



International Journal of Development and Sustainability

Online ISSN: 2186-8662 – www.isdsnet.com/ijds

Volume 1 Number 2 (2012): Pages 466-475

ISDS Article ID: IJDS12082001



Patterns of waste generation, treatment and disposal in the chemical and allied industries in Ghana

Osei-Wusu Achaw *

Department of Chemical Engineering, Kumasi Polytechnic, Kumasi, Ghana

Abstract

Environmental pollution and degradation in urban Ghana has been on the increase as a result of the nations drive towards industrialization, a generally weak regulatory regime, and a lack of capacity to manage the environment. This situation is affecting the well-being and livelihood of affected communities. As part of an effort to address the issue, a thirteen (13) item questionnaire was designed and distributed to seventy (70) companies in the chemical and allied industry to solicit and analyze data and information on the their waste management situation. Forty-seven, representing 67.1%, of the distributed questionnaires were completed and returned. The responses were analyzed using tables, percentages and bar charts. The results revealed that while 80.9% of the respondents generate waste as a result of the operation of the plants, 23.3% directly dump their waste into the environment without any prior treatment. Only one company was found that incinerate its waste, and only four (8.5%) had comprehensive waste water treatment plants. The low numbers of companies treating the waste they generate prior to disposal means that the chemical and allied industry is contributing to the environmental pollution and degradation in the country.

Keywords: Industrial waste, Waste handling, Waste water, Pollution, Environment

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International Society for Development and Sustainability (ISDS)

Cite this paper as: Achaw, O.W. (2012), "Patterns of waste generation, treatment and disposal in the chemical and allied industries in Ghana", *International Journal of Development and Sustainability*, Vol. 1 No. 2, pp. 466–475.

1. Introduction

Although not very well developed, the chemical and allied industries in Ghana play a significant role in the economy of the nation (Bermúdez-Lugo, 2009). However, in spite of their obvious benefits, some of these industries have adverse impact on the environment, economy, livelihood of the people and the communities in which they operate. The degradation of land, flora and fauna as a result of the activities of these industries often affects generations yet unborn (Lancaster, 2010). The chemicals they release into the environment affect air quality, water bodies, the health of their employees and all living organisms that come into contact with these chemicals. Specific chemicals like carbon dioxide and flouro-chloro carbons generated by some of the industries have now been found to be the cause of climate change. Poisonous chemicals which find their way into rivers, lakes, and underground aquifers cause health problems to affected communities who use these water sources. Others like the cement industry emit particulate matter into the environment and are the cause of respiratory diseases. Flue gases from refinery stacks affect air quality and sometimes are the cause of acid rain, which has been established to affect ecosystems (Driscoll et al., 2003). Waste water if not properly disposed off sometimes becomes breeding grounds for disease causing microbial agents.

A number of regulations exist in the country that spells out how industrial waste and environmental pollution should be dealt with (EPA Act, 1994). The EPA-Ghana, recently introduced a new instrument dubbed AKOBEN to promote compliance with its regulations (EPA-Ghana, 2010). AKOBEN uses public ridicule to goad companies polluting the environment to deal with the problem. In spite of the obvious negative impact of the activities of industry on the environment, the regulatory agencies, the local and national authorities in Ghana are still grappling with effective means of dealing with environmental pollution and degradation. The reasons are manifold. In the first place, a generally weak regulatory regime has created an environment where polluting industries are not motivated to adopt the requisite technologies and measures to deal with pollution related problems at their plants. Also, local authorities lack the capacity and resources to enforce regulations and deal with the causes of environmental degradation. Moreover, information and data are lacking on the specifics of waste the industries generate and the sort of mitigation plans that exist, if any, to deal with the waste.

It is to contribute to solve this that the study was undertaken; namely to collect data and information so that a rigorous assessment of the waste situation in the chemical and allied industry in Ghana could be done. The study presented herein is part of that broader objective, and presents the results on how waste is generated, treated and disposed off by a cross-section of the chemical and allied industries across five relatively industrialized regions of the country. It also investigates the uses, if any, to which the wastes are put, and if these wastes have any economic use or importance.

The chemical and allied industries were chosen because of the scope and depth of the waste they generate and the potentially harmful consequences of these wastes on the environment and on the health of affected communities if not properly handled. It is anticipated that the data and information generated from the study will enable local and national authorities to develop the appropriate mitigation or regulatory measures to deal with pollution and environmental degradation related problems from this sector of the industry. The

study was accomplished by designing and administering a thirteen (13) item questionnaire to seventy (70) chemical and allied industries across five regions of the country and analyzing the returned responses.

1.1. Materials and methods

The work employed descriptive survey research method to gather data using a questionnaire instrument. A thirteen (13) item questionnaire was designed and administered to seventy (70) selected chemical and allied industries across Ghana. Additionally, flow sheets of the industries were requested for study in order to authenticate the veracity of the process information submitted by the respondents. The industries selected cut across the broader spectrum of the chemical and allied industries in the country. Data and information received from forty-seven (47) respondents were subsequently analyzed using tables, percentages and bar charts.

2. Results and discussions

Out of the seventy (70) companies to which questionnaires were sent, forty-seven (47), representing 67.1%, responded. Table 1 gives the distribution of the categories of industries that responded to the survey. The bulk of the respondents are in the food processing and polymer products industry category, while the lowest numbers were recorded for the textile and paper products industries. The high numbers of respondents from the food processing and polymer products do reflect actual situation of these industries in Ghana (United Nations Conference on Trade and Development, 2011). However, the relatively low numbers for the extractive metallurgy (2), pharmaceutical (4), and water treatment (1) industries do not reflect the actual situation of these industries in Ghana.

The actual representation of these latter industries in Ghana is considerably higher than the table depicts. For instance, as of 2008 there were twenty-three extractive metallurgy plants and close to thirty-two registered pharmaceutical manufacturing companies in Ghana (Bermúdez-Lugo, O., 2009; Harper and Gyansa-Lutterodt, 2007). The small numbers recorded for these industries in the table was mostly due to the of officers of some of the companies to respond to the questionnaires. On the other hand, the very small numbers recorded for the textile (1) and paper products (1) industries reflect the actual situation of these industries in Ghana. Based on a UNIDO (United Nations International Development Organization) classification (Elaian, 1996) twelve of the companies surveyed, representing 26%, are large scale companies while the rest are of medium and small scale companies.

2.1. Waste generation and handling

Thirty-eight (38) companies, representing 80.9% of the forty-seven (47) respondents indicated that their company generated waste. Three (6.4%) of the respondents said their companies did not generate any waste, while six (12.8%) companies did not give any response to indicate whether or not they generated waste. Though small, it is still intriguing that three of these companies claim their plants do not generate any waste.

In particular, given the set-up of the companies in this group, as evidenced from the flow chart accompanying the responses, these companies use water to wash equipment even if not in large quantities. Therefore, water is necessarily later discarded and therefore constitutes waste. Moreover, it is highly improbable that no waste is left at the trail of the employees of the companies who expectedly would use all manner of consumables, including food and paper, and therefore are wont to produce all manner of waste. This response therefore raises a number of questions about the actual waste situation of these companies, namely, either the respondents are not being truthful about the actual waste situation of their companies or they lack appreciation of what constitutes waste. Equally, the six (12.8%) of the companies that failed to respond to whether or not their companies generated waste raises a number of questions. In particular, these same respondents gave responses to the other questions posed in the questionnaire. That they shied away from answering this singular question could be due to a number of reasons; important among them is the possibility that they are hiding the true waste situation of their companies.

Table 1. Classification of surveyed industries

Industry Category	Number of Respondents
Food Processing	10
Polymer Products	11
Cement	2
Pharmaceuticals	4
Edible Oil	4
Fuel Oil & Products	3
Industrial Gas Products	2
Alcoholic Beverages	3
Extractive Metallurgy	2
Textiles	1
Metals & Metal Products	3
Paper Products	1
Water Treatment	1
TOTAL	47

There is sometimes the tendency for companies to hide the waste they generate knowing very well the likelihood of public outcry and the possibility of government backlash. This is likely to be so if these companies are indiscriminately dumping the waste they generate without any prior treatment or if the waste has adverse effects on the environment. Even though assurances were given, in writing, to the companies involved in the study about the confidentiality of any information they would give, some still held back vital information about the waste situation of their companies fearful of the consequences if such information were made public. This tendency for some of the companies to hide data means that the regulatory agencies

should do better than just rely on information provided by the companies to gauge pollution related issues of the companies.

Eighteen (18) of the respondents, representing 38.3%, recycle the waste generated by their plants (Figure 1). Among those in this group are mostly the plastics and metal processing companies where the plastic bits and metal scraps could easily be gathered and recycled. Ten (21.3%) plants either directly or indirectly through waste management agents, dispose off the waste to waste dumps. In this category are some of the food processing, pharmaceutical, extractive metallurgy and paper industries. This number does not include the three (3) companies that treat the waste before disposing them off. Another ten (21.3%) of the companies sell the waste directly to third parties. These include mostly the food processing companies whose waste could be sold for use as fertilizers as happens in the case of the cocoa processing industries, and the metal processing plants that sell the metal scraps to third parties. Finally, one of the respondents stores the waste.

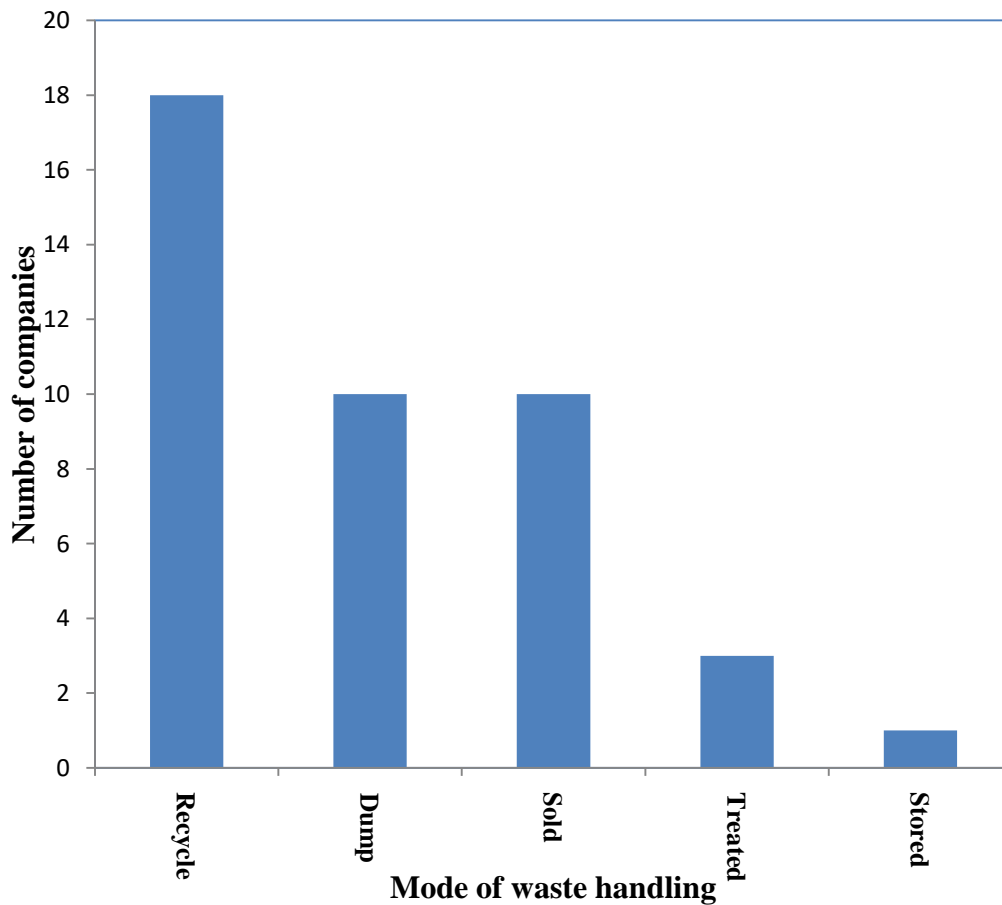


Figure 1. Distribution of mode of handling of waste among respondents

The specific wastes generated by the companies and the number of companies that generate them are listed on Table 2. The spectrum of waste generated by these companies is wide and includes gases, liquids and solids. If not recycled or treated before disposal, most of these wastes would have adverse effect on the environment and the health of employees and communities where the plants that generate them are sited. For instance, the gases such as the oxides of sulphur (SO_x), hydrogen sulphide (H_2S) and the oxides of nitrogen (NO_x) are known to be the cause of acid rain [Driscoll, et al., 2003] which has grave consequences on flora and fauna and consequently climate change and agriculture .

2.2. Waste water generation and handling

Seventeen (17) of the respondents, representing 36.2%, said that their operations generated waste water. Six (12.8%) of the companies generate no waste water while twenty-four (51.1%) of the respondents did not answer the question of whether or not their operations generated waste water. Here again, the large number of companies refusing to answer the question gives one cause to think that some of these companies appear to be not forthcoming with the truth about the actual state of their waste water situation. In particular, as evidenced from the process flow sheets that accompanied the responses, the processes of some of the industries clearly involve the use and disposal of water. Among these, for instance, are two food processing companies that based on the flow charts accompanying the responses, use water to wash intermediate operations and subsequently discarded the water. Similarly, there are three companies that use and discard condensed steam; and finally, there are others that from all indications discard water used to wash their equipment. It appears therefore that these latter companies clearly are not truthful about the state of waste water handling in their plants.

Table 2. List of specific wastes generated by the companies

Waste Type	Waste Specifics	No. of Companies
Gases	CO_2 , H_2S , NO_x , SO_x , $H_2O(v)$, N_2	6
Liquids	Detergent water, diluted product effluent, deluged water, oily water, oil, soap stock, sour water, milk, liquid residue	30
Solids	Plastic/Rubber chippings, cocoa shells, dust, paper cuts, aluminum scrap, aluminum dross, granules, fish bones and pieces, twines, defective packaging (cardboard and plastic), broken glass, steel drums, solid tailings, spent grain, spent filter aid, steel cuts, soiled cartons, yoghurt, food bits, rags, Pallets, damaged packaging and labels	19

The mode of waste water handling amongst plants that generate waste water is shown on Figure 2. Four (8.5%) plants directly dump the waste water without any treatment. That only eight (17%) companies treat the waste water before disposal or recycle (Figure 2) is also a cause for concern. In particular, save for the four (8.5%) companies that directly recycle the waste water and the one (2.0%) that stores the waste water, all the others could potentially be dumping the waste water into the environment. Waste water, when untreated, has been known to have serious adverse effects on the environment and the health of affected communities (Akarsubasia, et al., 2005; Akpor and Muchie, 2011). Once in the environment, the waste water could become breeding grounds for all manner of disease causing microbial agents. Again, the waste water could flow into and contaminate surface water bodies or seep into and pollute underground aquifers, which when later tapped for human consumption could have serious implications for the health of individuals that drink them. The prevailing situation should therefore engage regulatory agencies, local and national authorities to intervene in the matter by enforcing the requisite regulations and by application of appropriate deterrent sanctions. The methods used by the companies to treat the waste water include chemical treatment (4), filtration (1), comprehensive waste water treatment plants (4), density settling (1), and heating (1). Some of the companies use any combination of these methods such as, chemical treatment followed by filtration. It was observed that generally, those companies that treat their waste water are large scale in nature. Indeed, only the very large scale companies operate waste water treatment plants.

An important result of the study is the revelation that there is a seeming ambiguity among some of the responses on what constitutes waste. For instance, while eight indicated that they treated the waste water generated, only three respondents indicated that they treated the waste generated before disposal (Section 3.1). To the extent that waste water is also a waste, these responses indicate a seeming discrepancy in the minds of some of the respondents over what actually constitutes waste.

2.3. Effect of the waste generated on the environment

Only four companies, that is 8.5% of the respondents, studied admitted that the waste generated by their plants affected the environment. Twenty-nine (61.5%) of the respondents denied that their waste had any effect on the environment. Again, while 23.1 % of the respondents said they were not sure of the effect of their waste products on the environment, 5.1% said they did not know if the waste had any effect on the environment. The large number of companies denying any effect of the waste on the environment, when weighed against the 80.9% that actually generate waste raises a number of questions. First, there seems to be a lack of understanding among some respondents on how the wastes they generate affect the environment. In particular, there is the tendency for some respondents to think that once the waste is dumped or drained away, then it is taken care of such that it cannot have any effect on the environment. Second, it is also not too farfetched to reason that some of these companies are not forthcoming with the truth about the waste situation of their plants for fear of public outcry and possible sanctions by requisite agencies. However, there are those companies whose operations, indeed, do not indeed affect the environment any significantly. This last group includes some of the pharmaceutical companies in the country whose main activities revolve around mixing and packaging of active agents and relevant additives.

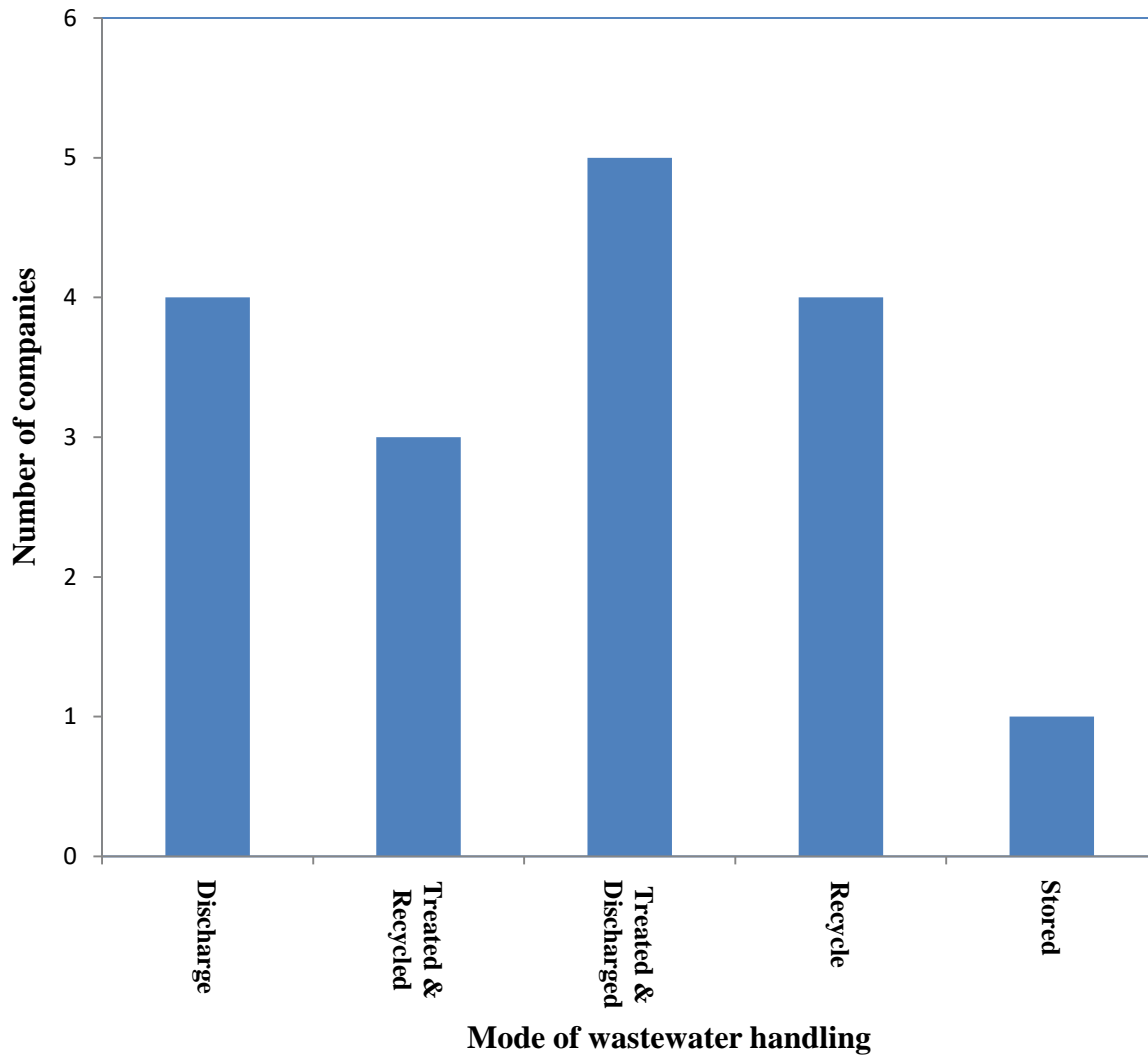


Figure 2. Distribution of mode of wastewater handling among respondents

Another remarkable observation that emerged out of these responses is that respondents in the well established companies understand in very clear and unambiguous terms how the wastes their operations generate affect the environment. Moreover, this last group of personnel gave unambiguous responses to the study questions. On the other hand, respondents in some small and medium scale companies showed lack of appreciation of what constitutes waste in their facility and the effect of the wastes they generate on the environment. This disparity could be due to a number of reasons. It could be that the small and medium scale companies do not recruit personnel of requisite expertise to oversee their operations. It could also be that the small and medium scale companies, in view of their capacity, were unable to invest in technology to handle waste and pollution related matters. Again, the 23.1% that are unsure of the effect of the waste they

generate on the environment and the 5.1% that do not know if the waste has any effect on the environment all represent a worrying situation. One probable implication of this situation is that the companies have no measures in place to deal with the consequences of the waste they generate. Given the list of waste generated by the companies surveyed (Table 2), and the possible serious effects some have on the environment, this situation is indeed disturbing and deserves swift intervention by the appropriate regulatory agencies and local or national authorities.

2.4. Economic impact of the waste generated

Twenty respondents, representing 42.6%, admitted that the waste generated at their plants had economic benefits. The benefits include the sale of the wastes, recycle of the waste, or the natural degradation of the waste and the attendant release of nutrients into the soil. 28.2% of the respondents indicated that the waste produced at their plants had no economic significance. Among these are mostly those plants that directly dump their waste. Lastly, 39.2% of the companies are not sure of the economic significance of the waste from their plants. Respondents in this last group are mostly from the small and medium scale companies. This last point further supports the earlier observation that the personnel in some of the companies lack the requisite expertise to handle waste related issues at their plants.

3. Conclusion

The results of the study show that the chemical and allied industries generate and dump varied waste into the environment which potentially contributes to the pollution and degradation of the environment of Ghana. Most of the industries studied, at least 80.9% of them, generate waste as a result of their operations. 21.3% of the companies dump the waste directly into the environment without any prior treatment. Only few companies actually treat the waste they generate prior to disposal into the environment. Four of the companies operated comprehensive waste water treatment plants, and only one company has a plant for treating solid waste.

Acknowledgements

The author wishes to express his appreciation to the Teaching and Learning Innovation Fund (TALIF) of the National Council of Tertiary Education (NCTE), Ghana, for the financial support that made possible this research.

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