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Environmental Management System (ISO 14001) Implementation and its Impacts on Waste Management in the Electronic Sector

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Abstract: Increments of waste due to the industrial and domestic activities had raised the need for a more efficient and systematic waste management. Factors like costs, ineffective enforcement and lack of environmental awareness had resulted companies taking easy way out to manage their waste. ISO 14001 is one of the initiatives for organization in running their business, while preserving the environment. Main objective of this research is to study the positive and negative impacts upon implementation of ISO 14001 on waste management in selected electronic factory, which is NEC Semiconductors (M) Sdn Bhd., which is located in Telok Panglima Garang, Selangor. Three methods were applied in this research; questionnaire for operators, management interview and field observation. This research found that the ISO 14001 is obviously has brought many positives changes on waste management aspects such as more orderly storage, inventory and labeling, good controlled of waste disposal and a reduction in waste generation. Furthermore, the organization also gained benefit in terms of company reputation and increasing staff awareness on the environment and its management. The implementation of ISO 14001 seems as very helpful for the management of waste. It become very systematic and efficient. Besides compliance to laws and regulations, the EMS gives an advantage to the company to compete locally and internationally.

Key words: Environmental management system, ISO 14001, NEC semiconductors, electronic sector

INTRODUCTION

Today, the world's population generates enormous amount of waste. Whether, we live in industrialized countries or developing countries in big or small cities, or whether we are rich or poor, we all produce waste. Problems faced by developing countries are mainly due to lack of resources for waste management, increase of operational costs, lack of awareness of environmental aspects, loss of natural resources and/or energy consuming processes and problems in handling hazardous waste (Grover *et al*., 2000).

In globalized international trade, industry should have a systematic process and strategic plan to ensure the quality of the product while, maintaining a good behavior in environmental management. Electronic and electrical industries produced product with global brands and marketed globally thus, it is important for them comply with global market needs.

In any manufacturing industries, the production processes involves conversion of certain raw materials through a variety of processes into product. Both product and waste are the result of manufacturing output. In an electronic industry such as semiconductors factory, there are two categories of waste; general waste and hazardous waste. Paper, plastic, glove, resin, emissions and domestic waste are known as general waste. Hazardous waste is more toxic and could implicate high risk to the environment. Flux, benzene, acid, alkaline, solder dross, solvent, solid and scheduled waste are very hazardous to human and environment. Hence, there are necessity for a systematic waste management system and effective enforcement in controlling and preventing any pollution and health risk from occurring.

To improve the waste management system, most industries implemented several voluntary environmental initiatives such as the ISO 14001. The International Organization for Standardization (ISO) is actively

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improving the comprehensive environmental and hazardous waste management system to their future certification requirements (Kuhre, 1995). Industries worldwide will have to work hard to achieve the new level of environmental management. Therefore, industries will benefit from ISO 14001 in marketing their products in the international market. The success and benefits of ISO 14001 has been reported widely. The organizations that implemented the standard have gained internal and external benefits in terms of increased awareness amongst employees, legal compliance and financial benefits through savings in consumption of utilities (Palmer and France, 1998; Boiral and Sala, 1998; Ann *et al*., 2006). By working together in an international perspective, environmental issues such as waste could be managed systematically. Trans-boundary movement of pollution and its negative impact on the environment can be minimized.

This research concentrated on waste management issue in organization as it is an important element occurred in many businesses. As reported by Kadaruddin (2000), among 12 major environmental issues in business organization, waste generation ranked first and most concerned by business when they implement ISO 14001. This study highlights evidences from case study in electronic factory that implement ISO 14001. The benefits of ISO 14001 will be highlighted with concentration on waste management aspect. In this research, NEC Semiconductors (M) Sdn. Bhd. has been chosen as a case study. NEC is one of the main players in the semiconductors industry in Malaysia and received ISO 14001 certification since, 1998.

MATERIALS AND METHODS

A qualitative approach has been applied in this research. A set of questionnaire has been distributed amongst management and non-management group. Ten percent of factory non management employees (n = 1000) have been picked as respondent. In addition 15 respondents from management group were also selected. The non management group was from the departments of Customer Satisfaction and Environment Management (CSEM), technical, quality and manufacturing. Interviews were also conducted to further understand the direction of organization environmental management and it relevance to global market. To validate the questionnaire and interviews results, filed observation on the physical implementation of ISO 14001 especially those related to waste management were also done.

RESULTS AND DISCUSSION

Based on questionnaire responds from all employee, ISO 14001 implementation in NEC has improved when instruction and details of the standard has been realize. It is important for any organization to fully understand the details of the standard before try to implement it. In NEC, external consultant was appointed at the early stage only to kick start the project. During early phase of implementation, the committee that has been set up conducted in-house training to further explain and train all employee on ISO 14001 application. More than 85% of respondents agreed that their understanding of the standard and ISO 14001 realization has tremendously changed when all information available through training especially in waste management aspects (Table 1).

Available information and detailed explanation of ISO 14001 will make both employer and employees work together to achieve organization environmental management goal in their daily business.

In implementing ISO 14001, NEC developed an eco-conscious product program. This program concentrated in converting present production processes into lead-free product processes. From October 2002-2005, this program has shown good progress, which the number of lead-free product increased by 60% (Fig. 1). The use of selective raw materials has contributed in producing environmental friendly products. With the new technology, NEC has been able to succeed in achieving their goals based on their environmental policy.

In earlier stage (before implementation of ISO 14001), a gap analysis has been conducted to identified problems and barriers of present waste management activities. This process is important to evaluate the most significance issues and concentration to develop Environmental Management Plan (EMP) were done based on priority. From the analysis, five major problems were identified and need to be tackled seriously. The most significance issues in NEC waste management are waste separation (60%) and waste labeling (53.3%). Another three issues namely, waste leakage, air pollution and waste disposal constituted between 13.3-20% of the problems.

NEC environmental management plan for waste management: The gist for ISO 14001 or any other environmental voluntary initiatives are to improve the environmental management of any organisation. These will include restructuring the governance of waste, creating EMP, changing procedures of packaging, labeling, storage, inventory and treatment to the disposal part. Organisation must also has clear policy and adhere to the spirits of the laws and regulations. There are civil

Table 1: Scenario after ISO 14001(EMS) implementation

Details	EMS understanding	EMS realization	EMS training	Waste management
Yes	86.7	93.3	86.7	93.3
No	13.3	6.7	13.3	6.7
Total (%)	100.0	100.0	100.0	100.0

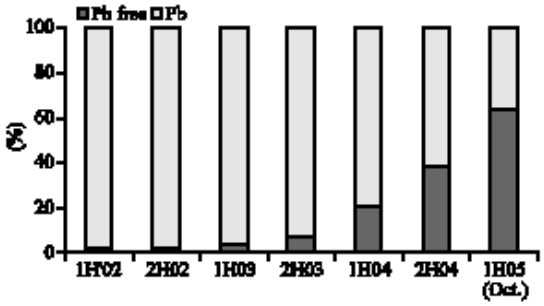

Fig. 1: Activity of eco-conscious product (lead free)

actions and criminal penalties associated with the failure to meet the environmental regulations and standards such as the environmental quality Act, 1974 and occupational health and safety Act, 1994 are to be referred to when handling the waste.

Waste separation, packaging and labeling: Waste separation, packaging, labeling and container requirements are found in a various reference. A different waste will use a specific container like drums, dumpsters, in bulk by vessels, tank cars, portable tanks, cylinders, barrels, cans, boxes, bottles, casks, bags, tank trucks and roll offs. Labels and placards are placed on shipping containers and transportation vehicles to indicate its content in case of emergency. The said information will help the handlers in determining of the degree of caution to be exercised in their daily job.

As mentioned before, NEC major problems are waste separation and labeling. The ISO 14001 has given clear indication on good management practice through procedures, working order and record preparation. The biggest changes after the EMS implementation in NEC are procedures and application that separate different kind of waste. The designs of waste containers are based on its durability and climate factors such as humidity and heat (Fig. 2 and 3).

Waste separation processes are not only in terms of selecting or dumping in selected or proper containers but have bigger advantages. Selected waste could be recycle easily based on its types or sold to recycling contractors thus, generate income to the organization.

Storage and inventory: General storage could minimize accidents from occurring. The most important provisions in ISO 14001 and occupational safety and health

Fig. 2: Separating boxes incurred before ISO 14001

Fig. 3: Separating place incurred after ISO 14001

regulations include signs and labels, emergency preparedness capability/contingency plans, hazards communication plans, appropriate containers, physical design and duration of storage. The use of proper labeling will minimizes the mixing of hazardous material waste and enhances good housekeeping. The word hazardous and chemicals waste must be marked clearly on each container as well as the date of each period of accumulation.

All waste in NEC has been stored in a proper waste warehouse. Spill killer is used in scheduled waste container to avoid any spillage or leakage from the container and to minimize the occurring of any accident. Leakage is one of the problems faced by NEC previously. With the enforcement ISO 14001, inventory management technique helped to remedy many of waste management problems. NEC had incurred an inventory management technique by using a first-in-first-out inventory method. This involves the use of the older product, which have been sitting on the shelf before using the newer items. Any variation have been recorded, reviewed and updated from time to time (Fig. 4 and 5).

Waste treatment: Considering the volume of hazardous waste generated, there is a serious shortage of treatment facilities in many part of the world. Regulations, permits and standards should comply with the local, state and

Fig. 4: Boxes and bottles are used for general waste

Fig. 5: Spill killer is used in scheduled waste container

federal standards and regulations that concentrate of the monitoring of ground water, financial accountability and closure/post closure process. Department of Environment (DoE) has full power on legislation and monitoring environmental performance.

NEC has considered various factors in solving waste treatment issues. At the top of the list is the technicality, efficiency, costs, employee safety, regulatory and public acceptance.

As ISO 14001 encouraged innovation in environmental management activities. NEC has developed their own technology for treatment of air emission. In this case, air scrubber and Wastewater Treatment Plant (WWTP) has been developed and taking into consideration the organization needs and capabilities. These facilities helped NEC to control the emission and waste emitted to the environment. Besides in achieving waste minimization target, NEC has also launched the environmental management programs such as 3R (Reuse, Recycle and Recovery). One of successful program is recycling of NG product (Fig. 6). Waste from NG product was separated and crush before being packed and sold to recycling contractor. This effort is not only reduce waste to landfill but also generate source of income for NEC.

Waste disposal: The amount of hazardous waste has been in decreasing because of regulatory restrictions, operational costs and increased in public awareness on the environment. No matter how many of treatment and waste minimization process are practiced, there will always be some hazardous waste that requires disposing (Kuhre, 1995). For example, the electronics manufacturing industry choose landfill compared to off-site recycling to dispose the waste. This is due to the fact that it is quicker, cheaper and involves less liability than dealing with a recycler who may not has all the necessary permits and controls (Freeman, 1990). In addition, the cost of waste collection and disposal services in developing countries are higher compared in developed countries (Cointreau, 2005). The implementation of ISO 14001 has given NEC opportunity for a better management of waste. Through waste separation and waste minimization program, NEC is able to dispose only less waste and waste that are no longer deem to recycle. Furthermore, hazardous and scheduled waste such as metal hydroxide and used flux are sent and dispose in proper facilities provided by the government (Kualiti Alam Sdn. Bhd. and redicare).

Waste minimization: The implementation of EMS in NEC has brought greater success in waste minimization program. The generation of general waste in NEC has been reduced by 43.5% from it peaked in 2000 (920 tons) to the lowest 380 tons in 2005 in all waste categories (Fig. 7). The generation of industrial waste also showed reduction by 41.8% from 65 tons in 1999 to only 28 tons in 2005 (Fig. 8). With a strategic and systematic plans, like launching the 3R concept, waste minimization training and eco-conscious products program has proved that ISO 14001 implementation has provided a systematic planning and management system that can contribute to environmental management success. Besides, commitment from the top management and all the employees, are not useless efforts but brought to an excellent performance in management and team work.

Besides given a positive impact to waste management system, additional benefits have been enjoyed by NEC Semiconductors (M) Sdn Bhd. operations. Survey result shows that 93% of respondents agreed that ISO 14001 make them realized how important to preserve the earth and increased their environmental awareness. Furthermore, 73.0% of respondents agreed that the standard is really increasing the reputation to the company especially among the stakeholders and the customers and 87.0% of them stated that there is more conformity in regulation and requirements when handling the waste (Table 2).

All in all, NEC has recorded many successes in environmental management efforts that not only benefit them in terms of compliance to regulations,

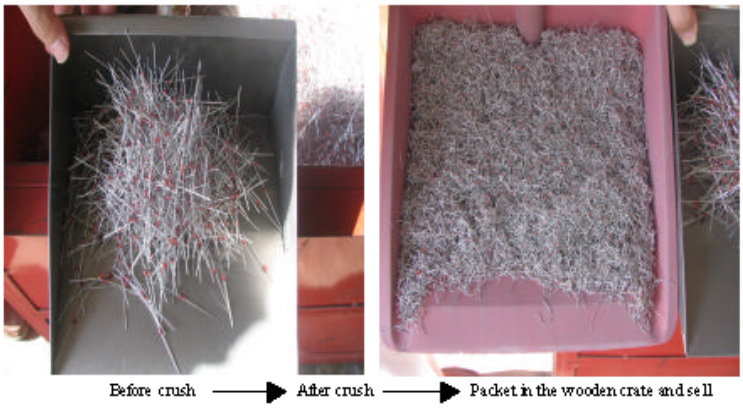

Fig. 6: Recycling process of NG product

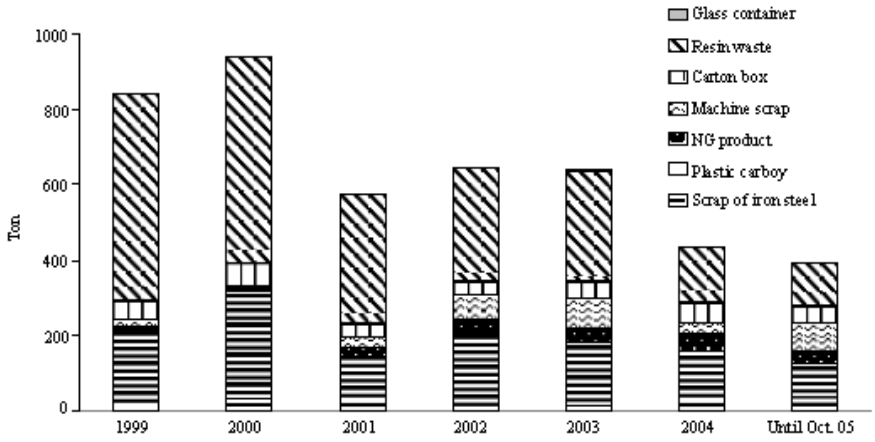

Fig. 7: General waste generation

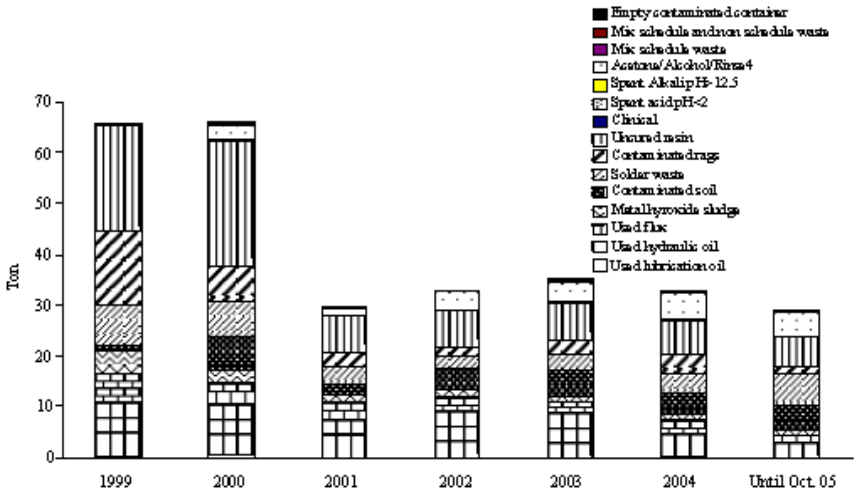

Fig. 8: Industrial waste generation

environmental reputation and image but also contributing to the financial aspects where proper management of raw materials and recycling contribute. A good waste management system and strategies (Fig. 9) has been build and practices in NEC and improvement is still can be done.

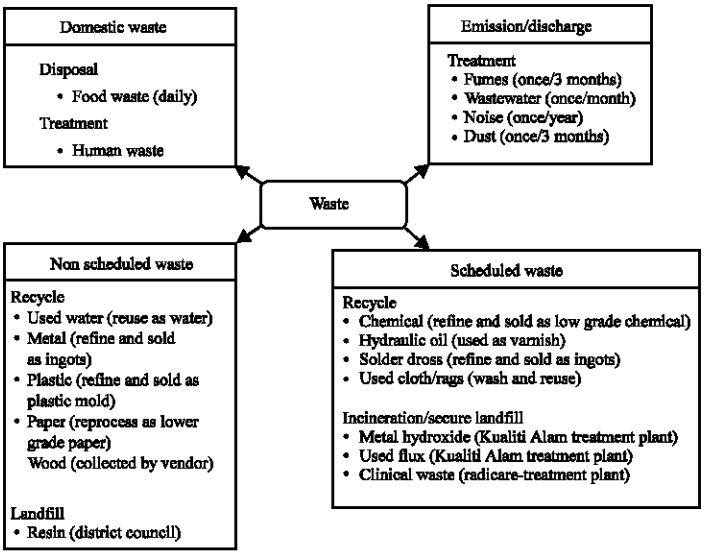

Fig. 9: Waste management and its categories

Table 2: Additional benefits of ISO 14001 to company

Extra benefits of ISO 14001 implementation to company	Volume (%)
Increase of compliance to legislation	87.0
Increase of company reputation	73.0
Increase of environmental awareness	93.0

CONCLUSION

There are more benefits and positive impact that NEC Semiconductors (M) Sdn Bhd. had received after implement ISO 14001. The investment of improvements NEC has invested for the last 8 years before are fruitful. Besides, to establish an action program in relation to environmental issues such as ozone-layer protection, global-warming prevention, industrial waste reduction and products recycling and to innovate and develop product technologies for the improvement are not easy tasks. The waste management method is combined with strategic and systematic system, plans and compliance to the ISO standard and regulation requirements. With organization environmental policy, they pledge full commitment to the protection of environment with regards to all activities, product and services through the pursuit of practices that harmonizes with the environment.

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