

Hazardous waste management in Egypt: status and challenges

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Abstract

Establishing Hazardous Waste Management in Egypt has faced a number of challenges, encompassing the absence of criteria to identify hazardous waste, as well as operational details on how to ensure safe handling of this waste during the different stages of its management, and the lack of treatment and disposal services. A number of these challenges have been addressed, while others have been used to promote hazardous waste minimization. Current efforts in Egypt to fully implement hazardous waste management make use of public private partnerships. Challenges faced and learned experiences are used for making recommendations for developing hazardous waste management in economies in transition.

Keywords: hazardous waste management, waste minimization, economies in transition, public private partnership.

1 Introduction

Hazardous waste (HW) management has been identified by the Egyptian Government as a priority concern for environmental protection. In this respect, the Egyptian law for environmental protection specifically addresses HW through a number of stipulations concerned with its proper management during the different stages of its lifecycle. Enforcing the stipulations of the environmental law has been faced with a number of serious challenges. The absence of pertinent operational details necessary to ensure compliance presented one set of challenges, particularly with what is concerned with the identification of HW. Another set of challenges entails the absence of HW treatment and disposal services.



This paper presents these challenges as well as lines of action which have been adopted to overcome them, focusing on how such challenges were exploited to promote waste minimization. The role of private-public partnership is crucial in assisting in the development of HW treatment and disposal services, and in this respect, it is also briefly presented and discussed.

2 Hazardous waste regulatory framework in Egypt

Although environmental protection has been implicitly included in a number of Egyptian legislations as early as the 1960s [1,2,3,4,5], its importance was explicitly recognized in the late 1980s, and culminated with the expansion of the Egyptian Environmental Affairs Agency's mandate as a coordination entity, followed by the issuance of the environmental law (Law 4/1994) in 1994, and its executive regulations (ER) in 1995. Within the framework of this new environmental legislation, hazardous waste was recognized, for the first time, as a potential source of significant environmental degradation. In this respect, Law 4 and its ER address the identification and management of HW through a number of stipulations aiming at minimizing environmental and public health risks of mismanagement practices of this type of waste.

The stipulations of Law 4 and its ER can be grouped into three principle categories addressing HW identification, HW management, and a control system based on licensing:

2.1 Hazardous waste identification

A general definition of what constitutes HW is provided by Law 4 on the basis of the risks such waste poses to environment and public health as a result of its 'hazardous' nature: *'Wastes of activities and processes or their ashes that maintain their harmful properties and have no subsequent original or substitutive uses'* [6].

Unfortunately, no specific hazardous characteristics have been identified by Law 4 nor the ER, and no waste streams, groups, or constituents have been listed. This was required from a number of different ministries and entities, each to specify the waste it considers hazardous within its field of competence, without providing any framework on the principles to be followed to achieve this.

2.2 Hazardous waste management

Law 4 and its ER specifically address different components of HW management through a number of stipulations concerned with waste minimization, waste storage, packaging, collection, transportation, treatment and final disposal [7]. These stipulations, though comprehensive in addressing the different stages of waste management, offering overall general requirements for each stage, lack operational details. These details would on the one hand enable waste generators and potential waste management service providers to comply to regulatory requirements, and on the other hand enable regulatory bodies to ensure the enforcement of these requirements.



2.3 Licensing system

With the aim of ensuring that generated hazardous waste streams are channelled through management systems complying with set regulations, a licensing system is stipulated [6,7]. Entities handling HW are required to obtain licenses from regulatory entities with a commitment to comply to regulatory stipulations, and upon demonstrating technical competence for carrying out the necessary operations for waste management. Breaching any of these regulations could instigated the revoke of the license, preventing such entities from being involved in HW management activities.

2.4 Reporting

During the development of the Egyptian environmental legislation, and as a consequence of limited financial, technical and human resources in this field, no requirements for environmental reporting to concerned regulatory entities were set. However, stipulations were included in the legislation for establishments to carry out 'self-reporting' by keeping an environmental register where environmental performance is recorded according to the set regulatory requirements. A register specific to HW management was also required, being the primary source of information for compliance to set regulations, and licensing conditions. Such registers are not sent to regulatory bodies, but kept at the establishments, to be accessed by environmental inspectors during inspection visits.

3 Enforcement of hazardous waste regulations

Environmental enforcement activities started a short period after the issuance of the ER. As expected in the initial stages of such activities, a number of difficulties had to be addressed and overcome. These not only entailed the allocation of necessary funds for such activities, but more importantly the development of necessary institutional framework and procedures, as well as the technical capacities [8,9,10]. During this initial phase, environmental performance with regards to hazardous waste management was not given a top priority. After all, the actual dimensions of environmental degradation due to mismanagement of hazardous waste was not as clear and pressing as that resulting from air and water emissions. Moreover, the area of hazardous waste was a novelty within the structure of public administration, particularly that of regulatory bodies. Furthermore, the identification of what constituted hazardous waste was not as clearly defined in the legislation as were the set limits for air and water emissions, or quality of air in the work environment, for example. However, as enforcement activities progressed, the need to set proper HW management in motion became more pressing, especially with regards to the industrial sector where it became clear that it might present the largest contribution to HW generation in Egypt.



3.1 Challenges

Two major setbacks became evident: the lack of specific criteria in the legislation with regards to what constitutes HW, as well as an absence of detailed agreed upon best practices on how to comply to requirements set in Law 4 and its ER. Although a number of HW classification systems, and a wide variety of best practices documents for HW management are available internationally, the need to develop a national classification system, and guidelines, based on such experiences, but adapted to the specificities of the Egyptian case was recognized.

3.2 Solutions

In response to a growing need to manage risks associated with non-identification of HW, and in consequence its mismanagement, the development of a national system for HW identification as well as a number of national guidelines setting best practices for different components of HW management, was carried out.

3.2.1 The national system for the identification and classification of hazardous waste

This is based on the US EPA for HW identification and classification. Waste is considered hazardous according to four principle characteristics. Quantitative criteria for these characteristics are determined by standardized laboratory tests. With the aim of maximizing the accessibility to this system, waste identified according to such criteria is listed according to sources enabling generators to directly identify generated waste as hazardous or not, and classify it for further handling [11].

The legal breakthrough of this system is obvious. It allows generators, regulators as well as potential waste management service providers to survey and identify HW types and estimated amounts generated from different sectors of the economy, particularly from industry. This is essential for the definition of the magnitude of environmental impacts the mismanagement of this waste results in, a process necessary to justify allocation of public funds for addressing HW associated problems, and identifying services needed in this field, as discussed below.

3.2.2 The operational guidelines

Operational guidelines were developed for different components of HW management [12,13]. Practically, these guidelines offer best practices used as standards for the assessment of HW management activities relative to the requirements set in the Egyptian legislation. They have been developed in light of practices and experiences available internationally, but adapted to the Egyptian conditions. These guidelines are expected to be regularly reviewed and updated according to the development of experiences in this field in Egypt.

3.2.3 HW management manuals

In addition to the best practices guidelines, the need for capacity building documents and training programs was identified. These offer assistance not only to entities handling HW to comply with legislation, but also to regulatory bodies



responsible for regulation enforcement. They primarily address the industrial sector, generating the widest diversity of HW types, and believed to be responsible for the largest contribution of HW generation amounts [14,15,16].

4 Hazardous waste treatment and disposal: the deadlock to compliance

Effective HW management entails either recycling/reusing this waste or its proper treatment and/or disposal. If such waste is not recyclable/reusable, the absence of treatment and disposal options seriously undermines efforts for the control of risks associated with this waste. After all, if a HW stream is identified as such, classified according to its hazardous characteristics, properly stored, labelled, collected and transported, only to be disposed of in sites not prepared to accommodate it, and without proper treatment, all efforts for its proper management are futile. In this respect, the absence of treatment and disposal options presents a serious challenge to justifications for the implementation of any measures for HW management. This is one of the most significant dilemmas facing regulatory bodies in Egypt.

Up till recently the major setbacks to complying to, and enforcing, HW management regulations were the absence of clear and measurable criteria for identifying and classifying HW, as well as the absence of guidelines for meeting the stipulations of the environmental legislation, as discussed above. This in turn undermined all efforts to estimate HW generation types and amounts, rendering the identification of needs for proper HW management impossible to determine with any degree of confidence. Although HW management has been set as a priority for action by the concerned governmental bodies and included in strategies for environmental action [17,18], the absence of reliable estimation of the dimensions of problems of HW mismanagement on one hand, and the substantial financial requirements needed to establish central HW treatment and disposal facilities, together with central budgetary limitations, on the other hand, significantly delayed the establishment of such facilities through public funds. Moreover, the involvement of the private sector in the establishment of such facilities and related services did not take place for the same reasons: it proved impossible to plan for these facilities and services, when not only the market size was unknown, but the type of market itself.

The absence of HW treatment and disposal options rendered the development and implementation of waste identification and classification criteria, together with the guidelines for HW storage, packaging, transportation and treatment, more of a problem than a positive step forward. Generators realized that if they identified what waste they generated, segregated it from non-hazardous streams, properly stored it on site, and for some waste, pre-treated it on site, they would be unable to dispose of it in any legal way! They would become liable for waste which they could not get rid of! In consequence, most HW generators evaded identifying the waste they generated, not segregating from non-hazardous streams, hoping that this would make their legal liability for its improper disposal less clear.



Regulatory bodies were in an equally odd situation: they are responsible for enforcing HW regulations, including those addressing disposal, and they were neither able to designate sites where legal disposal could be carried out, nor explicitly accept practices of illegal disposal! In this respect, regulators were not able to effectively enforce regulations which came to be considered non-enforceable.

The situation had arrived to a deadlock: on the one hand, HW regulations could not be enforced nor complied to because of the lack of treatment and disposal services, and on the other hand, HW treatment and disposal services could not be established because regulations were not enforceable.

5 Waste minimization: a way out

In light of the deadlock in enforcing HW regulations, and resulting in HW being illegally and unsafely handled on the generation site and illegally disposed of, waste minimization was seen as a way out. Waste minimization is one of the requirements of the Egyptian environmental regulation where it is rightly considered higher on the hierarchical scale than waste treatment, and disposal [19].

In this respect, if generated waste could be minimized at source, recycled and/or reused, this would lead to a decrease in waste amounts ending up in disposal sites unprepared for receiving this waste. Moreover, this would minimize potential health and environmental risks of this waste during the different stages of its management from generation up to disposal. In addition, waste minimization is considered a better environmental option than proper final disposal.

Regulatory bodies embarked on initiatives to promote waste minimization with a focus on the industrial sector. They coordinated these initiatives with a number of international funding mechanisms, as well as international development assistance agencies for technical assistance. Contribution from both these types of entities was crucial. Technical assistance was found to be necessary as a majority of waste minimization schemes entailed changes in technologies used. National and international funding mechanisms were sought to secure financial support for such initiatives. In an economy in transition, the primary focus in production is concerned with the competitive rentability of this production, and any measures that need extra funds, particularly capital investments, are considered a hindrance to production. However, if funding mechanisms are available, such measures would be more widely adopted, particularly if they also result in more effective raw material usage, and lower consumption of energy or other utilities.

A number of successful pilot projects [20,21], currently being replicated, were carried out. They relied on the will of establishments generating HW to take the initiative and commitment to implement suggested waste minimization measures. In order to successfully achieve these measures, such establishments have to identify their HW, segregate it from non-hazardous waste, and where applicable further implement other waste management measures. In this respect,



these waste minimization schemes are used as a 'carrot' for industrial establishments to comply with HW environmental regulations, at least with what is concerned with waste identification and documentation. It is interesting to note that a majority of the chosen minimization schemes are ones with short pay back periods, varying between 18 and 36 months [20,21], rather than ones ensuring maximum waste minimization, or best opportunities for compliance to environmental regulations, for example. If anything, this is but a reflection of the decision making process at the level of individual establishments with regards to cost of HW management: compared to the 'zero' cost of not complying to HW regulations, and not having these regulations enforced on them with what this entails of fines for non compliance, waste minimization schemes with best conditions for financial returns (shortest payback periods) are favoured. It is believed that this decision making process would evolve as HW management services, particularly treatment and disposal, become available, and HW regulations become enforceable and relying on the 'polluter pays principle'.

6 Hazardous waste management: the future

The way forward for HW management in Egypt lies in the establishment of the much needed treatment and disposal facilities and services. In this respect, a pilot project is underway in the city of Alexandria where a central treatment and disposal facility, is to receive industrial HW. This facility, part of a cooperation agreement between the governments of Egypt and Finland, is to pave the way for the establishment of other similar facilities in Egypt. Considered as a milestone for HW management in Egypt, and with the will to ensure its sustainable operation, extensive analysis and discussions have been carried out involving stakeholders: concerned governmental bodies, HW generators, as well as possible operators for the facility from the private sector [22,23]. The main issue of concern lies in the coverage of the cost of services.

There is a consensus among stakeholders that the 'polluter pays principle' would form the bases for covering the cost of services. However, there is a need to manage cost coverage in light of the degree of enforcement of environmental regulations, especially at the initial phase where treatment and disposal services become available for the first time. This is with the purpose of avoiding four possible scenarios. *Scenario I* entails relatively high costs of services, and weak enforcement. This would lead to a continuation of the current problematic practices of not identifying the generated HW, mixing it with non-hazardous streams, not treating it, and disposing of it illegally. *Scenario II* entails relatively high costs of services, and strong enforcement. This would lead to probable financial difficulties for a number of HW generating establishments, particularly within an economy in transition, as in Egypt. *Scenario III* entails relatively low costs of services, with weak enforcement. This would still lead to a continuation, at least partially, of the current problematic practices of not identifying the generated HW, mixing it with non-hazardous streams, not treating it, and disposing of it illegally. This is a plausible scenario because even though the cost of services is relatively low, generators would be comparing it with the current



zero' cost for disposing of their HW. *Scenario IV* entails relatively low costs of services, and strong enforcement. This would lead to an excessive use of such services on the detriment of the better environmental practice of waste minimization.

Of these scenarios, the second one is the most valid from an environmental performance perspective. However, the issues of extra financial burdens need to be addressed. It is believed that this can best be done with governmental interventions through different possible mechanisms to 'subsidize' such services at the initial stages, especially where reliable data on amounts and types of HW generated are not available due to non-compliance. These mechanisms should not rely on direct subsidies, but rather on ones related to environmental performance for HW management: compliant generators, would be given an exemption of part of the cost of services. In this respect, these governmental interventions must be seen as temporary. As enforcement is better implemented, and as data become reliable regarding HW generation, these interventions would be minimized. This is crucial so as to ensure that any 'subsidies' offered at the initial stage of services to encourage generators to join HW management systems, must not be detrimental to waste minimization in the long run.

Very importantly, the sustainability (financial as well as technical) of established treatment and disposal services and facilities must be ensured. In this respect, their operation on a competitive basis is unavoidable to ensure overall rentability of services. This can only be effectively achieved by the private sector involvement. However, this sustainability heavily rests on a constant level of effective enforcement of environmental HW regulations, with the aim of ensuring that generated waste, if not recycled and/or reused, is not illegally disposed of. At this early stage of development of these services in Egypt, enforcement is still weak. In consequence, risks to investments by the private sector in this domain are considered high, deterring many interested private sector entities from getting involved. The way out of this is through public-private partnerships [24], where public sector involvement can take a variety of forms. It can encompass joint ownership of facilities and operation of services, public ownership of facilities with concession agreements to the private sector, or public ownership of facilities with service agreements to the private sector. The respective roles and responsibilities of each entity within this partnership have a multitude of alternatives, to be tailor-made to each specific case. An added advantage to these partnerships is their ability to accommodate time-varying governmental interventions aiming at encouraging HW generators to become part of HW management systems, as discussed above.

For the case of the HW treatment and disposal facility in Alexandria, to become the ownership of the Governorate once complete, ways of involving the private sector in the operation of the facility and offering of the services, are under consideration. Moreover, preliminary steps are underway in the Governorate of Suez, known for its large petrochemical industrial sector, for investigating the establishment of a facility and services in Suez, where public-private joint ownership, involving HW generating establishments, is considered.



7 Initiating and developing national HW management systems in developing countries

Based on efforts and initiatives carried out to establish HW management in Egypt, accumulated experiences are believed to be relevant for the initiation and development of national HW management in other countries with economies in transition. The principle necessary stages are as follows:

Development of regulations: these regulations must rely on previous experiences available worldwide, but should be adapted to local conditions. Regulation must not be excessively detailed, nor too complex. If so, compliance would be challenging, and enforcement questionable. Most significantly, regulations must clearly and precisely identify what constitutes HW, preferably through characteristics or properties of the waste which can be practically and straightforwardly determined.

Waste minimization: this must be included in the regulatory requirements as an environmentally preferred alternative to waste treatment and disposal.

Guiding Documents: to ensure proper HW management, guiding documents, with mechanisms for updating, addressing different components of the management system need to be developed, emphasizing 'how' to comply to regulations.

Enforcement: Full enforcement of regulations should come after a 'grace period' in which technical assistance and capacity building are offered to both regulatory bodies, as well as generators. A focus must be placed on identification of the generated HW, its segregation from other waste streams, and the principles of waste minimization. Moreover, full enforcement should not take place before alternatives for treatment and disposal of the waste are in place, even if to a limited extent.

Costs for HW Management: the 'polluter pays principle' must form the bases for covering the costs of any HW services. However, this can only be followed if enforcement is effective. If it is not, the risks of illegal 'escape' of HW outside the management system are very high. In cases of weak enforcement, financial mechanisms would need to be set up to offer support for converging as much as the HW into the system. Such mechanisms should not be long lasting, but implemented over limited time ranges. Otherwise, they will become detrimental to waste minimization.

Public-Private Partnerships: these are effective for ensuring the sustainability of established services, facilities, and/or systems. The involvement of the private sector increases the possibility of rentability, whereas the contribution of the public sector limits the sensitivity of the sustainability of services and facilities to the level of enforcement. These partnerships are useful in the control of the costs of services, used to promote waste minimization on the one hand, and compliance to regulations with minimal risks of financial difficulties, on the other.



8 Conclusion

An overview of the development of the establishment of HW management in Egypt has been presented. A focus is placed on encountered challenges, with methodologies and mechanisms developed to address them. HW management is still not fully implemented in Egypt. However, learned lessons, together with the current steps to establish treatment and disposal services, are promising, as long as the will to effectively enforce environmental regulations is sustained. Recommendations for initiating and developing national HW management systems are presented for developing countries, with an emphasis on the promotion of waste minimization, as well as the role of public private partnership.

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