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A Study on Generation and use of Solid Waste in the Garment Industry

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ABSTRACT. *In Sri Lanka government policy is to accelerate industrialization. The garment industry has been one of the fast growing industries. This has resulted in rapid generation of solid waste which could lead to degrading environmental conditions for agricultural production and agricultural settlements close to the industries. Hence, guidelines on industrial solid waste management are needed.*

Major types of waste identified were fabric (43%), paper (4%), cardboard (5%) and polythene (4%). The remaining percentage (44%) of waste include sand, overlock waste and gunny bags. All the types of waste were clean and had potential for re-use or re-cycling. Existing disposal types were land filling (7%), burning (53%), dumping (30%) and other types (10%). The majority of industrialists burn their waste resulting in global warming. The consequences of global warming are well known.

Two types of garment industry waste users were identified. The majority of the users, that is 63%, act as middlemen by selling to the final users and the rest 46% make products directly out of the waste.

A major limitation of the study was obtaining accurate information on waste from the industrialists. There is significant potential for reducing the total quantity of waste generated by industries by adopting techniques of minimisation, recovery or re-use and re-cycling, prior to treatment and disposal in an integrated waste management system.

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INTRODUCTION

Industrial solid waste management is an important concern of environmental management. Since there are no established standards and adequate information on industrial solid waste in Sri Lanka, this study was undertaken to contribute towards the development of guidelines on solid waste management in the garment industry. The garment industry was chosen as it is the main export oriented manufacturing industry in Sri Lanka with a total of 748 factories within the three export processing zones of Biyagama, Katunayake and Koggala. Due to the rapid expansion of the industry in recent years, waste generation is now a problem. As a result agricultural land as well as agricultural settlements and health of farming communities that are found close to such industries could be affected in time. On the other hand if some of the waste products could be used as packaging material in agricultural marketing, low cost packing systems could be envisaged. The need for a solution has been expressed by the Board of Investment (BOI), the Central Environmental Authority (CEA) and Local Authorities.

Garment industry solid waste which contains carbon is susceptible to chemical reactions due to its composition and heat generated by microbial activity during decomposition. This would result in spontaneous ignition and posses a problem to the zone authorities due to fire hazard. Most garment factories do not have proper solid waste disposal facilities in the factory premises or in the vicinity. Where possible, waste is subject to open burning in the premises; otherwise it is transported to landfills or dump sites by private contractors or the factories' own transport. Such ad hoc disposal methods result in serious environmental impacts. Open burning would result in air pollution due to smoke and soot as well as the possible release of carcinogenic compounds from plastic burning. Open dumping would result in aesthetic problems as well as possible ground and surface water contamination. Solid waste at the two export processing zones of Biyagama and Katunayake is disposed off in an area within the zone. The public is allowed to scavenge waste unaided from the site at a nominal fee paid monthly or daily to the zone management. At Katunayake, it was proposed that 20% of waste from the dumping ground be incinerated, with a large portion of the balance being scavenged. Due to strict restrictions enforced in entering the zone as regulated under the BOI act, collectors have decreased in number. This has left much larger stocks than could be incinerated. Technological inadequacies in the incinerator has resulted in the emission of black smoke which causes problems to the airport closeby. Zone authorities have already received complaints from the neighbourhood and from the Katunayake International Airport about smoke

pollution. As a result, the incinerator has been discontinued with the waste being landfilled within the zone in an area of 8 hectares with daily soil cover.

The objectives of the study are to identify qualitatively and quantitatively the generation of solid wastes and disposal methods in the garment industry to recommend guidelines on appropriate management methods. A sample of garment factories were examined and a socio-economic survey on re-users of solid wastes was conducted in the Gampaha district including Katunayake and Biyagama Export Processing Zones.

METHODOLOGY

The study area

The study area is the Gampaha district which includes Katunayake Export Processing Zone (KEPZ), Biyagama Export Processing Zone (BEPZ) and Ekala Industrial Estate. There are a total of 162 garment factories out of which 33 are in the KEPZ and 7 in the BEPZ.

Quantification of waste

All the garment factories in Gampaha district were categorized as small, medium and large according to the number of industrial sewing machines in the factory *viz*; small - less than 100, medium - 100-199 and large - 200-299 machines as shown in Figure 1.

Proportionate number of factories; 3 : 2 : 1 respectively in small, medium and large category factories were picked up at random from total number of factories in the study area. Due to lack of willingness to participate in the study, in the large category of the sample, quantification was carried out in 3 small and 3 medium factories only.

Two gunny bags of thoroughly mixed waste from each factory were sorted out for qualitative and quantitative identification of waste. The quantification was done for a period of one month (January, 1996).

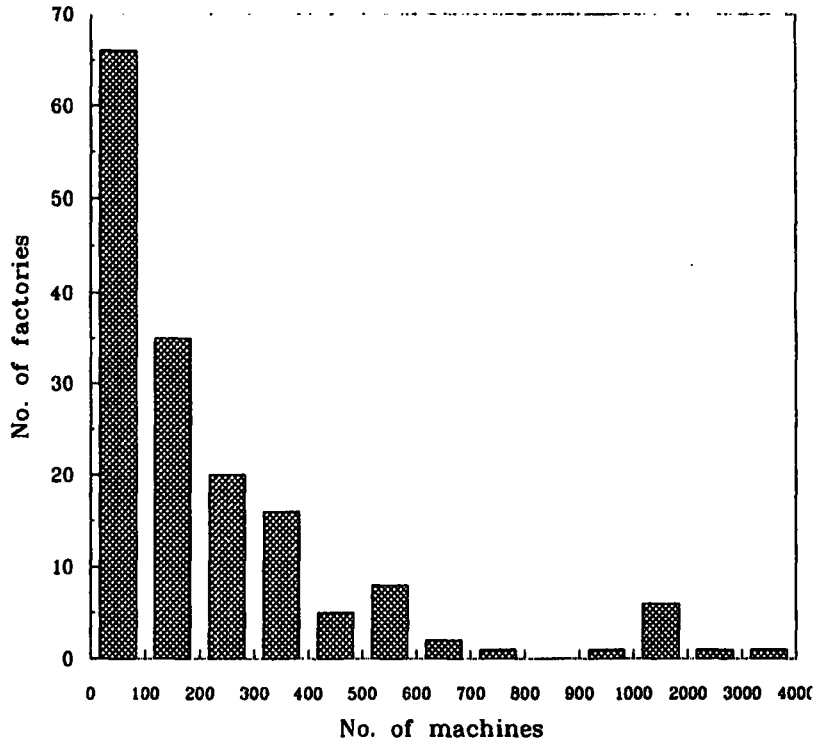

Figure 1. Garment factories in the Gampaha District in relation to number of machines.

Survey

A survey was conducted on a sample chosen at random, using a questionnaire. The sample consisted of 30 garment industrialists including the six factories selected for quantification. Information on types and quantities of waste, waste disposal methods, cost of disposal and income gained by selling waste were gathered. Another survey was conducted among thirty users of waste. Data on type/s, quantities and cost of waste purchased, methods of use and income gained were gathered. Ten houses in close proximity to the waste disposal sites were surveyed. Information to ascertain impacts on aesthetic beauty, health issues and willingness to pay for a clean environment were gathered.

RESULTS AND DISCUSSION

Quantified data

Number of machines in the selected six factories were 50 (A), 60 (B), 75 (C), 108 (D), 148 (E) and 154 (F). Major types of waste identified were fabric, paper, cardboard and polythene. Generation of solid waste types are seasonal in the industry. At the time this study was carried out, the waste type 'padding[1]' was not generated as all the factories were manufacturing summer clothes for the export market. All the types of waste observed were clean and had potential to be re-used in making other products or re-cycling.

Total quantity of waste

Total quantity (weight) of waste generated shows a direct proportional relationship with the capacity of the factory (Figure 2a). The variation in the daily generation of wastes too is higher in larger factories. High variation in the quantity generated could be resulted in the management of wastes.

Fabric waste

The quantity of fabric waste that goes to the disposal site is not directly proportional to the capacity of the factory (Figure 2b). The reasons for this are that factories A and E did not sell their fabric waste. Also, the factory E manufactured garments with denim, a heavy fabric through the study period. Large variation of quantities of fabric waste disposed within the factories is seen in the A, E and F factories. Because, large quantities of fabric waste would be generated during certain days of the study period when greater quantities of fabric are cut, due to high input rates in certain styles of the garments.

Paper waste

The generation of paper waste is not directly proportional to the capacity of the factory (Figure 2c). Also, irrespective of the capacity of the

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1 Padding is used as an insulating material in manufacturing winter garments.

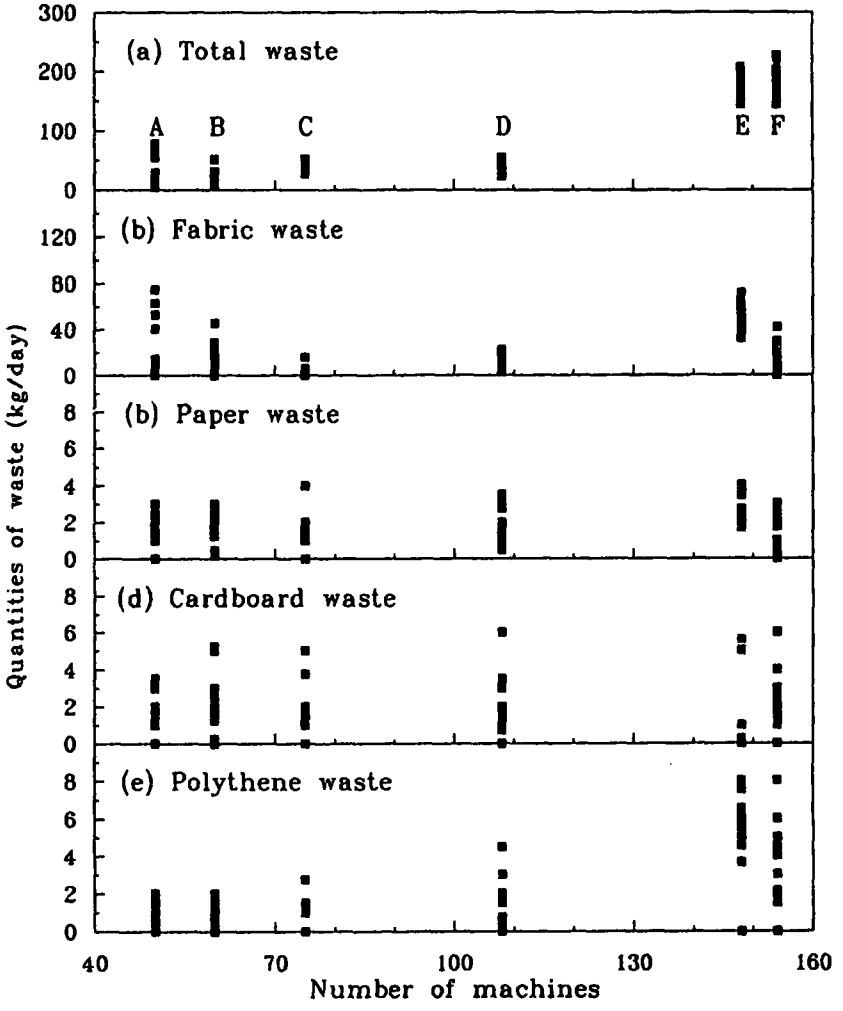

Figure 2. **Quantified waste in six garment factories with respect to number of machines.**

factory, quantities generated within the factory varied highly. This is because certain garments when manufactured in different colours and sizes, require many markers (which is a sheet of paper that contains all the components of a garment that is needed to be cut for a particular style and size), resulting in the generation of additional paper waste. The majority of the paper used are demy papers. None of the factories engaged in selling paper waste. In all the factories the paper waste is burnt.

Cardboard waste

The quantity of waste generated is not directly proportional to the capacity of factory (Figure 2d). Once again, there is a large variation within all the factories in the daily generation of this waste. This is because cardboard waste is generated in the garment industry from the packaging material of accessories and fabric brought into the factory. This depends on the number of imports and exports per day. It was found that undamaged cardboard boxes have a high demand by the users of waste, thus indicative of re-cycling potential.

Polythene waste

The quantity of polythene waste disposed is proportional to the capacity of the factory (Figure 2e). Quantities disposed by factories D, E and F had high variation within the factory. Polythene waste is generated in the garment industry due to the packaging material of the accessories and fabric. None of the factories sell their polythene waste. The most common method of disposal of polythene waste is burning. The smoke can contain dioxins and furans found to be carcinogenic to humans (Harrison and Hester, 1994).

Plastic waste

Zero or insignificant quantity of plastic waste was observed during the study. Though plastic is identified as a major type of waste, 100% of plastic waste is being re-used or re-cycled by the six industrialists. Plastic waste is generated as empty thread cones and packaging strapping. Some thread manufactures deduct 25 cents per plastic thread cone returned when buying thread. Also, there is great demand among plastic re-users for making whistles and re-cycled to make yoghurt spoons and soap boxes. Discarded strapping is used to weave baskets and to make toys.

Survey data

Survey data on quantities of waste generated by the garment industrialists were plotted to find whether the capacity of the factory is directly proportional to the quantities of each type of waste. These results contradict the quantified data of the waste identification survey of the study. Also, the data pattern appears very erratic.

Further, discussions with the industrialists revealed that they are making very rough estimates since they had no appreciation of the amount of waste generated and disposed of. The fact that there is no disposal cost incurred currently by industrialists has contributed to the lack of interest and knowledge of the waste disposal system.

Disposal methods of waste identified are land filling (7%), burning (53%), dumping (30%) and other types (10%). There are several contributing factors to methods of disposal *viz;* land filling - availability of site, burning - easiest method which clears the site, dumping - only method available in the industrial zones. Most industrialists are engaged in sale of waste. The highest demand exists for fabric waste, but this depends on the type of waste as some types do not have any demand at all, for example synthetic fabric offcuts. Approximate prices of fabric waste sold outside the zone are given in Table 1. Average income earned by selling waste was found to be Rs. 339 per day. This is a very rough estimate as some industrialists were hesitant to divulge the income gained by selling waste, as by law BOI factories are not allowed to sell the waste without paying duty. Although sale of waste is allowed, the buyer has to pay duty on waste. The quantity of waste bought has to go through customs, verification by BOI and zone security confirming that the goods are of no commercial value, since the goods brought in to the zone are duty free. This process is time consuming and tedious; therefore, buyers of waste are deterred from pursuing this avenue.

In the export processing zones the waste is transported by the industrialist to the dumping site; thereafter it is the responsibility of BOI to take care of disposal.

Generation of waste in the garment industry is the result of several factors such as style and size of the garment, the width of the fabric, skill of the workers drawing the marker, weights of different fabrics and methods of packaging from different countries.

Table 1. Prices of fabric waste.

DESCRIPTION	Rs/kg
Padding offcuts	10.00
Viscose-more than 1/2 m less than 1 m	120.00
Denim/Corduroy-more than 1/2 m less than 1 m	100.00
Denim/Corduroy-more than 1/4 m less than 1/2 m	65.00
Denim/Corduroy-less than 1/4 m	35.00
Cotton waste	3.00

Results from survey of waste users/scavengers (whose livelihood depends on this income) identified that there are two types of waste users. Sixty three percent of users act as middlemen by selling to final users and 46% make products directly out of the waste (Table 2). Some engaged in both types. Average income of a waste user is Rs. 189.40 per day. But this amount is higher than average cost per day (Table 2; fabric waste) as most of the users were not keen to give the actual amounts of income for fear of income tax.

Table 2. Types of waste re-used, average quantities and products made.

TYPE	COST Rs/day	QUANTITY kg/day	PRODUCTS
Fabric	395.25	30.22	Pillow cases, bed sheets, rugs, hats, shorts, underwear, baby clothes and soft toys.
Padding	26.42	7.13	To stuff pillows, mattress and soft toys.
Cardboard	35.20	29.16	To make boxes to export fruits and vegetables and to make pulp.

Limitations to increased use of waste as identified by survey of waste users:

1. The garment industrialists prefer selling the bulk of the waste to large purchasers rather than to individuals who come to purchase small quantities. Therefore, most of the users due to lack of capital to bulk purchase tend to buy the waste from the middlemen who quote very high prices. This results in the decrease in the quantity of waste purchased by the users.

2. High cost of duty payable when purchasing waste in the zones *viz;* Rs. 25.40/kg for fabric offcuts, packing material-padding and cardboard and Rs. 20.70/kg for empty thread cones. Other than government taxes, price of waste that has to be paid to the industrialist limits the number of users of waste.

3. Some of the industrialists are not aware how the garment industry solid waste can be used to get an additional income. Low cost of disposal and lack of awareness on negative environmental implications of the disposal methods of the waste also contribute to their ignorance on the use of waste.

The household survey revealed that the methods of disposal observed near the proximity of households were burning and dumping. The proximity to the disposal site from households ranged from 9 m - 30 m. Sixty percent of the households think the current disposal method impairs the aesthetic beauty of the site. None of the households surveyed were willing to pay to get rid of the disposal site, as they felt the polluter should clean the site.

CONCLUSIONS

As in all waste management systems, in the garment industry too, five steps in waste management namely: minimisation, recovery or re-use, re-cycling, treatment and disposal can be practised. The quality of waste types are such that the first three options should be actively pursued. For example, plastic, paper and cardboard can be re-cycled or re-used. Attempts should be made to determine if they could be used as packing material in agricultural marketing. The latter two methods of waste management *viz*; treatment and disposal can be used as a last resort as it is a direct cost to the industrialist and to the society.

The predominant component of garment industry solid waste is cloth, which is not easily degradable (National Building Research Organization, 1986). Landfilling of this may lead to land infertility which will be a future problem. The current practice of haphazard dumping or land filling has to be phased out, because improper setting or construction of solid waste dumps can lead to contamination of surface water and subsequently ground water through the process of run off (Scura, 1991).

Current BOI agreement with the investors is that the BOI has the sole responsibility for the disposal of waste. However, it is proposed that these terms of reference be amended to incorporate the "Polluter Pays Principle". Therefore, three approaches may be applied in addressing this issue *i.e.*, the BOI having a proper waste management system with cost recovery, industrialist to manage the waste system independently or to hire a private contractor, or management of waste by the BOI for which the industrialist will have to bear the cost depending on the quantities of waste disposed.

At present, the re-users are not provided with any assistance by the government or non-governmental organizations. Users of waste could be provided with assistance to use waste in innovative fashions such as use of fabric, paper and cardboard waste in manufacturing roofing felt, activated carbon from fabric waste and paper waste as animal bedding (Vogler, 1981). This could solve the problem of environmental pollution and provide new employment. If there is an incentive scheme, even the industrialists will be willing to re-use waste as a separate industry within the factory.

Most of the industrialists lack knowledge on the use of waste as a resource, as well as the environmental implications of improper disposal of waste. Therefore, it is important to carry out awareness build up programs for the industrialists on effective use and recycling of factory waste.

Waste minimization is in its infancy in the garment industry due to the extremely low disposal costs for wastes. As long as the avoided cost is not high *i.e.*, disposal methods would continue. However, with the development of proposed sanitary landfill at Welisara, which would accept non-toxic industrial wastes for a disposal fee, the concept of "avoided cost" will be apparent. This will force the industrialists to adopt methods of waste minimisation in order to reduce the cost incurred on waste disposal. In addition, proposed National Environmental Regulations which will prohibit haphazard dumping and burning of waste will compel the industrialists to incur the cost of waste disposal in an environmentally acceptable manner.

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