertheless, implementing such management is based on a complete picture of the situation and the use of a combination of techniques.

Quweisna Industrial Zone have to take a few steps before having an efficient waste management. They are summarized below:

- Waste analysis and monitoring.

- Move from uncontrolled dumping to sanitary landfill.
- Separation of the organic fraction.
- Involvement of the informal sector.

Once a good and reliable overall perspective of the waste flow is known, the solid waste management process can be carried out with the implementation of a panel of techniques to treat the wastes in order to have the most efficient waste management plan.

There are six functional elements that constitute the SWM system, which are listed as follows:

- Waste generation
- Storage
- Collection
- Transfer station and transfer vehicles
- Reduce, reuse, recycling and recovery (4Rs)
- Disposal

Quweisna Industrial Zone has tried to reach the objectives of integrated solid waste management through this “Waste Management Hierarchy”. This strategy was implemented at two levels (factory and industrial zone).

At the whole zone level (Industrial Clusters IC)

The whole zone level scenario or Industrial clusters (IC), or geographical concentrations of firms and ancillary units engaged in the same sector, can generate a multitude of advantages for small firms - from agglomeration economies to the benefits of lend themselves to sustainable development - directly through economic development, incomes, and well-being generated for the working people; and indirectly, through their wider impact on the local economy and environmental conservation.

Company to company by-products exchange is the only system for full optimization of resource utilization. The Cleaner Production programs facilitate to reduce, reuse, and recycle waste materials within a facility. This strategy will reduce the total volume of materials and products to be managed at the end of the production/consumption cycle. An eco-industrial zone can benefit its whole community by hosting such a cluster of resource recovery

companies, as well as promoting cleaner production and design for environment to increase efficiency and productivity of major companies and government facilities.

At each factory level

The main activities of each factory were:

- Introducing and promoting the idea of cleaner production with technical support and organizing training courses.
- Establish a fund to support cleaner production.
- Implementation programs related to cleaner production such as auditing, technical updates and special training programs for managers and employees.

At industrial zone level (in general)

The main activities at industrial zone level (in general) were:

- Creating a cooperative industrial ecosystem by encouraging by-products exchange among factories; changing factories cycle in zone from producers and consumers into producers.
- Creating a website to share information and encourage by-products exchange and creating clusters of industrial cooperation between factories.
- Legislation with the goal of having all activities comply with environmental norms such as enforcement of in-source separation and reduction pattern of industrial and municipal solid wastes due to the future expansion of zone and anticipated future increase in solid wastes, special incentive policies for scavengers and decomposers factories such as providing information about the zone wastes, reduce taxes and subsidies to offset operating costs, implementation of the principle of “Pay off the cost of pollution”.
- Providing technical assistance and training for industries due to the limited environmental management programs, especially for managers and strengthen the relationship between zone and city solid wastes management programs because there are some shared facilities for treatment and final disposal of solid wastes.
- Organizing events to promote recycling to the public. It is also helping with education in school. Currently most of the events are happening in the biggest zones and landfills, but it is a great opportunity to include all industrial zones in the network of the recycling concept.
- Any recycling implementation will have to deal with the economics of the process.

CONCLUSION

Quweisna Industrial Zone has tried to reach the objectives of integrated solid waste management through this Waste Management Hierarchy (Waste generation; Storage; Collection; Transfer station and transfer vehicles; Reduce, reuse, recycling and recovery (4Rs); Disposal). This strategy can be implemented through three scenarios as was mentioned above:

1. Whole zone level (Industrial Cluster IC),
2. Each factory level,
3. Industrial zone level.

The primary aim of this study was to select the best scenario for the waste management system for Quweisna Industrial Zone on the basis of an environmental-economic point approach. In most of the studies, economic and social aspects are used to compare these methods but due to the multiplicity of environmental factors and their complexity, the environmental aspect has been neglected. Scenario 2 and scenario 3 were selected as the best waste management scenario because, first they can be accomplished. Second, these scenarios include recycling, composting and landfilling. Third, the recovery of solid waste is economically and environmentally worthwhile. Instead of landfilling materials such as glass, plastic, metal, ceramic and paper, they can be assessed as secondary raw materials. Thus, it is possible to decrease the raw material need of the industry and to decrease energy consumption for the raw material production as well. The recovery of solid waste will also reduce the amount of landfilling.

REFERENCES

1. Design and implementation of integrated solid wastes management pattern in industrial zones, case study of Shahroud, Iran, Nazemi Saeid,¹ Aliakbar Roudbari,² and Kamyar Yaghmaeian³, Published, 2014 Jan 14.
2. https://www.env.go.jp/earth/coop/coop/c_report/egypt_h16/english/pdf/021.pdf.
3. Egyptian Environmental Policy Program, Solid Waste Technical Assistance Program, Solid Waste Management Privatization Procedural Manual, Chapter 10: Industrial Waste Collection and Disposal.
4. <http://www.monofeya.gov.eg/home/investment/InvestmentMap/QuweisnaIndustrialZone/Displayenews.aspx?ID=1>.
5. Solid waste management book, Subhash Anand, 2010.

6. Impact of solid waste on health and the environment, Special Issue of International Journal of Sustainable Development and Green Economics (IJS DGE), ISSN No.: 2315-4721, 2013; 2(I-1).
7. <http://shodhganga.inflibnet.ac.in/bitstream/10603/39319/8/09chapter3.pdf>.
8. Types, Amounts and Effects of Industrial Solid Wastes - Jinhui Li.
9. <http://www.sciencedirect.com/science/article/pii/S0956053X060022>.
10. http://www.eai.in/ref/ae/wte/typ/clas/india_industrial_wastes.html#sthash.KrxZ2IwP.dpuf
11. <http://localbodies.up.nic.in/swm/chap6.pdf>.
12. U.S. System - Code of Federal Regulations Title 40, Section 261.
13. Egyptian Ministry of Industry Draft Hazardous Waste Lists and List of Hazardous Materials, 1997.
14. Basel Convention - Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, March 1989.
15. Point sources of pollution: local effects and it's control – Vol. I - Types, Amounts and Effects of Industrial Solid Wastes - Jinhui Li.
16. <http://osp.mans.edu.eg/environmental/ch6f.html>.
17. <http://wgbis.ces.iisc.ernet.in/energy/SWMTR/content1.html>.
18. http://brage.bibsys.no/xmlui/bitstream/handle/11250/221510/master_mazaherian.pdf?sequence=1.
19. <http://osp.mans.edu.eg/environmental/ch6f.htm>.
20. <http://www.slideshare.net/felichimogo/a-lecture-on-waste-handling-and-collection>.
21. <http://mebig.marmara.edu.tr/Enve330/Chapter10.pdf>.
22. <http://osp.mans.edu.eg/environmental/ch6f.htm>.
23. <http://www.fao.org/docrep/007/y5104e/y5104e05.htm>.
24. <http://www.ukessays.com/essays/environmental-sciences/issues-associated-with-solid-waste-disposal-environmental-sciences-essay.php#ixzz3bny31qei>.
25. Egypt State of the Environment report, 2006 (MSEA, 2007. p. 48).
26. Solid Waste Management Privatization Procedural Manual, Industrial waste collection and disposal, EEAA, Egyptian Environmental Policy Program.
27. www.sadcpppnetwork.org.
28. Solid Waste Management Privatization Procedural Manual, Industrial waste collection and disposal, EEAA, Egyptian Environmental Policy Program.
29. http://www.bat4med.org/sites/default/files/publication/files/egyptian_national_analysis.pdf.

30. <http://www.monofeya.gov.eg/home/investment/InvestmentMap/QuweisnaIndustrialZone/default.aspx>.
31. Solid Waste Management Privatization Procedural Manual, Industrial waste collection and disposal, EEAA, Egyptian Environmental Policy Program.
32. Grant Proposal for Financing under the Mena Transitional Fund: Green Growth: Industrial Waste Management and SME Entrepreneurship Hub in Egypt.
33. <http://www.eeaa.gov.eg/english/reports/EPAP/Proper/IndustrialPolicy/IndustrialPollutionpolicyinEgyptEnglish.pdf>.
34. http://www.unep.org/ietc/Portals/136/Publications/WasteManagement/UNEPDTIE_Japanese_waste_english_web.pdf.